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**STUDY OF THE CANADIAN
HYDROGRAPHIC AND OCEAN SURVEYING INDUSTRIES**

Prepared by T.D.W. McCulloch
Executive Director

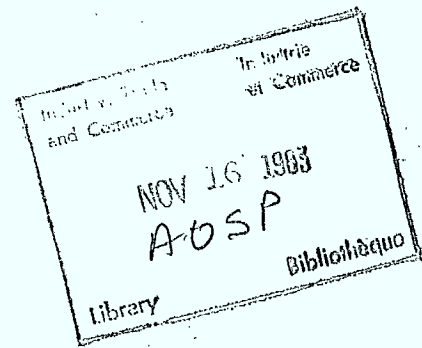
X Canadian Association of Hydrographic
and Ocean Surveying Industries

and

Jayhall Consultants

In cooperation with
Department of Industry, Trade & Commerce

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OVERVIEW - EXECUTIVE DIRECTOR, CAHOSI

The survey clearly underlines the large potential for Canadian Hydrographic and Ocean Surveying Companies in international oil, gas and mineral exploration and exploitation (a 10 billion dollar worldwide activity in 1982). It also demonstrates the opportunities abroad brought about by Law of the Sea decisions affecting the oceanic jurisdiction of coastal developing states. In dealing with future domestic markets in the hydrocarbon industry, it should be noted that Canada is still largely only in the geological and geophysical survey, exploratory and appraisal drilling phase of offshore activity. If all goes well, and the North Sea experience is followed, the second phase of offshore activity - development drilling and production and transportation of petroleum products - will bring about a quantum leap in hydrographic and ocean surveying activity as production platforms are precisely located and pipeline routes surveyed and mapped. There is also the domestic market in hydrographic surveys and charting for marine transportation needs. The industry has shown that it has the capability to undertake much of the work presently carried out by the Canadian Hydrographic Service. The industry also appreciates CHS offers to provide monitoring expertise on foreign and domestic contracts where required. Although the signs are encouraging regarding further contracting out by CHS, a study of the best balance between essential in-house activities and domestic industrial involvement and related to national cost benefits, should be considered at this time. It should be noted that other countries are now following Canada's lead in the privatization of hydrography.

I believe that there is much food for thought in the survey - with a great deal of action required in the future to optimize benefits for Canada and the industry. It should stimulate constructive discussion within industry and government on matters of concern to all.

The survey of the Canadian Hydrographic and Ocean Surveying Industries sponsored by the Federal department of Industry, Trade and Commerce and CAHOSI could not have been accomplished without the full involvement and interest of many individuals. In addition to the participants in industry, most of whom were most forthcoming in interviews and follow ups, I would like to pay tribute to a few people, without whose full commitment the survey would not have met its goals and objectives. I refer to Mr. Raymond Gladu of Industry, Trade and Commerce, whose concern and support was evident and essential to the success of the project. To Mr. John Shaw of the Bayfield Laboratory for Marine Science and Surveys, whose research contributed greatly to the venture. To Mrs. Anne White of the Bayfield Laboratory who patiently looked after my secretarial requirements, and juggled my frantic travel schedule successfully. Finally, to the CAHOSI consultant, Mr. John Hall of Jayhall Consultants, whose appreciation of what was required was evident from the beginning and whose absolute commitment to the project was constantly reinforced as the survey progressed.

CONSULTANT'S ACKNOWLEDGEMENT

More than 100 interviews with industry representatives, public servants and senior management in the exploration industry were conducted during this survey across Canada between March and July, 1983. Most of these were done jointly with Mr. T.D.W McCulloch, Executive Director of the Canadian Association of Hydrographic and Ocean Surveying Industries (CAHOSI).

The people interviewed provided outstanding cooperation and gave generously of their experience and insight, enabling a first-ever and in-depth look at this growing and important segment of Canada's oceans industry.

The conduct of the survey, sponsored by Industry, Trade and Commerce and by CAHOSI, generated an unusually high level of interest among the participants. The mutual exchange of information that took place was seen as an immediate benefit.

JAYHALL CONSULTANTS records sincere gratitude to the participants, the sponsors and Mr. McCulloch.

JAYHALL CONSULTANTS
OTTAWA, July 1983

INTRODUCTION

The Canadian Association of Hydrographic and Ocean Surveying Industries (CAHOSI) was formed in 1981 with the following objectives:

- (a) to assist members in exploring and exploiting domestic and foreign markets for hydrographic and ocean surveys;
- (b) to obtain the support of government in acquiring and executing domestic and foreign contracts for hydrographic and ocean surveys;
- (c) to promote the adoption by government of policies favourable to the Canadian hydrographic and ocean surveying industry;
- (d) to increase international awareness of Canadian leadership in hydrographic and ocean surveying technology;
- (e) to encourage the establishing of high standards of ethics, workmanship and professional competence with respect to hydrographic and ocean surveying;
- (f) to adopt such means for making known the objects and purposes of CAHOSI to the general public as may seem expedient.

In February 1981, six companies joined together to found the Association, the then President of CAHOSI proposed to the Consulting Services Division of the Department of Industry, Trade and Commerce that "With your assistance we investigate what the strengths and weaknesses of the industry are and what opportunities exist at the moment, and how best to present ourselves in both the domestic and international marketplace. We should also establish what potential the industry has in relation to world development, and what has to be done to take advantage of identifiable opportunities in the future". The Consulting Services Division of IT&C agreed in principle to such a study, on the basis of shared cost.

After some discussion the following preamble and terms of reference were agreed to by IT&C and CAHOSI:

The Canadian Association of Hydrographic and Ocean Surveying Industries (CAHOSI) was recently formed to promote the interests of member firms and particularly to assist them in penetrating overseas markets.

The study is necessary to upgrade the knowledge of both the association and the department with respect to the industry's capability and its potential.

Terms of Reference

To carry out a study of the industry, its strengths and weaknesses and to describe the opportunities that exist and the constraints being faced.

The study is to include:

- An identification of all possible components and evaluation of the capabilities of the domestic CAHOSI related industry, including companies, associations, and allied industries.
- A preliminary assessment of the present market volume in Canada and abroad for Canadian firms, with an assessment of business now going to non-Canadian companies, and a targetting of areas of highest opportunity for future business.
- An inventory of the assistance available and required from governments in Canada to further the aims of the industry. Such an inventory would include contacts and links to international agencies.
- An examination of constraints being faced by the industry and opportunities for future growth.

Authorization of the Study was officially forthcoming in late February 1983. CAHOSI contracted with JAYHALL Consultants to assist in the study, and interviews with CAHOSI related industry, associations, allied industries and appropriate public sector organizations commenced on the east coast of Canada in March 1983. Interviews together with collection and completion of relevant data continued across the country with completion in late June 1983. The report that follows hopefully meets the criteria contained within the terms of reference and will provide the necessary information to assist government in furthering the aims of industry, particularly CAHOSI related but also allied industry in the ocean sector.

There are presently thirteen member companies in CAHOSI.

EXECUTIVE SUMMARY

1. Private sector hydrographic, oceanographic and geophysical surveying in Canada amounts to between \$50M and \$60M a year, with the oil and gas exploration firms and government being the principal clients. Private clients provide the vast majority of industry contracts, with government awarding roughly \$5M per year in contracts, about 10% of its in-house activity.
2. The industry is highly skilled, capital and technology intensive and is extremely sensitive to changes in Federal government policies and programs.
3. Only in the last two years has the industry begun to organize itself by sector and on a national basis - this at the instigation of the larger and more successful companies. Its objectives are to expand the domestic market for Canadian companies and to expand the \$50M - plus potential export markets which fewer than a dozen firms have penetrated to any extent.
4. The environment in which the industry operates is characterized by a lack of a national oceans policy, divided federal jurisdictions among departments, even competition between some departments, poor communication between the sectors of government/private clients/industry and the familiar Canadian constraints of geography, degrees of regionalism and financing for operations and growth.
5. The industry has benefited widely from Federal contracting out policies and from government assisted trade missions and foreign aid programs. The industry's self organization through the Canadian Association of Hydrographic and Ocean Surveying Industries is seen as providing an important vehicle for accessing more specifically directed assistance and to increase exports throughout the world. Small and younger firms will need higher levels of support, especially in developing their marketing resources.
6. Export markets of \$50M - plus a year can be further developed by more firms becoming familiar with the requirements and procedures for participating in Canadian aid and trade programs. A large potential exists as a result of international oil, gas and mineral exploration. Canadian based

exploration firms and, second, the selling of Canadian expertise to the exploration multi-nationals, represent a virtually untapped market for most of the industry. Only the largest Canadian firms and those with operations or representation in Alberta are known sufficiently to these clients. CAHOSI clearly has a leading role to play.

The geographical areas of highest opportunity abroad are numerous. Penetration and expansion of these markets will be affected by several factors, including Canadian aid and trade policies and programs, experience already gained abroad by Canadian companies and by the quality and extent of timely intelligence available to capable firms.

Elements of the hydrographic and ocean surveying industry in Canada have gained marketable experience and techniques as a result of operating in remote and harsh environments. At the same time, there is an evident Canadian expertise in instrumentation developed under these conditions and in software creation and adaptation. There is, therefore, a base for a competitive edge for Canada.

7. Intelligence on business opportunities, at home and abroad, distributed swiftly and thoroughly, is the single greatest need throughout the industry. There would be additional benefits from broader and more frequent inter-sector contact and communication within the larger ocean industries community across Canada. Most desirable would be activities designed to "marry" the interests of contractors with instrumentation/software firms, wherein lie skills and technology of great worth and future potential for Canada.
8. It is essential that the contracting out programs of the Canadian Hydrographic Service (Department of Fisheries and Oceans) be continued, and expanded as far as is possible, to ensure the underlying health and development of the private sector and to provide the vital seeding activity for instrumentation/software development. Along with techniques developed under unique Canadian conditions, these areas distinguish Canada competitively abroad.

9. Better distributed, continuous information about availability of, and access to, federal/provincial programs is required. Many of the smaller firms are in poor or, at best, sporadic contact with the federal government and presently lack the human and financial resources to improve their situation. Coordination of the distribution of such information is needed to ensure that the pertinent information produced by numerous federal and provincial departments and agencies reaches the industry.
10. The adoption of a national oceans policy, and rationalization of conflicting or competitive departmental responsibilities, would impact favourably on the industry. The hydrographic and ocean surveying private sector should apply itself to this objective, in conjunction with current ongoing departmental initiatives.

Industry Profile

The Canadian Hydrographic and Ocean Surveying Industry is relatively young, only coming into its own slowly over the last two decades or so. Exploration for oil and gas began off Sable Island in 1959, on the Grand Banks in 1964, off British Columbia in the early sixties, and in the Beaufort Sea in the mid sixties. However, it was not until the early seventies, with the presence of oil and gas found on the Grand Banks and in the Beaufort Sea, and with small contracts being awarded by the Canadian Hydrographic Service, that the industry started to develop and expand. Further expansion took place in the late seventies with the discovery of Hibernia on the Atlantic Coast coupled with the finding of a potentially major oil field in the Beaufort Sea. In 1981 CHS awarded a major three year contract to private firms for the survey and charting of Lake Manitoba. Additional contracts have been awarded by CHS in the past two years. In addition to the domestic scene, Canadian based companies have since the fifties, exported their services to coastal states abroad in full competition with other countries and by participating in Canadian government - assisted programmes for developing nations. The industry is therefore poised today to take advantage of new opportunities when offshore oil and gas field operations move into the development phase, the additional survey requirements in the Arctic needed by the CHS for marine transportation charting, the marine geological/geophysical surveying that will be an essential part of the delimitation of Canada's exclusive economic zone, and the surveys connected with hydrocarbon exploration and development, port development and the particular needs of developing coastal states who require technical and financial assistance in delineating their exclusive economic zones.

The Canadian hydrographic and ocean surveying industry is thoroughly modern and dynamic. It is highly skilled, capital and technology intensive. It is however, diverse in the size and strength of individual companies, in its specializations and in its activity base. It is competitive both domestically and internationally and ranks in fourth in market size worldwide, coming only behind the United States, the United Kingdom and the Netherlands. The industry is ranked by those three leaders as among the most developed in the world.

The domestic industry is carried out by largely Canadian-owned and privately held companies whose annual volume for all activities, including hydrographic and ocean surveying, exceeds \$200M.

Each firm's activity base differs from most of the others, ranging from very large, (\$40M - plus), multi-disciplinary engineering consulting and contracting firms to long established land surveying companies which have expanded into the marine field, and from small, single-purpose hydrographic surveying specialists to larger (\$250K to \$6M) oceanographic, seismic or offshore navigation/positioning consultants and contractors.

Some firms have direct links, through ownership or contractual arrangements, with the vital and closely related hardware/instrumentation and software industry.

The Canadian industry's domestic reputation is built upon internationally accepted high levels of skills and experience and upon its demonstrated abilities in technological development, interfacing of instrumentation, software creation and entrepreneurial achievements under often difficult field conditions.

The industry tends to be concentrated in areas of the country close to the offshore activity or to client companies or government departments. The concentrations are located in Southern British Columbia, Alberta - particularly Calgary, Southern Ontario - Western Quebec, and Nova Scotia - Newfoundland.

A strong domestic practice must be developed and maintained to support a strong export activity. Canadian policies and programme initiatives available to industry must be as beneficial and comprehensive as those available to foreign competitors. The hydrographic and ocean surveying industry in Canada looks to the increasing involvement of Canadian consulting engineering companies and Canadian oil companies, in international projects. This involvement creates spin-off opportunities for Canadian service and equipment companies internationally and should be vigorously pursued.

The Canadian hydrographic and ocean surveying industry is composed of hydrographers, oceanographers, electronic engineers, cartographers, computer programmers, marine geophysicists, together with many other specialists such as management, technical, administrative and support staff. It can provide a wide range of services which include:

Industry Scope

Oceanographic and environmental consulting providing services in physical, chemical and biological oceanography.

Hydrographic and marine geology and geophysics surveys of rig and platform sites, including caisson placement, berm and conventional island constructions.

Pipeline and cable route surveys, seabed clearance surveys, shallow gas and drilling surveys.

Port and harbours surveys, hoe and port dredging surveys.

High resolution hydrographic surveys, coastal and estuarine geomorphology, sediment dynamics and analyses.

Arctic ice drift surveillance monitoring and prediction.

Geophysical surveys and interpretation.

Nautical chart compilation, fisheries chart compilation.

Precise offshore positioning for survey, dredge, coring and seismic vessels and drilling platforms.

Inertial surveys, airborne surveys, acoustic positioning.

Sub sea inspection surveys.

Integrated navigation systems. Navigation systems software development.

Hydrographic surveying and charting for marine transportation.

Bathymetric surveys.

Airborne hydrographic/photogrammetric surveys and laser profiling.

Over and through the ice hydrographic surveying in the high Arctic.

Underwater television with remote tethered submersibles.

Collating sailing direction information.

Offshore project management.

Shallow Seismic and deep sea Seismic surveys.

Size and Structure of the Industry

There are approximately 36 companies in Canada involved in hydrographic and oceanographic surveying activities. They range in size from a two man proprietorship to companies employing several hundred. The diversity of the companies and their underlying base of activity can be shown as follows:

Size and Structure of Companies

| <u>Staff Employed</u> | | <u>Description of Main Activity Base</u> |
|--------------------------------|--------------|---|
| <u>Hydrographic/Ocean base</u> | <u>Other</u> | |
| 396 | 414 | Oceanographic/Engineering/ Environmental |
| 97 | 12 | Marine Navigation Services |
| 86 | 431 | Geophysical Surveys and Inter- pretation |
| 161 | 1041 | Legal/Control and Engineering Surveys |
| 160 | 1040 | Civil Engineering |
| 17 | 30 | Aerial Photogrammetry |
| 5 | 75 | Conventional and Deep Diving |
| <u>Totals: 922</u> | <u>3043</u> | |

The Market

Market Size

The total Canadian surveying and mapping capability actually in production was estimated at \$750M per year in 1978. Even accounting for recession since 1981 that figure could well be around \$1B per annum today. Of that \$1B, approximately \$150M represents the hydrographic/oceanographic/geophysical involvement, with sixty per cent of that amount being the government effort, and the other forty percent representing the private sector. The private sector amount includes the related activities of offshore navigation and positioning for the oil and gas exploration and

development industry, and for the Canadian Government.

A precise breakout at this time by discipline/activity is beyond the scope of this study. There is no reporting requirement by sector. Individual firms have difficulty separating the marine components from the large surveying/construction/engineering/environmental projects in which they are involved.

In addition to the domestic market, Canadian companies are generating significant earnings from the export of their services and products in successful competition with the other major surveying nations, including the United States, the United Kingdom, the Netherlands and others.

The industry is both capital intensive (up to \$100K plus per employee) and a major employer of highly paid professionals and technicians.

Domestic Clients

The principal domestic clients are the hydrocarbon exploration/development industry offshore and government (mainly the Canadian Hydrographic Service but also other parts of Ocean Science and Surveys of the Department of Fisheries and Oceans, and other departments of government, both federal and provincial). The triple impacts of recession, restraint and some unforeseen aspects of the National Energy Policy produced some layoff and cutbacks in 1981 and 1982. The effects, however, are not consistent nationwide, and have been somewhat tempered by a Federal policy of contracting out rather than expanding in-house capability, and by positive effects of the willingness of some of the hydrocarbon exploration and development companies to transfer their in-house surveying requirements to outside independents. Some firms have specialities that are rare, and there are those whose human and technological range is most formidable. However, the smaller to medium sized firm's growth, and even survival, are frequently influenced by their weakness in management, marketing and capitalization.

A few large and sophisticated companies dominate the industry, and are likely to continue to do so. The smaller firms urgently need to develop contacts with governments, especially the federal network of client and support department. They also must broaden their coverage of prospective private sector clients, while at the same time arranging their affairs in such a way that they can afford to lease or buy the instrumentation they require to compete for contracts, and to develop their internal management infrastructures.

The domestic market should improve over the next few years, as there are a number of strong potential thrusts developing to expand offshore activity.

The oil and gas fields presently discovered off Canada's east coast and in the Arctic are still largely in the exploration phase. The go-ahead by Mobil Oil to develop the Venture Field off Sable Island should stimulate strong industry activity there over the next decade. Paralleling this activity could be a development thrust in the Grand Banks, where Petrocan is now increasing its level of drilling activity. The Beaufort Sea and High Arctic should go into the development phase within the next five years. If the North Sea experience is followed, the development phase with its increased drilling precise siting of production platforms, pipeline routing and associated marine transportation requirements should bring a quantum jump in hydrographic and ocean surveying activity.

Additionally, the planned increase in government contracting out of hydrographic and ocean surveying in the Arctic over the next three years should provide a welcome back up to the industry.

International Clients

Over the last decade a number of hydrographic and ocean surveying firms have made a significant impact on the international scene. Companies with underlying strength in such diverse areas as engineering, environment, geophysical mapping and control surveys on land, navigation systems and others, have expanded into the offshore, landing contracts in such widely scattered sites as Jamaica, Barbados, Brazil, Venezuela, Dubai, Oman, Senegal, Tanzania, Indonesia, Pakistan and several other countries.

The international market opportunities flow mainly from individual company initiatives, trade mission intelligence, international development bank notices and Canadian aid projects for developing countries.

These opportunities should increase over the next decade if Canadian companies can piggy-back on three Canadian strengths abroad. The first, which is already being used to some extent is the strong position of major Canadian consulting engineering companies overseas. The second is the increasing effort in offshore exploration activity around the globe that is now being joined by Canadian companies such as Ranger and Petrocan. Thirdly, and probably as promising as the other two, is the delimitation and survey of the exclusive economic zones of developing coastal states.

The following tables show the relative importance of private sector and government business to the hydrographic and ocean surveying industries on the domestic scene at present and its potential, together with a similar look at the international market.

| <u>TABLE I</u> <u>Canadian Hydrographic and Ocean Surveying Industries</u> <u>Total Market (Estimated - in 1983 dollars)</u> | | | | | | |
|--|----------------|-------------------|------------------------------|-----------------------------------|---------------------------|--------------|
| <u>Domestic Clients</u> | | | <u>International Clients</u> | | | |
| | <u>Private</u> | <u>Government</u> | <u>Explor. Comp.</u> | <u>Construct./ Eng. Comp.</u> | <u>Aid Programmes</u> | <u>Total</u> |
| <u>Present</u> | \$50M | \$5M | \$1M | \$3M | \$1M | \$60M |
| <u>Potential</u> | \$150M | \$30M | \$15M | \$10M | \$15M | \$220M |

| <u>TABLE II</u> <u>Government Programmes</u> | |
|---|------------------------------|
| <u>Inhouse</u> | <u>Contracts to Industry</u> |
| <u>Present</u> | \$90M |
| <u>Potential</u> | \$120M |
| | \$5M |
| | \$30M |

Government Policies

The hydrographic and ocean survey industry is strongly competitive at all levels of size of operations. It is sensitive to changes in Federal government policies, especially those affecting oil and gas exploration activities offshore, contracting out by Federal departments, foreign aid and trade, Research and Development incentives, taxation and Canadian content requirements. Agreements, or lack of them, between the Federal Government and the provinces are important factors affecting competition in the oceans sector.

Similarly, Federal, Regional and Provincial buying preferences and restrictions are seen as both helping and hindering local or national growth in the hydrographic/ocean subsector.

Inter-Sector Communication

In broad terms, poor communications between sectors characterizes the movement of information amongst government, private industry clients and the related, though diverse, segments of the ocean industry.

There is no single medium for such communication. Information transfer is hindered by the absence of a common activity or principal business base among the companies active in varying degrees in the domestic market for marine surveying, ocean and hydrographic services and products.

The large firms maintain obviously successful contacts on both national and international fronts with government and private clients. The smaller firms consistently identified "intelligence" as one of their most serious shortcomings, closely followed by "lack of contacts".

Since no single Federal department or agency has sole responsibility for policy or programs involving this oceans sector, the communication problem is compounded. Indeed, each public and private sector is demonstrably unaware of its precise audience(s).

Efficiency and productivity continue to improve rapidly in the industry as a result of instrumentation development and numerous Canadian achievements in creating new techniques.

Federal Interests

The Canadian Hydrographic Service of the Department of Fisheries and Oceans is playing a critical role by making its hardware and software needs known to the private sector and by contracting out a significant, if unsteady, amount of its surveying and hardware/software requirements.

Additionally, CHS has made it possible for Canadian companies to gain experience in the field, to establish their performance to world standards of excellence and to borrow extensively from its 100 year accumulation of knowledge.

It is stated policy of CHS to continue to contract out in this manner, subject to the annual vagaries of funding available and its ability to obtain funds for special activities.

Other federal government departments and agencies at interest in the health and efficiency of the private sector include:

1. Public Works, for its harbours work.
2. National Defence.
3. Energy, Mines and Resources, through its responsibilities for resources exploration and extraction.
4. Canadian Oil and Gas Lands Administration, which administer the Canada Oil and Gas Act 1982.
5. Office of Industrial and Regional Benefits (OIRB) to link Canadian industrial capabilities to large development projects.
6. Transport, including its Canadian Coast Guard.
7. National Research Council
8. Canadian International Development Agency, a major funding source for projects in developing countries.
9. ITC, DREE and External Affairs, whose programs, assistance and trade services abroad are highly significant for almost the entire industry.
10. Supply and Services, including the Canadian Commercial Corporation.
11. The Department of Fisheries and Oceans, carrying the Ocean Science and Surveys responsibility nationally, and with its influence through its regional research and operations establishments in Nova Scotia, Quebec, Ontario and British Columbia, not to mention its reputation and influence internationally.
12. Environment, with its interests in weather services, positioning, ice conditions, iceberg positioning and drift, etc.
13. Export Development Corporation.
14. The inter-sector Canadian Committee on Oceanography.
15. The new inter-departmental committee on the oceans (in formation at the time of this study).
16. Canada Manpower, whose programs are accessed frequently in the industry.
17. Indian and Northern Affairs - north of 60°.

Provincial Interests

Many of the Provinces are at interest in varying degrees.

Some employment is provided through use of service firms to survey inland lakes and waterways which are not included in the Federal hydrographic surveying activities for navigation purposes. Additional work results from hydroelectric, mining and municipally-related shoreside projects.

The Surveyors-General of the Provinces have influence on the industry in the matters under their jurisdictions.

In the areas of industrial development, the high technology characteristics of the allied instrumentation and software sector are generating support from the Provinces - leading in some cases to competition between provinces for what are considered to be desirable employers. Elements of the industry have benefitted from the establishment of ocean industries industrial complexes, particularly in Nova Scotia and British Columbia.

Nova Scotia, Ontario, Alberta and British Columbia provide significant support for export selling activities, supplementing federal programs in this area.

Although not a coastal Province, Alberta is the focus of a large and growing segment of the hydrographic and ocean surveying industry serving the oil and gas exploration companies. While these client firms are nearly all based in Calgary, the ocean service industry is based in both Calgary and Edmonton.

Many of these Alberta-based firms do business on the Atlantic and Pacific offshore, as well as in the Arctic. All are affected by federal and provincial tendering policies that restrict eligibility to quote.

The Department of Development, Newfoundland and Labrador, gives first preference to local sources and suppliers for all labour, equipment and services used by the industry. The Department of Development, Nova Scotia, gives preference to local services and goods if such services and goods are competitive in terms of fair market price, quality and delivery.

As a lobby, the hydrographic and ocean surveying sector is in its infancy. Divided responsibilities and some competition among federal departments combined with the absence of a national oceans policy as such, make the tasks of influencing government policies, programs and decision-making into a large scale challenge.

At the political and administrative levels, there is an understandable concentration of interest on fish and energy resources, on regional manufacturing expansion and ownership/jurisdictional disputes.

Associations

There are several national associations within the industry, each representing its own sub-sector(s). Organized and funded as they are along traditional lines, none is as yet an effective major force in the manner of one of their largest customers - the oil and gas industry.

The Canadian Ocean Industries Association (COIA) was formed to act and speak for the manufacturing and service sectors of the industry. At present its strength lies in the manufacturing and consulting fields, and has successfully represented these sectors of ocean industry in briefs to the Canadian Oil and Gas Lands Administration (COGLA) and to the Office of Industrial and Regional Benefits. The leading Canadian companies in hydrographic and ocean surveying formed their own national association, the Canadian Association of Hydrographic and Ocean Surveying Industries (CAHOSI), whose eligibility rules do not at present permit membership by manufacturing companies. Recent information showed that only one firm belongs to both associations.

CAHOSI has an active, full-time staff executive seconded from Fisheries and Oceans. COIA's affairs are administered through the Halifax office of the Canadian Manufacturers Association, for which some funding has been provided under the Canada-Nova Scotia Agreement.

There has been continuing, formal and informal liaison between the two organizations.

The client organization of most significance to those in ocean surveying without question is the Canadian Petroleum Association, whose members can and could provide a substantial portion of the present and future market at home and abroad for Canadian ocean services and instrumentation companies. CPA has an active and effective survey section which is an important vehicle, or meeting ground, for development and maintenance of contacts. The Alberta focus of CPA's exploration members' bases is to the obvious advantage of Alberta resident service firms and is also accessed by companies with representation in Alberta. There is also contact at the level of the regional off-shore exploration offices in such centres as St. John's and Halifax.

It is clear that the Associations have a useful service to perform by acting to present the capabilities and performance records of their members effectively to this client audience, especially on behalf of those small firms without the resources for direct and frequent contact.

Other useful association/organization contacts for industry members include the Canadian Advanced Technology Association, the several societies supported by geophysicists and petroleum geologists, whose national and regional events provide contact opportunities and occasions for exhibits. The Canadian Hydrographers Association, whose affairs are administered on a volunteer and part-time basis, provides an opportunity for exchanges within the industry. CHA has as yet undeveloped potential as a medium of information exchange and business development for service companies on both national and regional levels. The CHA has been heavily influenced by its strong government representation, but the recent formation of a regional branch in Alberta, with its entire enthusiastic membership from the private sector should provide interesting changes in CHA policy and direction.

A few of the larger service firms are devoting some effort to participation in national or international organizations for the marketing of professional services domestically and in export markets. Essentially, these are companies already active in export markets. Apart from licensing organizations, which number more than a dozen for large national firms, there are more than 50 Canadian and American associations and societies supported by multi-disciplinary Canadian companies.

For all but the richest and most diversified firms, for whom the multiplicity of memberships are a drain on net profits, available cash flow and regionally subjective self-interest determine the choices made by both small and medium sized firms as to those organizations in which to concentrate their subscriptions and active participation.

In terms of business development, the association whose foci include accurate early warning intelligence of contract opportunities and the generation of both domestic and foreign face-to-face contacts will emerge as the preferred choice for membership, financial support and involvement in activities.

That association will achieve its objectives and draw support by supporting domestic marketing and by becoming the vehicle for international recognition for its member firms and, indeed, for the industry as a whole. An effective association can position itself to take maximum advantage from the variety of government programs and assistance available and to be created in the industry's self-interest.

Despite the continuing efforts by interested federal departments to generate an oceans policy for Canada, and to provoke coordination of policy and programs encompassing the non-transportation, fisheries and energy elements of ocean interests, a vibrant, vocal and politically effective private sector organization will fulfill an evident national need.

Indeed, government has identified the requirement for a means of communication with the ocean industry it seeks to serve.

The industry is vitally at interest in oceans sector Research and Development and has a strong role to play in the coordination with government, universities and related private sector interests. Among the urgent questions are:

1. Rationalization of the activities of the multiplicity of federal departmental and agency interest in the oceans;
2. The implementation of much more effective government/university/industry liaisons designed to promote more extensive and profitable industry activities;
3. More effective application of federal/provincial funding programs in the oceans sector as a whole and, in particular, with respect to the service/instrumentation firms who are the subjects of this survey.

Another useful activity, the need for which is clearly identified by many of the survey respondents, is the encouragement of joint or co-venture enterprises among firms in the industry.

Note should be made that there are many links, either contract related or through ownership and affiliation, with firms whose primary activities are in the non-survey oceanographic sciences and instrumentation/software. These relationships are both complex and diffuse but they are real. They should be addressed by any association wishing to become the major force in the ocean industries sector.

Many contracts of financial interest to primarily survey/positioning oriented firms have their origins in other sector activities, in particular in heavy construction and engineering contracts at home and abroad.

Another association of interest to ocean surveying firms is the Canadian Oilfield Manufacturers Association, based in Edmonton. Its newsletter is a model of extensive intelligence distribution and "how to...." information.

At the regional level, ocean industries groups are proliferating. Many include every type of business that has anything to sell that is used or consumed afloat.

At the same time, the hydrographic and ocean surveying sector and the related manufacturing interests are undergoing or provoking changes. These include:

- (a) corporate reorganizations
- (b) new ventures by established firms and by entrepreneurs starting up
- (c) acquisitions by oceans multi-nationals
- (d) the painful process of venture financing versus proprietorship facing the small, Canadian-owned instrumentation/software firms. Some of the latter, indeed are financing slow growth through selling Canadian technology abroad with more success than they have in the domestic market.

MARKET GROWTH - CANADA

The domestic market for services is almost wholly dependent upon the following factors:

1. The levels of exploration and development work in Canada's offshore, presently including the Atlantic and the Arctic, and what work may be anticipated as a result of agreement between Canada and British Columbia with respect to the Pacific continental shelf within the 200-mile limit.
2. Continuation and expansion of Federal Government policies and programs in contracting out hydrographic, oceanographic and instrumentation work to Canadian-owned companies.
3. Extension of Canadian content rules to favour Canadian-owned companies.
4. Efforts by the companies themselves to market their services in a more effective manner, in competition with wholly foreign owned or controlled subsidiaries, and in order to penetrate long standing arrangements made outside Canada.
5. Development of more effective communications within the industry and to and from its major clients.
6. Availability and cost of financing for what continues to be a capital intensive, technology dependent industry.

MARKETS ABROAD

The single most important factor creating opportunities abroad for Canadian hydrographic and ocean surveying firms is the worldwide search for offshore oil, gas and high value metals, especially within the limits of each coastal nation's Exclusive Economic Zone, created under the Law of the Sea Convention. Additional opportunities may be anticipated in the longer term involving the international oceans and seabeds.

Most of the developing nations do not have in place the trained human resources, technology and necessary infrastructure, or the money, to meet their obligations under the Convention or to conduct exploration. Consequently, they are seeking assistance for such work from any nation willing to provide it.

Second, Canadian-based and owned exploration companies are already active in foreign offshore waters as operators or partners. In the case of Petrocan, in addition to the foregoing, some \$250M is available over five years in grants to qualifying developing nations, to assist them in funding and developing their own domestic oil and gas supplies - much of which can be spent with Canadian companies for products and services. The aid programme is administered by the Petro-Canada International Assistance Corporation.

Other independent exploration companies (Canadian) have stated their willingness to take competent Canadian hydrographic and oceanographic firms with them - provided that confidence in their ability to perform has been established. These major players have been identified during the survey. The contact information is included in the material provided to CAHOSI for distribution to its members.

The precedent for the opportunity that this circumstance creates is the long history of the U.S. and other multi-nationals importing U.S. and European skills into Canada to serve their operations ashore and offshore for almost 40 years.

To a limited extent, this process has begun for Canadian companies. It is, however, in its earliest and most fragile stage. Only a few of the Canadian companies offering such services have track records that are known to the exploration firms. In turn, the smaller or newer Canadian candidates have too little knowledge of the corporate players and people whose decisions are vital to them. In the interim, United States and other foreign firms are also active in Canada in the domestic, private market.

The present state of the marine surveying industry can be compared with the development and establishment of the Canadian aerial surveying industry in the post World War II years. As a direct consequence of the contracting out policies of the Federal government, the aerial photogrammetric industry was created in a situation where government in-house facilities have never provided more than 7 percent of the activity on the domestic scene.

With its 93 percent share of the total domestic market, the private aerial survey sector, beginning in the 1950's, with some considerable assistance from the Canadian International Development Agency, built a worldwide success in

exporting Canadian skills and technology - an export business that survives to this day and at a time when much of Canada's own domestic needs have been met.

In contrast, the Federal Government in 1983 continues to provide approximately 90 percent of all fresh and salt water hydrographic surveying for marine transportation requirements in Canada through the Canadian Hydrographic Service. Thus, while the importance of CHS's existing policies of contracting out surveys, instrumentation and software must be emphasized, the marine surveying industry does not have the opportunity to develop a domestic hydrographic base on the same scale as the aerial surveying industry.

The first question often asked abroad is "what work have you done for the Canadian Government?". Only a few firms have had the opportunity to be able to give fully satisfactory answers.

The Dominion Hydrographer stated to the consultants in May 1983, that he expected the policy of contracting out to be continued and that he does not anticipate any expansion of the Canadian Hydrographic Service. CHS is limited only by the availability of funding. This small (\$3M) base plus other oceanographic contracts remains a vital component in the private sector's base for penetration of export markets.

A few Canadian firms, and a smaller number of foreign connected firms operating from a Canadian base, have gained sufficient international experience from marine surveying and their larger, connected engineering work to qualify as effective international competitors.

Domestic business generated by offshore oil and gas exploration has generated saleable skills and instrumentation/software in the oceanographic-related fields. Considerable, though clearly expandable, business is already being done abroad by both large and small Canadian companies.

Most, but not all, firms have taken advantage of, or are planning to participate in, support programs administered by ITC, DREE and External Affairs.

ASSISTANCE NEEDED

Apart from the cost/capability barriers to entry into exporting, the principal areas where assistance to the industry is required are in:

1. Timely intelligence - more thoroughly distributed to those who are evidently willing to make use of it.
2. Marketing - The Industry, through its own actions by association, has recognized that collective action and coordination are needed. At the level of individual companies, the range of marketing skills and efforts is from sophisticated and apparently effective to almost non-existent or, in some cases, quite inadequate. While print is an important base component, the survey revealed that, amongst the material collected, some companies have a long way to go in putting their best foot forward.

The survey will provide a detailed and comprehensive inventory of the human and equipment resources and of the track records of the participating companies. It will be the basic tool for wider penetration of the foreign market opportunities for more companies, either alone or in some form of co-ventures. We recommend that it be accompanied by a well-illustrated, colour brochure that presents overall and specific Canadian skills, equipment and experience - domestic and foreign. There is an urgent requirement for this. At the same time, the smaller firms should be encouraged to upgrade their own literature with the export market in mind. Further, it would be highly desirable to produce a short (less than 15 minutes) videotape program that shows the Canadian industry at work and its accomplishments, for use at international exhibitions and conferences, through Canadian posts abroad and as an effective supplement to direct selling efforts and the materials recommended above. (The survey activity has identified sources of existing materials in the industry and in government and the exploration industry which could be used to bring the cost of a program within reach - over a period of time).

3. Trade Missions - Generally high levels of satisfaction were expressed by those companies who have participated in IT&C conducted trade missions.

The experienced firms made the following suggestions:

- a) Industry-specific, marine related missions would be most effective.
- b) Coordination of the industry's own efforts is required.
- c) More careful choices of the countries to be visited on any one mission should be made, with enough time allowed to concentrate on the best prospects. The best results have been achieved when Canadian Trade Representatives abroad have been properly briefed on the objectives and resources of the participating companies.
- d) The smaller firms should rely upon the efforts of the Canadian Association of Hydrographic and Ocean Surveying Industries to do some of their export marketing for them. It is noted that realistic assessment of their abilities to perform must be made, as part of the process of involving them in export markets. As noted under the heading of Domestic Market, some firms are poorly organized in the home market. Their thin management resources could be strained to be breaking point if they are over-encouraged to distract themselves into export markets.

The smaller firms, or those larger companies with limited experience abroad, should approach export markets as sub-contractors or in co-ventures with two principal groups of companies.

- 1) The large Canadian-based engineering consulting and heavy construction organizations, many of whom have 30 or more years of experience abroad. These firms become involved with projects that have marine components that are beyond their in-house capabilities. First, the small firms must identify themselves to these prospective clients and sponsors.
- 2) Canadian-based exploration companies, mostly in Calgary, Alberta, whose offshore activities abroad amount to hundreds of millions of dollars annually. Whether by mandate or persuasion, these firms can generate a substantial export volume for Canadian hydrographic, ocean surveying and related firms. Survey interviews with most senior management of these firms revealed that they are not familiar with the range of Canadian services and products available to them. In the absence of both such knowledge and of confidence in suppliers' performance, local, foreign and other international competitors will be chosen for the marine segments of their activities.

This survey has identified the major players and contacts in the exploration sector. CAHOSI is an obvious vehicle for the provision of this information to all interested Canadian companies.

CONCLUSIONS ABOUT EXPORTS

The marine export market potential can exceed the volume of the present domestic market in the short and medium terms. The cores of skills and experience are in place in Canada now.

If the qualifications identified above are met, the pace of worldwide exploration and development activities is such that the Canadian hydrographic and ocean surveying industry should be able to increase its volume by a minimum of \$10M annually to as much as \$25M to \$50M over a period of time.

ASSISTANCE FROM GOVERNMENTS

The assistance from the Federal government required or suggested is wide-ranging and is summarized as follows:

1. Specification of Canadian content in regulations and programs at home and abroad.
2. Continuation, expansion and refinement of trade mission and activities support.
3. More competitive export financing to give Canadian companies fully equal opportunity abroad when bidding on contracts.
4. Recognition that the service sector is a highly levered industry that produces high returns per employee to the economy; that more equal emphasis be given to the service sector in domestic policies and programs that presently are felt to unfairly favour the manufacturing sector and traditional production line job creation.
5. Extend and more sharply focus the volume and quality of intelligence from Canadian posts abroad. Distribute information swiftly and in time to act.
6. Provide Canadian companies with thorough, continuously updated information regarding availability of and access to Federal and Federal-Provincial programs. (While the large companies, as noted, maintain themselves well informed, the smaller firms need more aggressive assistance). Again, CAHOSI can be the medium for solving at least part of this problem of communication.

7. Revise Department of Supply and Services policies and practices so as to simplify qualification for eligibility in tendering; ensure that unsuccessful bidders know why they were not selected; apply more realistic requirements regarding equipment that must be imported from abroad for temporary use in Canada; ensure the accuracy of lists of eligible firms.
8. Greater incentives and support for Research and Development work, especially to encourage such work in the activities of service companies.
9. Maintain confidentiality with respect to export enquiries on behalf of individual companies to ensure that the information generated is not automatically or accidentally passed to competitors.
10. Make stronger efforts to reduce what are felt to be cumbersome and expensive conditions of doing business with government and in participating in otherwise worthwhile programs.
11. Taxes and Tariffs. The most frequently heard complaint concerned duties applied to the temporary import or purchase of equipment needed for surveys or positioning. The duties are felt to be excessive when there is no Canadian source of manufacture of the required instrumentation.

THE WAY AHEAD

Even considering the effect of the present business recession upon the industry the future looks promising. The opportunities are there for sustained growth both in Canadian waters and around the world. The industry has high technological capability and is extremely competitive all across its spectrum of industrial activity.

To become more effective and efficient in outbidding long term foreign suppliers of services to the oil/gas companies in both Canadian waters and overseas, it will probably be necessary to regroup the industry and amalgamate in a number of instances. However, the industry is flexible, innovative and adaptable to change, as shown by the number of survivors of the recession.

The linking of the industry to Canadian large corporate giants overseas is a strategy essential to the long term health of the industry. Canada already has considerable moral credibility abroad and is therefore strongly positioned to offer leadership in offshore services to the people of the developing coastal states whose standards of living are comparatively poor and who require dramatic progress to achieve standards somewhat comparable to those in the developing world.

The climate within which the industry works is crucial to its ability to strengthen its contribution to the economy. Therefore, both industry and government must work together to ensure that the proper climate is established and maintained. It is essential that governments recognize the industry's potential for economic growth and for contributing to the economy of other industrial sectors. That there is an appreciation of the industry's ability to help achieve the government's stated objectives in the implementation of the Canada Oil and Gas Act. Finally that there develops a general appreciation within governments of the industry's potential to generate export sales of services around the globe.

The creation of such a well automatically climate enhances the reputation of the industry nationally and internationally and guarantees that its contribution to Canada is significant.

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T.D.W. McCulloch - Commonwealth Association of Surveying and Land Economy,
Port Moresby, Papua New Guinea.

The development of a hydrographic and ocean surveying private sector in
Canada - 1983 - T.D.W. McCulloch, Canadian Institute of Surveying Conference,
Victoria, B.C.

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exclusive economic zones - 1983 - T.D.W. McCulloch, 2nd S.E. Asian Survey Congress,
Hong Kong.

APPENDIX A

CANADIAN GOVERNMENT PROGRAMS
TO ASSIST BUSINESS AND INDUSTRY
AVAILABLE TO AND/OR UTILIZED BY
THE CANADIAN HYDROGRAPHIC AND OCEAN SURVEYING INDUSTRY

Note: These programs were available at the time of preparation. Access to them will be affected by the availability of funds at the time of application and by policies in effect. Listings are by department. Telephone numbers for information are given. Users of this list who are located in centres other than the National Capital Region of Ottawa should consult their regional federal government directories for information on the availability of toll-free numbers maintained by some departments and agencies. The following is a list of ITC/REE regional offices for direct service:-

REGIONAL OFFICES

British Columbia

Regional Industrial and Development
Bentall Centre, Tower IV
Suite 1101
1055 Dunsmuir Street
P.O. Box 49178
Vancouver, British Columbia
V7X 1K8
Facsimile: (604) 666-8330
Telex: 04-51191
Telephone: (604) 661-2220

Alberta

Regional and Industrial Development
The Cornerpoint Building
Suite 505
10179-105th Street
Edmonton, Alberta
T5J 3S3
Facsimile: (403) 420-2924
Telex: 037-2762
Telephone: (403) 420-2944

Saskatchewan

Regional and Industrial Development
Bessborough Tower
Suite 814
601 Spadina Crescent, East
S7K 3G8
Facsimile (306) 665-4399
Telex: 074-2742
Telephone: (306) 665-4318

Northern and Special Programs

Regional and Industrial Development
Bessborough Tower
601 Spadina Crescent, East
Saskatoon, Saskatchewan, S7K 3G8
Facsimile: (306) 665-4399
Telex: 074-2742
Telephone: (306) 665-4358

Manitoba

Regional and Industrial Development
3 Lakeview Square, 4th Floor
185 Carlton Street
P.O. Box 981
Winnipeg, Manitoba
R3C 2V2
Facsimile: (204) 949-4992
Telex: 075-7624
Telephone: (204) 949-2300

Ontario

Regional and Industrial Development
1 First Canadian Place
Suite 4840
P.O. Box 98
Toronto, Ontario
M5X 1B1
Facsimile: (416) 366-9082
Telex: 065-24378
Telephone: (416) 365-3775

Quebec

Regional and Industrial Development
Stock Exchange Tower
800 Victoria Square, Room 3709,
P.O. Box 247
Montreal, Quebec
H4Z 1E8
Facsimile: (514) 283-3699
Telex: 055-60768
Telephone: (514) 283-5938

New Brunswick

Regional and Industrial Development
Assumption Place
770 Main Street
P.O. Box 1210
Moncton, New Brunswick
E1C 8P9
Facsimile: (506) 388-6429
Telex: 014-2200
Telephone: (506) 388-6411

Regional Offices

Nova Scotia

Regional Industrial and Development
Queen's Square
45 Alderney Drive
P.O. Box 1320
Dartmouth, Nova Scotia
B2Y 4B9
Facsimile: (902) 426-2624
Telex: 019-22525
Telephone: (902) 426-3458

Newfoundland

Regional and Industrial Development
Parsons Building
90 O'Leary Avenue
P.O. Box 8950
St. John's, Newfoundland
Facsimile: (709) 772-5093
Telex: 016-4749
Telephone: (709) 772-4866

Prince Edward Island

Regional and Industrial Development
Confederation Building
134 Kent Street
Suite 400
P.O. Box 1115
Charlottetown, Prince Edward Island
C1A 7M8
Facsimile: (902) 566-7431
Telex: 014-44129
Telephone: (902) 566-7410

In addition to these regional offices, the department has a "Business Centre" which can be reached at Zenith 0-3200. The call will be connected to the nearest regional office. In Ottawa, the centre is located at:

C.D. Howe Building
235 Queen Street
1st Floor East
Ottawa, Ontario
K1A 0H5
Telephone: (613)995-5771

INDUSTRY, TRADE AND COMMERCE/REGIONAL ECONOMIC EXPANSION

Industrial and Regional Development Program

The I.R.D.P. is a national, sector neutral program which operates in support of regional industrial development initiatives. The program is designed to address the needs of business through the typical corporate development cycle with appropriate forms of financial support depending on the nature of the project, the need for program support, and "value for money" considerations. A range of instruments is available including grants, contributions, repayable contributions, participation loans and loan guarantees. The elements under consideration for financing are:

- a) industrial development climate
- b) innovation
- c) establishment
- d) modernization/expansion
- e) marketing
- f) restructuring

The maximum level of support under each element is enriched through a graduated scale of four tiers under the tier group system.

EXTERNAL AFFAIRS

International Trade

As a result of the ITC/REE/External Affairs reorganization, External Affairs is responsible for the overall development of international trade through its network of Canadian Trade Representatives abroad. Each major geographical sector has an Ottawa headquarters desk and personnel responsible for the development of trade missions and fairs. The department publishes annually updated lists of Canadian representatives serving in Canada.

Contact (613) 996-6448

Program for Export Market Development

Repayable loans for project bidding, export market identification, participation in trade fairs abroad, sponsorship of incoming foreign buyers, formation of export consortia and sustained export market development. The program is administered by External Affairs and delivered together with ITC/REE.

Contact (613) 994-1418

Promotional Projects Program

Exhibits at foreign trade fairs, sponsorship of incoming and outgoing missions.

Contact (613) 995-6221

NATIONAL RESEARCH COUNCILIndustrial Research Assistance Program

Financial support to research workers engaged in approved industrial research projects of high technical merit accompanied by prospects of a high return and good business plans for achieving success.

Contact (613) 993-0331

Program for Industry/Laboratory Projects

Promotes further work on research results from NRC and other government department laboratories to determine whether commercialization would be economic or whether a specific Canadian opportunity exists. The program supports projects from the conceptual stages through the prototype or pilot-plant development within the company.

Contact (613) 993-0695

SUPPLY AND SERVICES CANADAAcquisition of Goods and Services

Acquisition of goods and services by the Federal Government. Science and Engineering Procurement Services of technically complex products, and Research and Development services.

Contact (613) 993-3760

Unsolicited Proposals Program

Written proposals for a research and development project submitted by an individual or an organization in the private sector on its own initiative to endeavour to satisfy the achievement of the scientific objectives of a particular department.

The Unsolicited Proposal process is used frequently by marine surveying and instrumentation firms. It has been an important factor in innovation in instrumentation, software and the development of now accepted techniques - leading to some degree of competitive advantage for Canadian companies at home and abroad.

Contact (819) 997-7218

Canadian Commercial Corporation

112 Kent Street, Ottawa, Ontario, K1A 1E9. Contact (613) 996-0634

CCC, through back-to-back contracts, ties together the requirements of foreign governments and international agencies with suppliers of Canadian goods and services in government-to-government arrangements. Acts as a prime contractor, sub contracting to Canadian firms. CCC head office handles Capital Project exports, with each approved by its Board of Directors. Other export sales are handled for CCC by the Export Supply Centre and Products Centres of Supply & Services Canada.

Contact (819) 997-5714

CANADIAN INTERNATIONAL DEVELOPMENT AGENCY

Place du Centre, 200 Promenade du Portage, Hull, Québec K1A 0G4

CIDA operates and administers Canada's International Development Assistance program in some 80 countries, of which about 40 lesser developed countries receive the majority of funds. O.K.

Contact (819) 997-5456

Bilateral Programs

Develop and implement programs and projects that promote the social and economic progress of developing countries receiving bilateral (direct government-to-government) aid from Canada.

Contact (819) 997-6565

Multilateral Programs

Canada's contributions to international organizations (UN agencies and international development banks) are handled through the Multilateral Branch, which is a source of information on activities.

Contact (819) 997-7615

Industrial Cooperation Programs

These are designed for Canadian companies wishing to investigate industrial cooperation opportunities in developing countries.

Contact (819) 997-7901

Canadian Project Preparation Facility

Enables Canadian Companies to provide project pre-feasibility studies to developing countries to accelerate their industrialization and to facilitate Canadian participation in project implementation.

Contact (819) 997-7901

Technical Assistance

Matches Canadian technical capacities to developing country needs.

Contact (819) 997-7901

Starter and Viability Studies

Reduce front-end costs a Canadian company must incur to investigate opportunities in developing countries for joint ventures direct investment licensing agreements, co-contracts, etc...

Contact (819) 997-7901

Canadian Technology Transfer Facility

Enables Canadian firms to test and adapt their technology in developing countries as a lead-in to long-term cooperation with their developing country counterparts.

Contact (819) 997-7901

Non-Government Programs

Assist associations and institutions to participate in international development.

Contact NGO Division (819) 997-6202

Employment and Immigration Canada

Access to programs through regional offices and local Canada Employment Centres throughout Canada.

Canada Manpower Training Program

Provides workers in Canada with the skills to qualify for better paying, steadier and more satisfying jobs. The program partially refunds employers for employee training costs.

Canadian Trade Skills Training

Focuses on skills requiring longer and technically more complex training, thus concentrating on a specific labour market problem area. The Commission's commitment will be for periods greater than one year.

New Technology Employment Program

Creates jobs for highly educated graduates in scientific and technical fields who are unable to find employment in their disciplines.

New Employment Expansion and Development Program

Creates employment for exhaustees.

Energy, Mines and Resources

Canada Oil and Gas Land Administration (COGLA)

The prime Federal Regulatory Agency responsible for exploration and production of mineral and energy resources in 6.5 million square kilometres of the Arctic, the Atlantic and Pacific offshores, the Yukon and Northwest Territories.

Information (613) 993-3760

Petroleum Incentives Programs

Encourages Canadians to participate in petroleum and gas exploration and development, with benefits tied to degree of Canadian control and ownership area and type of undertaking.

Contact: Energy Sector, Petroleum Incentives Administration -

(613) 996-2611

Continental Shelf Surveys

Offshore geological surveys. Contact Geological Survey

(613) 995-4089

Research Agreements Program

Grants to non-Federal Institutions in support of programs in engineering and sciences.

Contact: External Research Program Office (613) 995-3081

Export Development Corporation

110 O'Connor Street, Ottawa, Ontario K1P 5TP (613) 237-2570

EDC operates commercially to assist Canadian exporters to meet normal commercial credit competition in world markets. Finances medium and long term transactions to foreign buyers of Canada capital goods and services. Guarantees loans by banks to foreign buyers. Provides 100 percent guarantees on performance and bid security via irrevocable letters of credit; provides insurance on receivables, political risks, wrongful calls.

Federal Business Development Bank

Regional Offices in Montreal, Vancouver, Winnipeg, Toronto and Halifax. Branches throughout Canada.

Provides financial assistance to all types of Canadian business which cannot get funding elsewhere on reasonable terms and conditions. Loans, interim and equity financing.

Counselling Assistance to Small Enterprises

CASE uses more than 2,000 retired counsellors in business management, accounting, marketing, production and personnel to assist small firms in improving their methods of doing business. Nominal fees.

Fisheries & OceansSmall Craft Harbours Program

Fisheries and Oceans is responsible for 2300 small craft harbours and marine facilities throughout Canada, including the Great Lakes. Contracts customarily are let through the Department of Public Works. With Policy Enquiries, CONTACT (613) 995-2023. Locally, CONTACT nearest regional small craft harbours office.

Canadian Hydrographic Service

Produces charts of navigable waters, including the larger lakes and rivers inland. Contracts with private sector for marine surveying and chart construction. Funds research and development in instrumentation and software.

Contact (613) 995-4437 with general enquiries and CONTACT the Regional Hydrographers in Dartmouth, Nova Scotia, Quebec City, Burlington, Ontario (for Ontario and Manitoba) and Sydney, B.C. regarding tenders and contracts.

In addition to these specific programs and services, there is considerable interaction between Federal departments and agencies and the private sector to create technological transfer.

Contracting in and contracting out, involving Federal scientific institutes in many parts of Canada, is an ongoing process. While it is beyond the scope of this study to measure its success, private sector participants were quick to identify its significance. Regionally, such activity was most often measured in terms of effectiveness of the individual public servants with the responsibility for industrial liaison. Frequent staff changes were criticized, especially when they resulted in such posts being left vacant for extended periods of time.

Some institutes operate with an unadvertised policy of accepting contract in up to a modest financial limit annually - even though unique scientific or technical facilities may stand idle because of changes in internal Federal programs.

Recently, some Federal institutes have become much more aggressive in contact with industry and business in order to make their needs in instrumentation and service known. It remains to be seen if this policy will be consistent over a period of years and if the required follow-up process will be maintained.

Other institutes have continuing relationships with universities but no organized contact with industry and business. Each institute and each department pursues its own policies or operates in the absence of some form of effective strategy in relation to industry.

Apart from specific programs on a national level from time to time, the private sector sees lasting benefits to be achieved from an expanded interaction with Federal scientific and technical institutes on a continuing basis, with competent personnel assigned to industrial liaison and consistent backing from Federal science management.

The private sector has a role in fostering such contact and in creating opportunities for interaction.

APPENDIX B

INTERNATIONAL AND FOREIGN DEVELOPMENT
ORGANIZATIONS
THAT FUND WORLDWIDE OFFSHORE ACTIVITIES

INTERNATIONAL AND FOREIGN DEVELOPMENT ORGANIZATIONS
THAT FUND WORLDWIDE OFFSHORE ACTIVITIES

APPENDIX B

1.

Australian Development Assistance Bureau
P.O. Box 887
Canberra City ACT 2601
Australia

Asian Development Bank
P.O. Box 789
Metro Manila, Philippines

Abu Dhabi Fund for Arab Economic
Development
P.O. Box 814
Abu Dhabi
United Arab Emirates

African Development Bank
African Development Fund
B.P. 1387
Abidjan 01, Ivory Coast

Arab Fund for Economic and Social
Development
P.O. Box 21923
Kuwait

BMZ-Germany
Federal Ministry for Economic Cooperation
Bundesministerium für Wirtschaftliche
Zusammenarbeit
Karl-Marx-Strasse 4-6
D-53 Bonn 12
Federal Republic of Germany

Caribbean Development Bank
P.O. Box 408
Wilkey
St. Michael, Barbados

Commonwealth Development Corporation
33 Hill Street
London W.1
United Kingdom

Caisse Centrale de Cooperation Economique
233 Boulevard St. Germain
F-75007 Paris
France

Danish International Development Agency
DK-1256 Copenhagen K
Denmark

Swiss Development Agency
EDA
Elgerstrasse 73
CH-3003 Berne
Switzerland

European Economic Community
General Secretariat
170 Rue de la Loi
B-1040 Brussels
Belgium

Export-Import Bank of Japan
1-4-1 Chome, Otemachi
Chiyoda-Ku
Tokyo, Japan

Inter-American Development Bank
808-17th Street, N.W.
Washington, D.C. 20577 U.S.A.

International Monetary Fund
700 19th Street N.W.
Washington, D.C. 20431 U.S.A.

Al-Niaba Palace
Islamic Development Bank
Jeddah
Saudi Arabia

Kuwait Fund for Arab Economic Development
P.O. Box 2921
Kuwait

Norwegian Agency for Development
Box 8142
Oslo - DEP
Oslo, Norway

Organization of American States
General Secretariat
1889 F Street N.W.
Washington, D.C. 20006 U.S.A.

Overseas Development Administration
Eland House
Stag Place
London SW1E 5DH
United Kingdom

Overseas Economic Cooperation Fund
1-4-1 Chome, Otemachi
Chiyoda-ku
Tokyo, Japan

Organization of Petroleum Exporting Countries
Special Fund, P.O. Box 995
A-1011 Vienna, Austria

Saudi Fund for Development
P.O. Box 5711
Riyadh, Saudi Arabi

Swedish International Development Authority
S-10524 Stockholm
Sweden

United Nations Development Programme
1 United Nations Plaza
New York, N.Y. 10017
U.S.A.

United Nations Industrial Development
Organization
Vienna International Centre
P.O. Box 300
A-1400 Vienna
Austria

United States Agency for International
Development
320 21st Street N.W.
Washington, D.C. 20520
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APPENDIX C

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APPENDIX C

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APPENDIX C

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APPENDIX D

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Atek Hydrographic Surveys Ltd.

Burnett Resource Surveys Ltd.

Canadian Engineering Surveys Co. Ltd.

Can-Dive Services Ltd.

* Canocean Resources Ltd. &
Canocean Engineering Ltd.

Cansite Surveys Ltd.

Renald Carriere & Associates, Inc.

Coast Pilot Ltd.

Dobrocky Seatech Limited

Eastcan Group of Survey Consultants
Limited

Fenco Consultants Ltd.

Fentronics Limited

Geomarine Associates Limited

Huntec (70) Limited

Hunter and Associates

IEC Beak Consultants Ltd.

Kenting Earth Sciences

* Lavalin Inc.

* M.S.E. Engineering Systems Ltd.

Marinav Canada Inc.

Marshall Macklin Monaghan Ltd.

Martec Ltd.

McElhanney Surveying & Engineering Limited

McQuest Marine Sciences Limited

Nordco Limited

Nortech Surveys (Canada) Inc.

Northwest Hydrographic Surveys Ltd.

Offshore Navigation (Canada) Ltd.

Offshore Survey and Positioning
Services Ltd.

Pacific Ocean Sciences Ltd.

Pelchat Grenier Geo-Marine Inc.

Seaconsult Marine Research Ltd.

Seakem Oceanography Ltd.

Swan Wooster Engineering Co. Ltd.

Terra Surveys Limited

W.D. Usher & Associates Ltd.

Robert Whiffen Associates Ltd.

Richard Young & Associates

* Companies with associated activities

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ACRES, founded in 1924, is employee owned and a major international consulting organization operating worldwide through a network of subsidiaries, affiliates and associates in 60 countries.

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J.M. Gardiner
S. Tibshirani
F.H. Jonker
Senior Officers
D.B. Sampson
E. de R. Barondes

R.G. Tanner - Hydrographic

ACRES provides consulting services for marine and heavy civil engineering projects to government and industry throughout North America and around the world, covering all aspects from conceptual planning and siting study, through preliminary engineering, feasibility studies, cost estimates, site investigations and model simulation to preparation of designs, specifications and construction supervision and management.

ACRES is expert in ice and winter navigation work for government, industry and national and multi-national exploration companies. It undertakes major dredging projects.

The firm maintains its own laboratories and provides services in biological analysis and bioassay; chemical and physical analysis, physical modelling; soil and rock mechanics testing, hydraulic, aerodynamic, civil and architectural design evaluation.

Internationally, ACRES has worked in 60 countries, including projects sponsored or financed by the Arab Bank, Asian Development Bank, Canadian International Development Agency, European Development Fund, European Investment Bank, FAO of the United Nations, Inter-American Development Bank, International Bank for Reconstruction and Development, Saudi Fund for Development and the United Nations Development Program.

Overseas project offices are maintained in Argentina, Dominican Republic, Ghana, Indonesia, Kenya, Nepal, Pakistan, Panama, Peru, Thailand and the United Kingdom.

| | |
|---------------------|-------|
| TOTAL EMPLOYEES | 1,200 |
| Hydrographers | 1 |
| Oceanographers | 2 |
| Hydraulic Engineers | 20 |

ATEK HYDROGRAPHIC SURVEYS LTD.
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COQUITLAM, British Columbia. V3K 1C9

TELEPHONE: (604) 525 6259

CORPORATE OFFICERS AND KEY PERSONNEL:

Hugh M. Fraser, President
C.M. Gale, P. Eng., Secretary
Derek J. Ashford, P. Eng., Director

ATEK offers precise offshore positioning, bathymetry, 24-hour tide monitoring, engineering surveys. With associates, provides side scan sonar, sub-bottom profiling, bottom & core sampling and current monitoring.

Company has a small fleet of vessels under 40 ft.; crystal controlled digitizer; Wang 2200 microprocessor; flatbed plotter; HP 85 mobile unit; Tellurometer MRD1 - 3 range positioning system; HGA geodometer 122 with Teledyne Gurdy coder connected to Tectronics plotter.

| | |
|--------------------|---|
| TOTAL EMPLOYEES: | 8 |
| Hydrographers | 1 |
| Engineers | 2 |
| Survey Technicians | 3 |

ARCTIC SCIENCES LTD.
1986 Mills Road,
SIDNEY, British Columbia. V8L 4C1

TELEPHONE: (604) 656 0177
TELEX: 049 7282

CORPORATE OFFICERS AND KEY PERSONNEL:
David Fissel, President
Gary Wilton, Secretary

ASL provides physical oceanographic services, remote sensing and technical services, and oceanographic surveys for environmental and operational studies.

| | |
|-----------------------|----|
| TOTAL EMPLOYEES: | 16 |
| Oceanographers | 4 |
| Electronics Engineers | 1 |
| Computer Pers. | 5 |

BURNETT RESOURCE SURVEYS LTD.
2973 Lake City Way,
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02

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Pat Wong, Secretary & Director, Business Development
David Dixon, Director & Production Manager

03

Aerial photography and photo services; Topographic Mapping and Cartography. Burnett was founded in 1966. Its aircraft are capable of flying aerial photography up to an altitude of 25000 feet, (photographic scale of 1:45000) and are equipped with Wild RC-8 aerial cameras having a valid National Research Council Category A calibration report; Aero Triangulation with strip and block adjustment utilizing first order stereo plotters and computer adjustment; Topographic and/or Planimetric Mapping can be produced at scales from 1 inch equals 20 feet to almost any small scale; in pencil manuscript or fairdrawn form; Volume Determinations, using a digital recorder interfaced to a first order stereoplotter, provides volume measurements of materials removed; the full range Cartography department is experienced in custom drafting, including colour separation and complex colour atlas production; Mosaics; Ground Surveys are offered, using modern EDM devices and first order Wild survey equipment in support to photogrammetry. Burnett offers consulting services in the nature and density of control networks for their own control surveys. Burnett specializes in offshore, over-the-ice photography and has extensive experience in the Beaufort Sea area of the Arctic and in the Atlantic Ocean.

04

05

06

WORK DONE:

Beaufort Sea for Gulf, Dome and Esso.
Labrador for Eastcan/Petrocan.
Volume for Canadian Federal and Provincial Governments and Crown Corporations approximately \$1,000,000 annually.

07

| | |
|-------------------|----|
| TOTAL EMPLOYEES: | 35 |
| Cartographers | 8 |
| Programmers | 1 |
| Aircraft Engineer | 1 |

08

Burnett works abroad. Experience includes Tanzania, Saudi Arabia, Peru and Indonesia (for KLM).

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William Kennedy, General Manager

Edward Walton, Vice President Finance

Ken Clifford.P.Eng.,CLS, Director International Marketing (Calgary)

CES, through its marine and special projects division, provides offshore project management; offshore positioning for survey, dredge, coring and seismic vessels and drilling platforms; hydrographic surveys, including inland waters; hydrographic software packages; satellite navigation and positioning; caisson placement; berm and conventional island construction; inertial surveys; airborne surveys; ice movement studies; and acoustic positioning.

Special skills include in-house research and development in software and hardware; development of interfacing, communications and integrations hardware; in software - development and implementation of navigation, bathymetric and positioning software - with emphasis on real time.

Examples of work done abroad include:-

1973 Kenya. Positioning for Chevron of U.S.

1974 Sudan. Positioning for Chevron of U.S.

1975-76 Alaska North Slope - Photogravity, positioning on land and ice

TOTAL EMPLOYEES:

75

Hydrographers

30 (including technicians & support staff

Electronic Engineers

4 (software)

Electronic Engineers

2 (hardware)

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CAN-DIVE offers all types of conventional and deep diving systems and capabilities.

PRINCIPAL SERVICES/PRODUCTS

- Construction diving
- Offshore rig diving
- One atmosphere systems
- Sea Otter submersible
- Search and salvage capability
- Side scan sonar
- Sub-bottom profiling
- Positioning systems
- U/W television

SPECIAL SKILLS AND KNOW-HOW

- Offshore rig support
- Hyperbaric welding
- One atmosphere welding systems
- Underwater video and still photography
- 3,000 feet bell systems

EXAMPLES

- 900 ft. Arctic dive for Panarctic Oils Ltd.
- 2,850 ft. dive offshore Nova Scotia for Chevron Standard Ltd.
- Habitat weld repairs in Beaufort Sea for Dome Petroleum

TOTAL EMPLOYEES: 80-130 (seasonally)

CANOCEAN RESOURCES LTD. &
CANOCEAN ENGINEERING LTD.
610 Derwent Way,
NEW WESTMINSTER, British Columbia. V3M 5P8

TELEPHONE: (604) 524 4451
TELEX: 04 351372

And:
926 5th Avenue SW,
CALGARY, Alberta. T2P 0N7
TELEPHONE: (403) 265 6913
TELEX: 03 827839

CORPORATE OFFICERS AND KEY PERSONNEL:
Ken Montgomery, General Manager-Sales (Calgary)

CANOCEAN, a wholly owned subsidiary of NOVA Corporation, is a world competitor and industry leader in one-atmosphere subsea production systems for the oil and gas industry. Contract research and development, design engineering, project and construction management are also a major part of its activities. Offices and facilities are maintained in Canada, the United States, the United Kingdom and in Brazil.

Marine services include: installation and commissioning and on-going maintenance of subsea dry encapsulated production equipment; flowline pull-ins; hyperbaric diving; remote operated vehicles (SCORPIO); tethered one-atmosphere subsea service systems, welded pipeline connections and control system maintenance. Special equipment services include: subsea wirelining, polished rod equipment, work-breathing systems, surface well access tools and subsea hot taps.

CANOCEAN's manufacturing plant is a certified pressure vessel and plate shop, fully equipped to produce diving bells, subsea chambers, decompression chambers, refinery pressure vessels and specialty pressure vessels. It has also structural steel fabrication and machinery installation capabilities for manufacture of service support equipment and other special oilfield hardware.

CANOCEAN's applied research and development capabilities are its main strength, qualifying it to carry out the widest range of projects in R & D, Arctic engineering, systems and process evaluations and to develop entirely new subsea production systems.

TOTAL EMPLOYEES: 315



Cansite Surveys Limited

CANSITE SURVEYS LIMITED
Suite 507
206 - 7 Avenue S.W.
Calgary, Alberta
T2P 0W7

Telephone: (403) 234-9979
Telex: 03-822052

CANSITE SURVEYS LIMITED
Suite 812, Cogswell Tower
Scotia Square
Halifax, Nova Scotia
B3J 3K1

Telephone: (902) 425-6851
Telex: 019-21828

CORPORATE OFFICERS AND KEY PERSONNEL:

J. Tom Lockhart, President and General Manager
R. G. Ireland, Vice President and Eastern Region Manager
K. M. McGladrey, Chief Surveyor
L. van der Klugt, Operations Manager

CANSITE offers marine navigation services, including rig positioning, survey vessel navigation, bathymetric and high resolution geophysical surveys, sub sea inspection surveys, dredging control surveys, R.O.V. navigation. The firm maintains Syledis, Argo, Mini-Ranger, Trisponder radio positioning systems, Satellite receivers, HP 200 series computers and peripherals. The company is experienced in offshore projects, coastal engineering projects and computer development projects.

TOTAL EMPLOYEES: 15
Hydrographers 3

RENALD CARRIERE & ASSOCIATES, INC.
219-1140 Morrison Drive,
OTTAWA, Ontario. K2H 8S9

TELEPHONE: (613) 820 4545
TELEX: 053 4950

BRANCH OFFICE:
2-3516- 26 Street NE,
CALGARY, Alberta. T1Y 4T7

TELEPHONE: (403) 280 4800

KEY PERSONNEL:

Ron J. Carriere, BScE (Surveying), P.Eng., President
Ken Clifford, BScE (surveying), P.Eng., Vice President
Charles Chamberlain, BScE (Surveying), P.Eng., Director Research & Development
Paul Mrstik, BEng (Electronics), P.Eng., Operations Manager
Denis Gélinas, BSc (Surveying), Research Scientist

RENALD CARRIERE was formed in 1977 to provide consulting services in the application of the modern survey technologies and techniques of doppler and inertial surveying. RC&A provides services in project management, doppler surveying, inertial surveying, software development, research and development, photogrammetry, digital cartography and hydrographic surveying. Its staff includes surveying engineers, geodesists, photogrammetrists and professional surveyors. It has an ownership interest in Société de Gestion Numérique Inc., the Quebec based company specializing in digital cartography.

Research and development in surveying and mapping includes:- new applications of inertial survey systems; interfacing of external sensors such as metric cameras, video cameras, radar and laser profilers; development of data base management systems; CAD-CAM technology; global positioning system receivers; software development; development of map scanning software.

TOTAL EMPLOYEES:

9

01

COAST PILOT LTD.
10807 Madronna Drive,
S.R.1, SIDNEY, B.C.

TELEPHONE:

Marine Telephone: MV Coast Pilot
N115 350
VG 4340

02

Ian Campbell, President
Linda Campbell, Secretary

03

Hydrographic surveys and oceanographic support.
Vessel charter for oceanographic work in salt and
fresh water.

04

Canada Land Surveyors.
Equipment includes 44ft. survey vessel M.V.Coast Pilot
and 13ft. high speed launch.

05

06

CPL since 1975 has specialized in the collection of hydrographic field
data for updating navigational charts and Sailing Directions for the
Canadian Hydrographic Service of the federal Department of Fisheries and
Oceans.

Operations in Arctic waters include a Beaufort Sea pingo study in 1980 for
CHS, sidescan mosaic and field sheet preparation for the Pingo-like Feature
Test Area.

Bench Mark Manual preparation for the West coast of British Columbia and
conversion to metric for the Tidal Section of CHS.

Acoustic releases testing program for Arctic Sciences Ltd.

07

TOTAL EMPLOYEES: 3
Hydrographers 1
Survey Assistants 2

DOBROCKY SEATECH LIMITED
9865 West Saanich Road,
P.O.Box 6500,
SIDNEY, British Columbia. V8L 4M7

TELEPHONE: (604) 656 0111
TELEX: 049 7487

BRANCH OFFICES:

DOBROCKY SEATECH (NFLD.) LTD.
P.O.Box 2278, Station C,
ST. JOHN'S, Newfoundland. A1C 6E6
TELEPHONE: (709) 364 2981
TELEX: 01 649 25
James B. Dempsey, Technical Manager

DOBROCKY SEATECH (ATLANTIC) LTD.
16 Canal Street,
DARTMOUTH, Nova Scotia. B2W 4Y3
TELEPHONE: (902) 463 4099
TELEX: 016 4925

CORPORATE OFFICERS AND KEY PERSONNEL:

John J. Dobrocky, President
Margaret H. Garner, Secretary Treasurer
Andrew L. Wood, Manager-Administration
David S. Woodroffe, Head-Field Operations
Brian N. Lea, President, Dobrocky Seatech (Nfld) Ltd. (St. John's)

DOBROCKY SEATECH is a Canadian oceanographic and environmental consulting firm providing services in physical, chemical and biological oceanography, numerical modelling, hydrography, marine geology and marine geophysics. The hydrographic and marine geology and geophysics survey section has staff experience in hydrographic surveys, rig and platform site surveys, pipeline and cable route surveys, seabed clearance surveys, pre and post dredging surveys, port and harbour surveys, shallow gas and drilling surveys, sediment transport and mapping and beach erosion.

SEATECH has a large inventory of instruments and equipment, a well equipped warehouse and shop, several vessels and a staff of experienced technicians. Services include high resolution hydrographic surveys, coastal and estuarine geomorphology, sediment dynamics and analyses, lake and reservoir volume studies, outfall and submarine cable and pipeline surveys, and pure and applied research.

Facilities and equipment include microwave positioning with automatic survey capability, water level recorders, dredges, piston corers, gravity corers, bottom grabs and survey sounders.

Computer services include standard processing and plotting of oceanographic data, and custom software development. There is a PDP 11-34A data processing system and a fully equipped electronics laboratory with an adjacent precision machine shop.

Other services include field program design and execution in lakes, rivers, coastal and open ocean from vessels, helicopters, fixed wing aircraft and over-ice vehicle trains, shallow water diving, graphics and drafting.

TOTAL EMPLOYEES: 27
Physical Oceanographers 2
R & D 4

The EASTCAN GROUP OF SURVEY CONSULTANTS LIMITED
Suite 256,
Bayers Road Shopping Centre,
HALIFAX, Nova Scotia. B3L 2C2

TELEPHONE: (902) 453 1843

CORPORATE OFFICERS AND KEY PERSONNEL:

Roy A. Dunbrack, CLS, Chairman
Douglas K. MacDonald, CLS, President
A.E. Wallace, OLS, NSLS, Director & Vice President - Administration
David T. Roberts, CLS, Director and Vice President
Eric D. Smith, NBLS, NSLS, Director and Vice President
A. Allan Macdonald, CIM, P.MGR, Secretary

The EASTCAN Group provides a full range of surveying services including cadastral, geodetic, topographic, hydrographic and offshore positioning surveys.

Electronic navigation, positioning and sounding provided for charting, seismographic surveys, wellsites, submarine pipeline and cable routes, dredging, and piling and caissons.

In-house computational facilities include Hewlett Packard 3000, Series 3, 1024K system; Data General Nova 1210 and peripherals; Hewlett Packard 9830, 8K system and peripherals.

In hydrography, major assignments include Canso Strait Development Program, Glace Bay heavy water plant for Deuterium of Canada, well positioning for Mobil Oil, coastal control for offshore positioning systems for Shell Canada off Nova Scotia Coast and Sable Island and the Fairview Container Terminal Project for the National Harbours Board.

TOTAL EMPLOYEES: 80

FENCO CONSULTANTS LTD.
1 Yonge Street,
TORONTO, Ontario. M5E 1E7

(A Division of LAVALIN)

TELEPHONE: (416) 361 4722
TELEX: 06 23765

BRANCH OFFICES:
VANCOUVER, CALGARY, EDMONTON, HAMILTON, TORONTO, OTTAWA, MONTREAL, FREDERICTON,
HALIFAX, ST. JOHN'S

CORPORATE OFFICERS AND KEY PERSONNEL:
J.Galli, President, Engineering Design
K.Poulsen, Vice President, Marine Structures

In addition to a wide range of engineering services, FENCO's marine activities include services in economics, environmental and oceanographic sciences, meteorology, iceberg surveillance and protection, iceberg towing, measurement and drift prediction, aerial iceberg and sea ice reconnaissance, and computer software development, provision of observers on offshore drilling rigs. FENCO's fields of activity include arctic ice technology, offshore drilling, transportation and structures.

Clients include governments in Canada and abroad, international development banks and both domestic exploration firms and multi-nationals.

TOTAL EMPLOYEES: 450 approx.

FENTRONICS LIMITED
P.O. Box 85,
PORT HAWKESBURY, Nova Scotia. BQE 2VQ

TELEPHONE: (902) 625 1736
TELEX: 019 37522

BRANCH OFFICE:
43 Ochterloney Street,
DARTMOUTH, Nova Scotia

CORPORATE OFFICERS AND KEY PERSONNEL:

David A. Steeves, CLS, P. Eng.

FENTRONICS are communications and navigation consultants offering positioning support services; client representation and quality control, remote switching and alarm systems, DP systems service and acoustical equipment service. The firm has experience in drill ship positioning and hydrographic surveying in Atlantic and Arctic waters.

| | |
|------------------------|----|
| TOTAL EMPLOYEES: | 12 |
| Surveyors | 1 |
| Survey technicians | 4 |
| Electronic technicians | 7 |

GEOMARINE ASSOCIATES LIMITED
5112 Prince Street,
HALIFAX, Nova Scotia. B3J 2L4

TELEPHONE: (902) 422 6482
TELEX: 019 23514

BRANCH OFFICE:

ST. JOHN'S, Newfoundland (Field operations and warehouse support)

CORPORATE OFFICERS AND KEY PERSONNEL:

Gerald H. Munro, B.Sc., MBA, Geologist and General Manager
Alan S. Ruffman, President
John McG. Stewart, Vice President
Dr. Peter Simpkin, Division Manager (ST. JOHN'S)

GEOMARINE provides marine intermediate digital geophysical surveys and interpretation, and compilation of analogue and digital geophysical data. It acts as a prime contractor for surveys and as a client representative. Specialties include marine seismic surveying and geophysical interpretation and reporting. The firm has extensive experience abroad, including Greenland, Uruguay, Africa and Western Europe.

TOTAL EMPLOYEES: 26 (plus 14 part time)

HUNTEC (70) LIMITED
2130 Lawrence Avenue East,
SCARBOROUGH (TORONTO), Ontario. M1R 5C7

TELEPHONE: (416) 751 8055
TELEX: 06 963640

BRANCH OFFICE:
Argo Building,
Bedford Institute of Oceanography,
P.O.Box 851,
DARTMOUTH, Nova Scotia. B2Y 3Z5

TELEPHONE: (902) 463 2380
TELEX: 019 31446

CORPORATE OFFICERS AND KEY PERSONNEL:
David Gray, President

John Hamilton, Marketing Administrator
D.Russell Parrott, M.Eng., P.Eng., Analyst-Geophysicist (Dartmouth)
Tom Goudy, Manager (Dartmouth)

HUNTEC is a hardware manufacturer and provides geophysical survey services with an emphasis on the seabed. Specialties include underwater acoustics and signal processing techniques for seabed information. Unique capacities include the company's precision and information content, and its software methods of extracting information with an integrated approach. Contract research and development represents a significant portion of its business in geophysics and hardware development.

TOTAL EMPLOYEES: 75

Hunter & Associates
6870 Gorway Drive, Suite 201
Mississauga, Ontario
L4V 1P1

TELEPHONE: (416) 678-6844
TELEX: 06-983527

Hunter Associates, established in 1977, is a multidisciplinary resource management consulting firm, offering a wide range of environmental and engineering services. It is a federally incorporated company in Canada, wholly owned by its active full time employees.

CORPORATE OFFICERS AND KEY PERSONNEL:

G.T. Hunter, President
Janet Moate, Hydrographic Surveys
Jean-Pierre Bache, Geomorphologist
David W. Smith, Ecologist/Biologist
Sheryl King, RPF, Forester

Hunter and Associates specialize in the use of airphoto interpretation and advanced remote sensing technology for coordination of environmental field research leading to resource management policy recommendations. The firm is well equipped to efficiently identify and resolve physical land use planning issues and development feasibility both on a local and on a regional basis. In addition, Hunter and Associates have developed expertise in ecological (biophysical) land classification and in coastal zone management including shallow water bathymetric surveys.

Recent work includes a Coastal Conservation Study in Barbados. Work included environmental dual frequency acoustic surveys for water column and sub-bottom profiling, sediment transport and erosion studies, comparative historic shoreline analysis by photogrammetry, marine biology surveys by Scuba diving, colour and photography and video surveys, environmental modelling and recommendations for environmental mitigation and design solutions. Another recent project was research and application for remote sensing methods to shallow water bathymetric charting for the Canadian Hydrographic Service. Techniques include aerial photography, laser profiling, airphoto interpretation, analytical photogrammetry and airborne positioning. Other recent projects include Coastal Zone research and management studies in the Atlantic Provinces, the Arctic Islands, Ontario and British Columbia.

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| TOTAL EMPLOYEES | 10 |
| Hydrographers | 2 |
| Geomorphologists | 1 |
| Biologists | 1 |

| | | |
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| TOTAL EMPLOYEES: | 120 | |
| Oceanographers | 4 | (Vancouver) |

KENTING EARTH SCIENCES LIMITED

380 Hunt Club Road,
OTTAWA, Ontario. K1G 3N3

TELEPHONE: (613) 521 1630
TELEX: 053 4173

BRANCH OFFICES:

7070 Farrell Road SE,
CALGARY, Alberta. T2H 0T2
TELEPHONE: (403) 252 3346
TELEX: 038 24712

248 Lesmill Road,
DON MILLS, Ontario. M3B 2T5
(Toronto area)
TELEPHONE: (416) 445 9716
TELEX: 069 66523

General Delivery,
Postal Station B,
Torbay Road,
ST. JOHN'S, Newfoundland. A1A 2X2
TELEPHONE: (709) 753 9080

KENTING AFRICA RESOURCE SERVICES LIMITED since 1966 has maintained offices at:

53 Lawson Street,
P.O.Box 1658,
LAGOS, Nigeria.
Mr. Henry Gansen
TELEPHONE: 636555 or 636239
TELEX: 905521308

P.O.Box 589,
Bompai Road,
KANO, Nigeria.
Mr. Z.Wroblewicz
TELEPHONE: 2828
TELEX: 90577155

KENTING ITALIA S.R.L. maintains offices at:

Via Guido d'Arezzo, 14
00191 ROMA, Italy.
Dr. E.Moriondo.
TELEPHONE: (06) 845 3579
TELEX: 612413 IMESA

KENTING ALSO HAS REPRESENTATION in CAIRO, EGYPT; MILAN, ITALY; MANILA, PHILIPPINES; TOKYO, JAPAN; and BANGKOK, THAILAND.

Other associated companies include: Kenting Oilfield Services; Kenting Drilling; Kenting Exploration Services; Kenting Helicopters; Technical Enterprise; Kenting Drilling Services Ltd.(U.K.); and Cactus Drilling Corporation of Texas (U.S.A.). KESL is a wholly owned subsidiary of TRIMAC LIMITED of Calgary, a 95 percent Canadian owned company providing services in the energy and transportation industries.

CORPORATE OFFICERS & KEY PERSONNEL:

Douglas G.MacKay, Chairman of the Board
John E.Macartney, General Manager
John E.Walker, Assistant General Manager (Photogrammetry)
Robert W.Stemp, Assistant General Manager (Geophysics/Geology)
Dwayne E.O'Grady, Manager of Finance & Administration
E.C.Anderson, Manager Calgary office
Ronald Moore, Manager Don Mills office
Gerald Curtis, Manager Newfoundland office

Continued....

KENTING is the oldest established aerial surveying company in Canada and through its worldwide operations since 1947 in more than 85 countries is one of the world's best known and respected survey and mapping companies.

Primary services are in aerial photography and remote sensing; airborne geophysical exploration; geodetic, engineering and control surveys; photogrammetry, including advanced digital mapping services, and specialized cartography; resources surveys and development; groundwater exploration and irrigation design; and hydrographic surveys. Other divisions of KENTING are active in petroleum and gas well drilling, oilfield construction, pipeline services and helicopter charter.

KENTING operates 9 of its own aircraft around the world. It has a wide ranging expertise in resource development, with specialists in agriculture, forestry, soils science, hydrology and irrigation design.

Its airborne geophysical services, backed by a strong in-house research and development capacity, are considered to be among the world's leaders.

KENTING has a full digital mapping capability with automated mapping procedures, backed by its own state-of-the-art software.

KENTING now offers the airborne gradiometer, an in-board vertical magnetic gradient system based on the highly successful prototype developed and proven by the Geological Survey of Canada. The gradiometer provides superior resolution and sensitivity and is the desired method required for a detailed mineral survey in drift covered areas and areas of complex geology.

The international hydrographic survey division uses the most modern and reliable equipment available, which can be installed in any suitable vessel or aircraft. KENTING has developed a unique proprietary electronic recording system which correlates data from several sources through a real-time, on-board computer, being simultaneously recorded in analog and digital form. With a comprehensive computer map compilation section, automated high resolution flat bed drafting capability, specialized maps and charts can be produced. Capabilities in hydrography include full positioning and sounding packages, with data recording systems suitable for rivers, lakes or off-shore hydrographic work and pre- and post-dredging operations. Services are offered in satellite position fixing for off- or onshore locations, with fully equipped crews for the land based positioning of control nets. KENTING has experts in current metering, sediment and water quality sampling and analyses.

As Canada's biggest airborne mapping and surveying firm (1982: \$122,000,000), KENTING is thoroughly experienced in international agency projects, government work and private assignments. Projects have been successfully completed in all areas of North and South America, nearly every country in Africa, throughout Asia, the Middle East and Western Europe - 85 countries in all.

| | |
|------------------|-----|
| TOTAL EMPLOYEES: | 200 |
| Hydrographers | 1 |
| Oceanographers | 1 |
| Cartographers | 25 |
| R & D Personnel | 8 |

LAVALIN INC.
1130 Sherbrooke Street West,
MONTREAL, Quebec. H3A 2R5

TELEPHONE: (514) 288 1740
TELEX: 055 61250

BRANCH OFFICES:
Throughout Canada in principal cities.
(See also listing for FENCO CONSULTANTS LTD., of Toronto, division of LAVALIN)

CORPORATE OFFICERS AND KEY PERSONNEL:
B.Lamarre, President
M.Dufour, President, Lavalin International Inc.
H.Kivisild, Vice President, Arctic Technology (Calgary)
J.H.Allen, Vice President, Ocean Science and Operations (Halifax)

LAVALIN is one of Canada's largest and oldest engineering services companies, offering practically every field of engineering, design, project management and general consulting in the applied sciences, including economics, environmental and ecological studies, computer sciences, marketing, nuclear energy and ice technology. LAVALIN has specialists in marine installations, terrain sciences, geotechnical investigations and engineering, aerial surveys and Arctic development.

The International Division maintains permanent offices in Africa, Asia, Europe, and the Middle East.

LAVALIN engineers and scientists were pioneers in the field of Arctic technology. Several technological breakthroughs for the petroleum industry, including ice platforms and ice islands for drilling rigs, ice roads and Arctic ports, were engineered by LAVALIN.

The company owns and operates a fleet of aircraft for photographic and electronic surveys. Ground facilities include interactive digital-analogue systems for graphic displays, aero-triangulation by analytical stereo-restitution, inertial and Doppler surveying methods, and conventional mapping through analogue photogrammetry.

The firm makes extensive use of computers through three main, linked centres in Montreal, Toronto and Calgary, accessed by regional offices. Specialists provide consulting, software and hardware services on demand.

Expertise extends to such maritime projects as tanker ports, offshore installations and Arctic ports.

A division specializes in worldwide trading, making possible the purchase of any equipment or material and its safe shipment anywhere in the world.

Through MacLAREN PLANSEARCH Division, comprehensive services are offered in environmental sciences, water resources, urban and regional planning, economic and social studies, ocean sciences and operations, transportation studies and computer sciences. (Edmonton, Alberta and branch offices)

LAVALIN has worked abroad in more than 50 countries for more than 40 years.

TOTAL EMPLOYEES: 3,000 plus

M.S.E. ENGINEERING SYSTEMS LTD.
265 Canarctic Drive,
DOWNSVIEW, Ontario. M3J 2N7

TELEPHONE: (416) 661 5646
TELEX: 065 23982

BRANCH OFFICES:

M.S.E. ENGINEERING SYSTEMS ATLANTIC LTD.

ST. JOHN'S, Newfoundland.

EDR MANAGEMENT ASSOCIATES,
DOWNSVIEW, Ontario.

Distribution, lease and utilization of scientific products for oceanographic, hydrographic, geophysical and environmental study programs.

PRINCIPAL SERVICES/PRODUCTS

- Oceanographic instrumentation
- Data buoy systems
- Acoustic navigation and positioning
- Oil spill recovery systems
- Aquatic sampling products
- Oceanographic winches
- Hydraulic lift and skidding systems
- Process control equipment
- Epoxy resins for chocking & grouting, speciality coatings

SPECIAL SKILLS AND KNOW-HOW

- Complete service support including calibration, repair and overhaul
- Engineering design modifications
- Short term and long term equipment leasing

EXAMPLES

Key customers include:

- Major oil companies
- Electric utilities
- AECL
- Government agencies such as Fisheries and Oceans, Environment, Transport, National Defence, Energy, Mines and Resources

KEY PERSONNEL

| | |
|-------------------|---|
| Alfred W. Egerton | President |
| Robert T. Fraser | Vice President, Sales, Marine and Energy Division |
| Raymond Elder | Manager, Resins Division |

MARINAV CANADA, INC.
1140 Morrison Drive,
OTTAWA, Ontario. K2H 8S9.

Telephone: (613) 820-6600
Telex: 053-4117

BRANCH OFFICES:

1 - 3530 - 11A Street N.E.
Calgary, Alberta, T2E 6M7.

Telephone: (403) 276-6897
Telex: 038-27588

1000 Windmill Rd., Suite 22,
Dartmouth, Nova Scotia, B3B 1L7.

Telephone: (902) 469-6247
Telex: 019-31681

AFFILIATED COMPANY:

Geonautics Ltd.
P.O. Box 8833,
St. John's, Nfld. A1B 3M9.

Telephone: (709) 364-1200
Telex: 016-4596

CORPORATE OFFICERS AND KEY PERSONNEL:

Peter C. Wilson, President
Tony J. Mason, Vice President & General Manager.
Pierre Richard, Secretary
Wendell E. Bleeks, Controller
A. Roy Falconer, P.Eng. Manager Engineering
Ed J.L. Williams, CLS, Chief Surveyor
J. Moe Rowsom, Manager Operations
Ian Tilmouth, Manager - Marinav Canada Inc. - Calgary
C. Al. Greatrex, Supervisor - Marinav Canada Inc. - Dartmouth

MARINAV provides offshore navigation and survey services, primarily hydrographic and bathymetric; rig site surveys; pipeline and cable route surveys; pre and post plot services; pre and post dredging surveys; charting services; integrated navigation systems; doppler satellite survey services; data acquisition systems; shallow seismic investigations; tide and current measurements; contract electronics maintenance; specialized engineering development; navigation software development.

Special skills and services include: - offshore positioning, utilizing short, medium and long range electronic navigation aids and satellite navigation equipment; acts as manufacturers' sales and service agent for Magnavox (Satellite navigation), Del Norte (Microwave positioning systems), Krupp Atlas (Sonar products); Global Thermo-electric Power Systems Ltd. (Thermoelectric generators); equipment rentals (Artemis, Trisponder, Syledis, Maxiran, ARGO, Loran C, Satellite-Transit & GPS Navstar) and personnel services.

Equipment available includes a full range of electronic survey control systems and integrated navigation systems, specifically designed to provide precise position fixing for marine and airborne survey operations. Marinav introduced multiuser navigation services of this type in the Canadian Arctic in 1960, Hudson Bay in 1965, in Alaskan waters in 1980, including Cook Inlet, Gulf of Alaska, Norton Sound and the Beaufort Sea, and in Gulf of Mexico in 1981, offshore California in 1982 and Alaskan North Slope in 1983.

MARINAV maintains a staff of trained, field experienced program managers, professional surveyors, hydrographers, engineers and technicians, including operators provided to clients. The Offshore Survey Group serves offshore resource exploration and development, commercial shipping and fishing, scientific research, dredging and harbour control, tidal monitoring, airborne surveys and all Provincial and Federal Agencies.

The company has extensive experience throughout Canada and overseas having undertaken work in North Sea, Spain, Egypt, Persian Gulf, Bahamas, Caribbean, Brazil, Ecuador, S. Pacific, Japan, Bermuda, Sri Lanka, Singapore, Zaire and Argentina.

TOTAL EMPLOYEES: 42 Including:

| | |
|----------------------|------|
| Program Managers | - 4 |
| Hydrographers | - 5 |
| Oceanographers | - 1 |
| Scientists | - 1 |
| Electronic Engineers | - 3 |
| Cartographers | - 1 |
| Technicians | - 10 |
| Master Mariner | - 1 |

MARSHALL MACKLIN MONAGHAN LIMITED
275 Duncan Mill Road,
DON MILLS, Ontario. M3B 2Y1

TELEPHONE: (416) 449 2500

BRANCH OFFICES:

In Ontario, in Burlington, Cambridge, Elliot Lake, Mississauga, Waterloo and Whitby.

999-8 Street SW,
CALGARY, Alberta. T2R 1J5
TELEPHONE: (403) 245 2774

10180- 102 Street,
EDMONTON, Alberta. T5J 0W5
TELEPHONE: (403) 423 6820

AFFILIATED FIRMS:

Cansult Limited, a Canadian consortium of consulting engineers organized to undertake work internationally.

Marshall Macklin Monaghan Ontario Limited - surveying

Marshall Macklin Monaghan Western Limited

CEP Consultants Ltd.

CORPORATE OFFICERS AND KEY PERSONNEL:

P.A.Monaghan, President

J.W.L.Monaghan, Secretary

H.L.Macklin, Chairman of the Board

Kenneth A.McLennan, Executive Vice President

L.R.Kentridge, Vice President Planning

H.N.Edamura, Vice President Corporate Development

J.L.Tersigni, Vice President Municipal Engineering

J.A.Metcalf, Vice President Operations Cansult Limited

W.M.Pinkerton, Vice President Western Canada (Edmonton)

A.L.Atkinson, Vice President

C.E.Stockman

G.E.Maunders

S.R.G. Gonin, Treasurer

MARSHALL MACKLIN MONAGHAN, a leader in its fields, has for more than 30 years provided expert capabilities in engineering, surveying and planning for projects of varying sizes and scope across Canada and in the international market. Market sectors include environmental, transportation, tourism and recreation, municipal and public works, urban development, buildings and structures, resource management, surveying and mapping.

Through CANSULT, formed in 1961, and its member and affiliate specialized firms, MM & M participates in a broad spectrum of international projects, including marine engineering, surveying, public works, transportation, land reclamation, urban and regional planning and architecture. Other services include materials testing, hydrogeology, geotechnical sciences, equipment procurement, personnel training, and project management.

Projects have been undertaken throughout Canada, the United States, Central and South America, the Caribbean, Africa, the Middle East, Europe, India and South East Asia.

Continued.....

Special services are provided in applied surveys, legal surveys, mapping and photogrammetry, geodetic surveys and hydrographic surveys. In hydrographic surveys, MM & M offers offshore positioning, bathymetric surveys, current measurements, tidal measurements, gravity measurements, sediment sampling, dredging surveys, route selection, specifications, contract administration and operational management. Complementing the firm's hydrographic capacity are photogrammetric, cartographic and computational services. All survey computations and plotting are performed on the firm's VAX 11-780 computer and Calcomp 960 beltbed plotter. The software library includes a survey coordinates package for standard survey calculations and plotting, HCA and VCA for least squares adjustment of horizontal and vertical control networks, PBA for photogrammetric block adjustments, GEODOP program package for Doppler Satellite Positioning calculations.

| | |
|------------------|--|
| TOTAL EMPLOYEES: | 450 |
| Surveying | 100 |
| Hydrographers | 3 |
| Cartographers | 11 |
| R & D | 2 Computer sciences & applications, geographic information systems and applications |

MARTEC LIMITED
5670 Spring Garden Road,
HALIFAX, Nova Scotia. B3J 1H6

TELEPHONE: (902) 425 5101
TELEX: 019 22770

CORPORATE OFFICERS AND KEY PERSONNEL:

Dr. Alan MacLean, President
J.L.Warner, Vice President
W.G.Tidmarsh, Vice President
Alan V.Bell, Vice President
Barry Curtis, Secretary Treasurer (Montreal)

MARTEC provides scientific and engineering services related to the marine environment through a qualified and experienced staff of engineers, oceanographers, marine biologists and computer scientists. Principal activities include stress analysis in marine structures, applied oceanography, arctic oceanography and ice engineering, environmental impact analysis and ocean engineering. Specialties include benthic ecology, behaviour of spilled oil, ice and iceberg drift prediction, mathematical modelling using finite elements, and measurement and analysis of oceanographic data. Clients include the major Canadian and multi-national exploration firms & governments in the Atlantic, Arctic and Pacific Oceans. MARTEC maintains laboratory facilities and has developed an analytical capacity which is completely mobile. Overseas projects include South Yemen, Nigeria and Indonesia.

| | |
|-----------------------|----|
| TOTAL EMPLOYEES: | 20 |
| Oceanographers | 5 |
| Electronics Engineers | 1 |
| Computer Pers. | 6 |

McElhanney Surveying & Engineering Ltd.
200-1166 Alberni Street
Vancouver, British Columbia
V6E 3Z3

Telephone: (604) 683-8521
Telex: 04 51474

BRANCH OFFICES:

McElhanney Surveying & Engineering Ltd.
(Equipment) 1495 Venables Street
Vancouver, B.C. V5L 2G3

Telephone: (604) 254-6281
Telex: 04-507802

McElhanney Surveying & Engineering Ltd.
107 Colonnade Road
Nepean, Ottawa, Ontario K2E 7M3

Telephone: (613) 225-9170
Telex: 053-3174

McElhanney Offshore Surveys Ltd.
P.O. Box 13515, Station A
St. John's, Newfoundland A1B 4B8

Telephone: (709) 726-4252
Telex: 016-3243

McElhanney Surveying & Eng. Ltd.
450, 999 - 8th Street, S.W.
Calgary, Alberta T2R 1J5

Telephone: (403) 245-4711
Telex: 038-25637

McElhanney Services Ltd.
1, 101 Thornhill Drive
Burnside Industrial Park
Dartmouth, Nova Scotia B3B 1S2

Telephone: (902) 463-0041
Telex: 019-31670

ASSOCIATED COMPANIES INCLUDE:

McElhanney Associates
McElhanney Land Surveys (Alta.) Ltd.

CORPORATE OFFICERS INCLUDE:

| | |
|------------------|--|
| R.A. Brocklebank | President (Vancouver) |
| W.H. Morton | Vice President Marketing (Vancouver) |
| D.B. Thomson | Vice President & Manager Marine & Geodetic Services (Vancouver) |

MARINE & GEODETIC SERVICES DIVISION KEY PERSONNEL

| | |
|------------------|--|
| John R. Adams | Manager Navigation & Positioning (Calgary) |
| John H. Allen | Manager Business Development & Planning (Vancouver) |
| John Blair | Manager Geodetic Services (Vancouver) |
| Mike Cole | Manager McElhanney Offshore Services Ltd. (St. John's) |
| Anthony Gale | Manager Marine & Geodetic Equipment (Vancouver/Venables) |
| Hans J. Gray | Manager Hydrographic Surveys Branch (Vancouver) |
| Simon K. Melrose | Manager Environmental Data Services (Calgary) |
| David Powell | Manager Geophysics (Halifax/Dartmouth) |
| Tom W. Windeyer | Manager McElhanney Services Ltd. (Halifax/Dartmouth) |

McELHANNEY is one of Canada's largest and oldest employee owned surveying, engineering and mapping companies, organized into five operational divisions: Marine & Geodetic, Engineering, Land Surveys, Petroleum Surveys, and Mapping. Founded in 1910, the company continues to expand its services to the natural resource development industry and all levels of government in Canada and in more than 50 countries around the world.

Services include hydrographic surveys, offshore positioning and navigation, oceanographic and ice management services, geophysical surveys and interpretation, sea floor mosaics, geodetic and control surveys, computer systems development, data processing, digital mapping, photogrammetric mapping services, oil field and pipeline surveys, communication path surveys, route location and design, reprographic and cartographic services.

McELHANNEY owns and operates a wide range of precision monitoring and measuring systems including: Miniranger and Trisponder for short range; Syledis for up to 200 kilometres; ARGO for up to 700 kilometres; LORAN-C for up to 1,500 kilometres; Doppler satellite receivers for unlimited ranges; Oceano Acoustic navigation system and Litton Dash II inertial system. Precision echo sounders include Atlas Deso 10, Edo, Raytheon and Ross. This equipment is complemented by Klein and ORE side scan sonars and NSRF V-fin deep towed sparker system and Geosource MDS 10 digital system with Teledyne streamer.

Site surveys, rig location surveys, survey vessel navigation and onshore control surveys have been completed off Canada's east, north and west coasts, Africa and Asia. The Canadian east coast Argo chains provide complete coverage from Baffin Island in the north, through Labrador and Grand Banks to the Scotian Shelf and Georges Bank in the south. McElhanney's Beaufort chains stretch from Banks Island in the east to Alaska. Hydrographic activities in marine and inland waters include acquisition, compilation, processing and analysis of survey and bathymetric field data for: Feasibility studies, navigation, pre and post dredging surveys, seabed topography and sampling, sub-bottom profiling, hydrographic charts and digital chart production, coastal zone management, underwater pipeline, cable and outfall route location surveys, dock, wharf and mooring surveys and marine construction surveys. All final computing, processing, plotting, editing, cartographic drafting and reporting are done in McElhanney's own offices.

McELHANNEY's geophysical capabilities combine electronic, engineering and marine operational skills in interfacing navigation and positioning systems to such tools as side scan sonar, sub-bottom profilers and multi-channel digital seismic equipment for operations inshore, on the continental shelf, or on the continental slope. Turn key services are offered.

Systems Development Teams determine suitable hardware, develop a program and documentation to interface with any computer hardware including peripheral equipment, and then field tests the system prior to training of the client's staff. Field processing is performed on HP9816, HP9825 and HP9826's with all software custom designed in-house by McElhanney's research and development personnel. In-house computer systems comprise a DEC PDP 11-44 in Calgary and a DEC PDP 11-70 in Vancouver.

The firm maintains a full range of equipment for navigation & positioning, geophysical, geotechnical, hydrographic, geodetic, computing and environmental services. Inventory exceeds \$7,000,000.

Work abroad began in 1959 with the Mekong River survey and mapping program in Laos, Cambodia, Thailand and Vietnam. Foreign contracts completed since then include Angola, Argentina, Australia, Bahamas, Barbados, Brazil, Chile, Colombia, Ghana, Greenland, Guatemala, Haiti, Indonesia, Iran, Jamaica, Kenya, Korea, Kuwait, Libya, Malaysia, Mexico, Nepal, Nicaragua, Nigeria, Oman, Pakistan, Paraguay, Peru, Qatar, Rwanda, Saudi Arabia, Senegal, South Africa, Syria, Tanzania, Trinidad & Tobago, United Arab Emirates, United Kingdom, U.S.A., Venezuela, Yemen, Zaire.

TOTAL EMPLOYEES: 400 (100 Professionals, 200 Technicians)

| | | |
|-----------|---------------------------|----|
| Includes: | Hydrographers | 5 |
| | Oceanographers | 2 |
| | Cartographers | 2 |
| | Geodesists | 10 |
| | Offshore Surveyors | 20 |
| | Geophysicists | 8 |
| | R & D personnel | 12 |
| | Electronics Technologists | 10 |

MARINE & GEODETIC SERVICES DIVISION KEY PERSONNEL

| | |
|------------------|--|
| John R. Adams | Manager Navigation & Positioning (Calgary) |
| John H. Allen | Manager Business Development & Planning (Vancouver) |
| John Blair | Manager Geodetic Services (Vancouver) |
| Mike Cole | Manager McElhanney Offshore Surveys Ltd. (St. John's) |
| Anthony Gale | Manager Marine & Geodetic Equipment (Vancouver/Venables) |
| Hans J. Gray | Manager Hydrographic Surveys Branch (Vancouver) |
| Simon K. Melrose | Manager Environmental Data Services (Calgary) |
| David Powell | Manager Geophysics (Halifax/Dartmouth) |
| Tom W. Windeyer | Manager McElhanney Services Ltd. (Halifax/Dartmouth) |

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Services include hydrographic surveys, offshore positioning and navigation, oceanographic and ice management services, geophysical surveys and interpretation, sea floor mosaics, geodetic and control surveys, computer systems development, data processing, digital mapping, photogrammetric mapping services, oil field and pipeline surveys, communication path surveys, route location and design, reprographic and cartographic services.

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Site surveys, rig location surveys, survey vessel navigation and onshore control surveys have been completed off Canada's east, north and west coasts, Africa and Asia. The Canadian east coast Argo chains provide complete coverage from Baffin Island in the north, through Labrador and Grand Banks to the Scotian Shelf and Georges Bank in the south. McElhanney's Beaufort chains stretch from Banks Island in the east to Alaska. Hydrographic activities in marine and inland waters include acquisition, compilation, processing and analysis of survey and bathymetric field data for: Feasibility studies, navigation, pre and post dredging surveys, seabed topography and sampling, sub-bottom profiling, hydrographic charts and digital chart production, coastal zone management, underwater pipeline, cable and outfall route location surveys, dock, wharf and mooring surveys and marine construction surveys. All final computing, processing, plotting, editing, cartographic drafting and reporting are done in McElhanney's own offices.

McELHANNEY's geophysical capabilities combine electronic, engineering and marine operational skills in interfacing navigation and positioning systems to such tools as side scan sonar, sub-bottom profilers and multi-channel digital seismic equipment for operations inshore, on the continental shelf, or on the continental slope. Turn key services are offered.

Systems Development Teams determine suitable hardware, develop a program and documentation to interface with any computer hardware including peripheral equipment, and then field tests the system prior to training of the client's staff. Field processing is performed on HP9816, HP9825 and HP9826's with all software custom designed in-house by McElhanney's research and development personnel. In-house computer systems comprise a DEC PDP 11-44 in Calgary and a DEC PDP 11-70 in Vancouver.

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Work abroad began in 1959 with the Mekong River survey and mapping program in Laos, Cambodia, Thailand and Vietnam. Foreign contracts completed since then include Angola, Argentina, Australia, Bahamas, Barbados, Brazil, Chile, Colombia, Ghana, Greenland, Guatemala, Haiti, Indonesia, Iran, Jamaica, Kenya, Korea, Kuwait, Libya, Malaysia, Mexico, Nepal, Nicaragua, Nigeria, Oman, Pakistan, Paraguay, Peru, Qatar, Rwanda, Saudi Arabia, Senegal, South Africa, Syria, Tanzania, Trinidad & Tobago, United Arab Emirates, United Kingdom, U.S.A., Venezuela, Yemen, Zaire.

TOTAL EMPLOYEES: 400 (100 Professionals, 200 Technicians)

| | | |
|-----------|---------------------------|----|
| Includes: | Hydrographers | 5 |
| | Oceanographers | 2 |
| | Cartographers | 2 |
| | Geodesists | 10 |
| | Offshore Surveyors | 20 |
| | Geophysicists | 8 |
| | R & D personnel | 12 |
| | Electronics Technologists | 10 |

McQUEST MARINE SCIENCES LIMITED
489 Enfield Road,
BURLINGTON, Ontario L7T 2X5

TELEPHONE: (416) 639 0931, 639 0934
TELEX: 061 8503

KEY PERSONNEL:
R.K.McMillan, B.Sc., M.Sc.
J.W.Prior, M.Sc., P.Eng.

McQUEST provides marine geophysical consulting services, side scan sonars and positioning systems.

Special skills and equipment include: the only 500 kHz side scan sonars in Canada; geophysical and side scan sonar training courses and equipment; specialized applications (rotary, etc.); and underwater television with remote tethered submersibles.

Clients include Canadian Federal and Provincial governments, Transcontinental Gas Pipeline Corp., TransCanada Pipeline Ltd., Domtar. Marine business done abroad in Bangladesh, U.S.A., Panama, Brazil, Barbados, Turks & Caicos. Land contracts in India, Saudi Arabia, England, Algeria and West Africa.

| | |
|------------------|--------|
| TOTAL EMPLOYEES: | Varies |
| Oceanographers | 1 |
| Geophysicists | 1 |

NORDCO LIMITED
34 Glencoe Drive,
P.O.Box 8833,
ST. JOHN'S, Newfoundland. A1B 3T2

TELEPHONE: (709) 364 1200
TELEX: 016 4596

BRANCH OFFICE:

Suite 1902,
727 6th.Avenue SW,
CALGARY, Alberta. T2P 0V1
TELEPHONE: (403) 265 1151

CORPORATE OFFICERS AND KEY PERSONNEL:

Dr. David I.Ross, Director of Operations
Dr. Roger A.Stacey, Director, Ocean Engineering

NORDCO claims the largest staff of scientific, engineering and technical consultants devoted to the ocean environment in eastern Canada. It offers a multi-disciplinary systems approach to all aspects of ocean resource development from geophysical surveying to fisheries technology and socio-economic studies, to ice and ship transit studies, weather forecasting, and electronic instrumentation design and maintenance. The company, which is majority owned by the Government of Newfoundland, also carries out considerable research and development, both in-house and under contracts, through the application of innovative human and technological resources to solve problems associated with the marine environment. Hydrographic work is contracted out. The company has produced Atlantic fishing charts for the Federal Department of Fisheries & Oceans.

NORDCO's oceanographic capabilities encompass a complete range of data collection, analysis and interpretation services required to determine environmental loadings and design criteria for structures in the marine environment. An extensive inventory of precision instrumentation, maintained and calibrated in-house, is available for the study of current, tidal, wave climate and water column characteristics. The data processing facility uses custom developed analytical software, with significant advances made in the development of computer models of environmental factors for applications in oil spill prediction, marine installation design and resource development impact.

NORDCO is involved in the acquisition, compilation and interpretation of data on coastal geomorphology, oceanographic processes, biological resources and socio-economic factors for assessing coastal development planning and effective resource management.

Major elements are ice research, geophysical and geological services. Geo services are marketed through the consulting consortium of GEONAUTICS LIMITED, whose member companies provide a resource base of more than 300 specialists.

| | |
|-------------------------|---------|
| TOTAL EMPLOYEES: | 85 |
| Cartographers | 2 |
| Oceanographic Engineers | 2 |
| Weather group | 11 |
| Tech. Support | 20 plus |

NORTECH SURVEYS (CANADA) INC.
309- 2nd. Avenue SW,
CALGARY, Alberta T2P 0C5

TELEPHONE: (403) 262 0800
TELEX: 03 827983

BRANCH OFFICES:
95 Akerley Blvd.,
DARTMOUTH, Nova Scotia. B3B 1R7
(902) 469 3736
Telex: 019 31588
NORTECH CANADA INC,
1600 East, St.Martin Blvd.,
Tower B, Suite 240,
LAVAL, Quebec. H7G 4S7
(514) 668 4643
Telex: 05 267540
NORTECH SURVEYS (U.S.A.) Inc.,
Suite 127, 2010 North Loop West,
HOUSTON, Texas, U.S.A. 77018
(713) 681 9406
Telex: 791 803

Representatives in London, England; Sydney, Australia; Peking, China.

CORPORATE OFFICERS AND KEY PERSONNEL:

Alex Hittel, ALS, CLS, P.Eng., President & Chairman of the Board
A.P.Cox, Executive Vice President - Administration
R.L.Wade, P.Eng., Executive Vice President - Marine
T.J.Crago, CLS, Vice President - Control Surveys
Dr.G. Lachapelle, Vice President - Research & Development
H.G.Falkenberg, ALS, P.Eng., Vice President - Legal & Engineering Surveys
G.Bacus, Vice President - Nortech U.S.A. (Houston, Texas)
R.Shantz, Manager - Inertial Operations
C.H.Wohlrs, Manager - Doppler operations
N.Beck, Geodesist - GPS Development
P.C.Fenton, Survey Engineer - Industrial & Government Projects
J.C.Keat, Marine Operations Manager
R.L.Hunter, Field Surveyor (Dartmouth, Nova Scotia)
S.McCarron, Field Surveyor (Dartmouth, Nova Scotia)
J.E.Hagglund, Senior Survey Engineer - Special Projects
P.L.Knapp, Senior Electronics Engineer - Special Projects
R.J.Wilson, Manager - Legal and Engineering
L.J.Fleming, Accounting Manager
B.M.Prairie, Administrative Coordinator

NORTECH operates worldwide as integrated surveying company, offering inertial, satellite, land and legal surveys in support of resource exploration and production, marine and offshore surveys, engineering and research services, horizontal and vertical control, and marine positioning.
The company was founded by Shell Canada, which subsequently sold the assets to the group now in control.
NORTECH maintains in excess of \$10,000,000 of equipment in support of its operations.

Continued.....

In the marine field of offshore surveys, Nortech employs the most advanced technologies available and has provided marine surveying to the petroleum industry for more than 15 years. The firm emphasizes its continuing commitment to applied research and development to yield unique solutions to technical and operational survey problems. The range of services includes: rig positioning; hydrographic surveys; seismic navigation; survey engineering and consulting; pipeline surveys; quality control; interactive mapping; and acoustic positioning.

Positioning hardware includes a spectrum of short, medium and long range positioning systems, satellite doppler receivers, long baseline acoustic receivers, computers, plotters and custom designed interfaces.

TOTAL EMPLOYEES: 71

Ø1

NORTHWEST HYDROGRAPHIC SURVEYS LTD.
8911-152nd. St.,
SURREY, B.C.
V3R 4E5

TELEPHONE: (604) 588 8541

BRANCH OFFICE:

NORTHWEST HYDROGRAPHIC SURVEYS OF ALBERTA LTD.

5110-97A St.,
EDMONTON, Alberta.

T6E 5E6

TELEPHONE: (403) 437 0510

Ø2

Gordon Murray, President
Jorgen Johansen, Secretary
Michael Slater, Project Manager
Raymond H. Janzen, BCLS
Eric I. Kaardal, CLS, BCLS
E. Pare, Party Chief
W. Pare, Party Chief
T. Newman, Senior Instrumentman

Ø3

NORTHWEST HYDROGRAPHIC SURVEYS LTD. is a subsidiary of Aplin & Martin Ltd., Consulting Engineers, which has a permanent staff of hydrographers, surveyors, engineers, cartographers, planners, technicians, data analysts and supporting office personnel. NHS was incorporated in 1969 and has been incorporated in Alberta as NHS of Alberta Ltd., since 1978.

Experience includes navigation for 40 submarine cable lay events and repairs; seabed and current measurements, surveys for pipelines and cable routes; bathymetric surveys for dredging quantities; surveys for harbours, ferry approaches and effluent dispersal systems; coastal topography and on-shore control surveys.

NHS continues to expand its resources and retains specialists in climatology, interpretation of marine geophysical records, determination of engineering properties of submarine soils and route inspection by manned submersibles.

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FACILITIES & EQUIPMENT

Field:

- 1 Geodimeter 120 EDM equipment
- 1 Kern DM500 EDM equipment
- 1 Hewlett Packard 3800 EDM equipment
- 6 Tellurometers MRA 2
- 2 Kern and Zeiss 1" theodolites
- 6 Zeiss 020 20" theodolites
- 4 Zeiss automatic precise levels
- 1 Kern reducing tacheometer
- 2 Stihl power saws
- 5 ½-ton panel vans
- 1 Boston Whaler 14' boat, 25hp, trailer
- 4 VHF portable FM radios

OFFSHORE SURVEY & NAVIGATION LTD.
#2, 1216 - 34 Avenue N.E.
Calgary, Alberta T2E 6L9

TELEPHONE: (403) 276-7996
TELEX: 038 27721

OFFSHORE SURVEY & NAVIGATION LTD.
1974 Spicer Road.
North Vancouver, British Columbia V7H 1A2

TELEPHONE: (604) 929-7961
TELEX: 043 52838

ASSOCIATE COMPANY:

OCEAN NAV LTD.
P. O. Box 5340
Prescott & Harbour Drive
St. John's, Newfoundland A1C 5W2

TELEPHONE: (709) 753-6621
TELEX: 016 4769

ASSOCIATE COMPANY:

OFFSHORE SURVEY INC.
Seattle, Washington, U. S. A.

CORPORATE OFFICERS AND KEY PERSONNEL:

Helmut H. Lanziner, President & Chairman of the Board
Harry J. Asher, Vice President, General Manager & Director
Wayne Knowles, Secretary
Gerry Lowdon, Director
Jospeh De Lerno, Director

PRINCIPAL CONTACT IN Canada:

Harry J. Asher (Calgary)
Helmut H. Lanziner (Vancouver)

OSNL are positioning service specialists, providing accurate, flexible and comprehensive positioning, data processing and mapping facilities for geophysical, hydrographic, oceanographic, photo mapping, pipelaying, well location, dredging and engineering operations.

The company is strong technically and logistically, having each year provided radiopositioning systems and ships' personnel to Nova Scotia and Newfoundland waters (Raydist, Mini-Ranger, Argo, Loran-C and Satellite); Eastern Arctic (Mini-Ranger, Argo, Loran-C and Satellite). In recent years, operations have extended to the Beaufort Sea (Shoran, Argo).

OSNL has significant experience in vessel navigation for offshore exploration, plus rig positioning and shallow seismic site surveys, notably for Dome Petroleum in the Beaufort Sea for four drillships in polar ice.

A complete maintenance and service workshop is maintained in St. John's, Newfoundland, with a similar, and larger facility in Calgary, Alberta, and Vancouver, British Columbia.

In addition, OSNL is a leader in sidescan, acoustic and surface positioning techniques and services, developing its own software, and specializing in Navigation and Positioning - employing Hewlett Packard computers.

The company owns and operates a variety of equipment, ranging from Rotary and conventional side scan sonar, underwater wellhead TV systems and surface Miniranger navigation systems.

OSNL has designed and developed several methods and systems, including a high resolution acoustic ice motion monitoring system, a rotary side scan sonar device and a deep water (2,000 ft.) high resolution pipeline survey system.

The firm owns and operates a 50 ft. survey vessel, "OFFSHORE SURVEYOR", specially outfitted with a heavy duty A-frame, an oceanographic winch with slip ring and 2,500 ft. of double armoured cable, together with mooring winches to permit four-point mooring for precise underwater television and coring duty. Its navigation system has been in use in the Canadian Arctic since 1980, assisting offshore supply vessels to navigate narrow dredged channels even when ice covered - with no subsequent groundings. The system is appropriate anywhere in the world where precise navigation is required. OSNL is experienced in the High Arctic and the Beaufort Sea for the resource exploration and development industry in both winter and summer conditions.

TOTAL EMPLOYEES 37

(All employees are Canadian)

PACIFIC OCEAN SCIENCES LTD.
107F Discovery Park,
3700 Gilmore Way,
BURNABY, British Columbia. V5G 4M1

TELEPHONE: (604) 438 9207

CORPORATE OFFICERS AND KEY PERSONNEL:

Dr. Noel Boston, President
Dr. James Stronach, Vice President
Dr. James Helbig, Secretary
John Chase, Treasurer

POS provides professional consulting services in ocean sciences, specializing in numerical modelling, data processing, and interpretation and computer services. Principal activities include all aspects of physical oceanography, research and development, applications of ocean sciences to environmental and operational requirements. Special skills are identified as numerical modelling of physical oceanographic systems, computer processing of large data arrays, and logistics of large buoy arrays.

Major Projects include the Current Atlas for the Strait of Georgia and Strait of Juan de Fuca; the Fraser River plume; design and deployment of Southern Hemisphere drifting buoy array for the Global Weather Experiment (FGGE); and physical oceanography of the Labrador Shelf Region. Staff experience abroad includes projects for the World Meteorological Organization, Geneva; SEKA (Turkish pulp and paper organization) in the Mediterranean and Black Seas; and for Petroleos de Venezuela, Caracas.

| | |
|------------------|---|
| TOTAL EMPLOYEES: | 4 |
| Oceanographers | 3 |
| R & D | 1 |

PELCHAT GRENIER GEO-MARINE INC.
4450 rue Thibault,
SAINT-HUBERT, Quebec. J3Y 7T9

TELEPHONE: (514) 676 0373

CORPORATE OFFICERS AND KEY PERSONNEL:

Robert Pelchat, B.Sc.a., a.g.
Guy Grenier, B.Sc.a., a.g.

The firm offers land surveys, bathymetric surveys, side scan sonar, position fixing, dredging surveys and quantity calculations, bathymetric map construction, current studies, and hydrographic surveys.

Equipment includes:- Del Norte Trisponder; Hewlett Packard HP9845A; Raytheon Echo sounder DE719B; Hewlett Packard HP9871A plotter; small vessels and modern surveying equipment.

Experience includes surveys and bathymetric maps in the St. Lawrence River, the Port of Montreal, Iles de la Madeleine, Contrecoeur.

TOTAL EMPLOYEES: 10

01.

SEACONSULT MARINE RESEARCH LTD.

405-1200 WEST 73rd. Avenue,

VANCOUVER, B.C. V6P 6G5

Telephone: (604) 266 9135

Telex: 045-07625

Branch Office:

SEACONSULT LIMITED,

200-194 Duckworth St.,

ST. JOHN'S, Newfoundland A1C 1G6

Telephone: (709) 722 7023

Laurie W. Davidson, M.Sc., President (St. John's)

02

Donald O. Hodgins, Ph.D., P.Eng., President

Laurie W. Davidson, M.Sc., Vice President

Sandra L. M. Hodgins, B.A.Sc., Dip. E.S.T. (Delft), Secretary Treasurer

Paul H. LeBlond, Ph.D., F.R.S.C., Principal

03

SEACONSULT is a multi-disciplinary consulting organization established in 1975 to provide specialized services in coastal engineering and oceanography. The company has highly qualified professionals combining experience and academic achievement in engineering, meteorology and the marine sciences. Seaconsult Limited was incorporated in 1980 in St. John's, Newfoundland to extend services in that province.

04

SEACONSULT provides consulting services in civil engineering, hydraulics, applied physical oceanography, environmental impact assessment and mathematical modelling related to offshore hydrocarbon development, civil marine construction, pollutant dispersion, and environmental research.

05

SEACONSULT has very large data processing capabilities and specializes additionally in software development on IBM and Hewlett Packard mainframe systems. Seaconsult has an agreement of cooperation with the Danish Hydraulic Institute, Copenhagen, Denmark.

06

07

TOTAL EMPLOYEES: 10

Oceanographers 2

Engineers 3

Computer Programmers 2

08

SEAKEM OCEANOGRAPHY LTD.
2045 Mills Road,
SIDNEY, British Columbia. V8L 3S1

TELEPHONE: (504) 656 0881
TELEX: 049 7460

CORPORATE OFFICERS AND KEY PERSONNEL:
Peter G.Berrang, President
David J.Thomas, Vice President
David R.Green, Secretary

SEAKEM offers services in chemical, physical and biological oceanographic surveys, operating in Arctic, Pacific and Atlantic waters. Additionally, the firm manufactures oceanographic instruments. The company's equipment includes 14 Aanderaa and Neil Brown current meters, 8 Mesotech acoustic releases with several deck units, 3 Datawell wave buoys with shore station, an Aanderaa remote recording weather station and a PDP-11 34A DEC computer with 6 terminals.

TOTAL EMPLOYEES 10 (Ocean surveying)

SWAN WOOSTER ENGINEERING CO. LTD.
1525 Robson Street,
VANCOUVER, British Columbia. V6G 1C5

TELEPHONE: (604) 684 9311
TELEX: 451275

BRANCH OFFICES:

550-6th. Avenue SW,
CALGARY, Alberta.
TELEPHONE: (403) 269 4717
TELEX: 038 21572

1820 Hollis Street,
HALIFAX, Nova Scotia.
TELEPHONE: (902) 423 8221
TELEX: 019 22733

1740 Sun Life Bulding,
MONTREAL, Quebec.
TELEPHONE: (514) 866 5325
TELEX: 5560247

26 Hiscott Street,
ST. CATHARINES, Ontario.
TELEPHONE: (416) 685 8441
TELEX: 061 5300

United States offices are maintained in Atlantia Georgia; and Portland,Oregon.

CORPORATE OFFICERS AND KEY PERSONNEL:

Dr. J.Khanna, P.Eng., Manager of Engineering
Michael Tarbotton, P.Eng.

SWAN WOOSTER's activities are directed primarily to the natural resource industries, covering civil, structural, mechanical and electrical engineering as well as transportation planning and economics. Main thrust is in ports, marine terminals, bulk materials handling, forest products and mining industries and in the development of industrial infrastructure. The company is active in services to the offshore oil and gas industry, particularly in Arctic waters.

SW has hydrographic and some physical oceanographic capacities. The firm operates a state-of-the-art automated hydrographic survey system, Autocarta 11, providing computer-based field data acquisition, processing and preparation of final work charts, cross sections and dredge volume calculation. Tide corrected and edited charts and profiles are printed on a flat bed plotter with usual same-day results. Its system is suitable for both large and small areas and is an excellent base for sub-bottom profiling, side scan sonar, and current and sediment measurements.

SW has carried out numerous hydrographic surveys in many coastal and port areas of British Columbia waters and in the Caribbean, South and Central America, Asia, Africa and the Middle East.

| | |
|------------------|----------------------------------|
| TOTAL EMPLOYEES: | 400 (700 total, with affiliates) |
| Hydrographers | 6 - 10 |
| Marine Engineers | 10 |
| Computing | 9 |

TERRA SURVEYS LIMITED
Hydrographic Division,
Marine Technology Centre,
9865 West Saanich Road,
SIDNEY, British Columbia. V8L 3S1

TELEPHONE: (604) 656 0931
TELEX: 049 7184

HEAD OFFICE:
2060 Walkley Road,
OTTAWA, Ontario. K1G 3P5

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TELEX: 053 3502

TERRA is one of Canada's largest resource mapping and geophysical exploration organizations, offering consulting and professional services on a global basis to engineering groups, mineral and petroleum industries, national and local governments and international development agencies.

CORPORATE OFFICERS AND KEY PERSONNEL:

A.D. (Tony) O'Connor, CLS, Manager Marine Surveys, Hydrog.Div. (Sidney)
Roy Depper, President. (Ottawa)
Jack Pautz, Manager Photogrammetric Division (Ottawa)
F.J. (Rick) Quinn, Manager Marine Geophysics (Sidney)
J.P. (Jim) Hawkins, Manager Gravity Section (Sidney)

TERRA's Hydrographic Division provides complete surveying services in all waters - offshore, coastal, inland and Arctic. These include: charting, drill site investigations, port and harbour development and maintenance, pipe and transmission line crossings, water inventory, marine park development and environmental assessments. Terra's personnel are experienced in the Canadian Arctic, South America, Australia, Africa and the Middle East. They offer offshore positioning, tide and current studies, side scan sonar investigations, oceanography and geophysics, multi-disciplinary project coordination and international consulting for industry and governments. Terra is particularly experienced in coastal and inland water applications.

Recent experience includes Arctic Hydrographic Survey through the ice in Viscount Melville Sound for the Canadian Hydrographic Service, Side scan sonar for Alaska Power (U.S.) for cable crossings at Wrangell, Alaska, and Water level recordings at four locations in the United Arab Emirates.

Terra will train local personnel.

TOTAL EMPLOYEES: 7 (Hydrog-Marine Division)
Hydrographers 4
Marine Geophysicist 1

W.D.USHER & ASSOCIATES LTD.
503 West Chambers,
12220 Stony Plain Road,
EDMONTON, Alberta. T5N 3Y4

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BRANCH OFFICE:
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CORPORATE OFFICERS AND KEY PERSONNEL:

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Hugo C. Engler, CLS, Vice President
William K. Anderson, P. Eng., CLS, Secretary
Robert E. D. McCuaig, M.A.Sc., P. Eng., CLS, Treasurer & Edmonton Manager
Donald R. George, ALS, Director and Camrose Manager
Roger W. Leeman, P. Eng., ALS, Director
H. Douglas MacAulay, ALS, Director
Project Supervisors:
Kenneth D. Ritz, B.Sc.E
Kenneth M. Larsen, B.Sc. Eng., EIT
Ronald J. Hunka, CST
John M. Byrne, CST

USHER, founded in 1957, provides professional services in survey engineering, land and hydrographic surveying. The company utilizes electronic distance measuring equipment, satellite positioning, inertial navigation system and computing facilities and is well versed in geodesy, photogrammetry, hydrography, statistics, numerical analysis and computer sciences.

| | |
|------------------|--------------------------|
| TOTAL EMPLOYEES: | 35 |
| Hydrographers | 2 |
| Engineers | 2 (Software Development) |

ROBERT WHIFFEN ASSOCIATES LTD.
P.O.Box 219,
GOULDS, Newfoundland. AOA 2K0

TELEPHONE: (709) 368 3696

CORPORATE OFFICERS AND KEY PERSONNEL:
R.G. (Bob) Whiffen, NLS, President
David Vallis, NLS, CLS, Vice President
Frank Hall, CLS, Director

WHIFFEN offers hydrographic surveys, engineering, legal and control surveys. It claims to be the only Newfoundland firm with qualified hydrographers on staff and with the only automated drafting capability. It uses a Hewlett Packard computer and drum plotter, Tellurometer CA 1,000's, 101's and small range Sokkisha EDM. WHIFFEN maintains an association with Offshore Development Corporation Inc. of St. John's, Newfoundland, physical oceanographers. The firm has completed contracts for NORDCO in North Labrador and in the Straits of Belle Isle; and numerous contracts in Newfoundland and Labrador for Newfoundland Design Associates, including drogue studies, transmission line surveys and municipal engineering surveys.

| | |
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| TOTAL EMPLOYEES: | 12 |
| Hydrographers | 3 |
| Cartographers | 1 |
| R & D | 1 |

RICHARD YOUNG & ASSOCIATES
P.O.Box 9247, Station B,
ST. JOHN'S, Newfoundland.

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BRANCH OFFICE:

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CORPORATE OFFICERS AND KEY PERSONNEL:

Richard Young, LS, President
Neil Parrott, LS, Manager Goose Bay
Jelle Terpstra, Consulting Engineer

YOUNG offers inshore hydrographic surveys, legal, topographic and control surveys. The firm has performed harbour and breakwater surveys for the Federal Department of Public Works.

| | |
|------------------|---|
| TOTAL EMPLOYEES: | 8 |
| Hydrographers | 4 |

APPENDIX E

MEMBERS
CANADIAN COMMITTEE ON OCEANOGRAPHY
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APPENDIX F

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APPENDIX G

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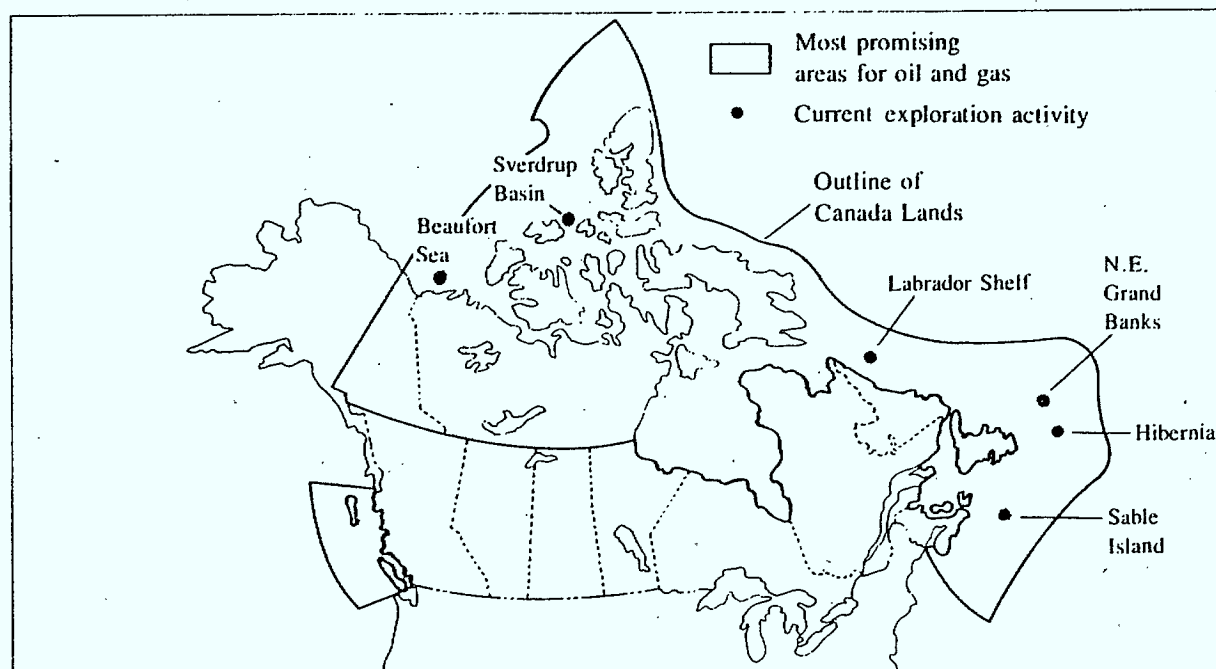
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Director, Marine Ecology Laboratory
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Atmospheric Research Directorate
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THE CANADA LANDS

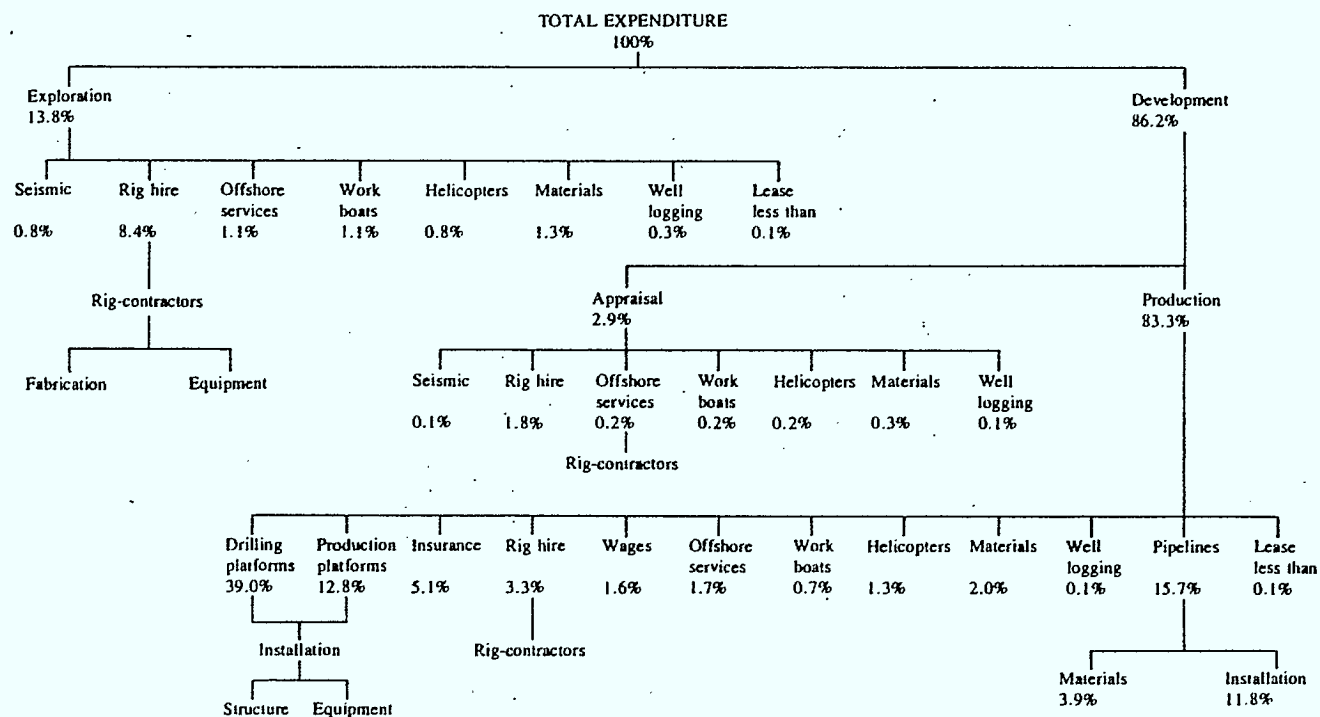


Source: Canada, Department of Energy, Mines and Resources, *The National Energy Program* (Ottawa, 1982), p. 43.

APPENDIX I

THE NORTH SEA EXAMPLE

POSSIBLE BREAKDOWN OF FUTURE EXPENDITURE FOR OFFSHORE OIL PRODUCTION: THE NORTH SEA EXAMPLE



Source: Cazenove & Co., *The North Sea, the Search for Oil & Gas and the Implications for Investment* (London, September 1972).

VK597/.C32/M24
McCulloch, T.D.W.
Study of the Canadian
hydrographic and ocean
AOSP c. 1 aa ISTC

DATE DUE - DATE DE RETOUR

MAY 12 1992

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