Industry, Science and Technology Canada
Industrie, Sciences et Technologie Canada

REPORT ON THE STATUS OF THE GEOMATICS INDUSTRY IN CANADA 1991

Canada

PREPARED BY

THE TASK FORCE ON THE STATUS OF THE GEOMATICS INDUSTRY IN CANADA

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PREPARED FOR

INDUSTRY, SCIENCE AND TECHNOLOGY CANADA

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I. EXECUTIVE SUMMARY

A. PRECIS

1. 1985 TASK FORCE REPORT

The present study is a follow-up to the 1985 Task Force Report on the Surveying and Mapping Industry in Canada. The 1985 Report made a series of recommendations that generated a new vision of the industry and the concept of geomatics. It led to the formation of the Geomatics Industry Association of Canada (GIAC) and the National Administration Centre of Surveying and Mapping.

Both GIAC and the Canadian Institute of Surveying and Mapping were active in promoting action on the recommendations. As a result, the 1985 Report pointed the way to the new geomatics environment now evolving.

2. STATUS OF THE GEOMATICS INDUSTRY

a. Private Sector

During the 1980s the geomatics industry joined the mainstream of the growing information revolution. The technologies developed and used from space and for automated cartography are now the foundation on which governments and the resource and development industries construct spatially referenced data bases.

The range of services offered by the geomatics private sector has expanded from surveying and mapping to include remote sensing, geographic information systems, and producing and marketing associated hardware and software. Still, the single largest business remains surveying, and within that business, cadastral surveyors make up the largest group. Cadastral surveying will continue to serve the land boundary demarcation needs of governments and the private sector. Global Positioning System (GPS) technology has revolutionized the survey process and can readily provide precise geographical positions on land or at sea.

Mapping is still an important business as well, and during the 1980s, mapping companies made large capital investments for hardware and software in order to make the transition from a paper to a digital map environment.

Governments at all levels remain the largest customer of the geomatics private sector, and this trend is expected to continue. Since 1985, the private sector has doubled its billings for services and equipment/software to an estimated $750 million. Remote sensing and GIS are the geomatics activities with the most rapidly expanding markets.

Remote sensing and GIS also account for the bulk of the increase in employment in the six years prior to 1991. Employment has increased from 9,000 to 12,000. While the percentage of university and community college graduates increased, the percentage of employees with high school diplomas decreased. As the trend to higher levels of scientific and technical processes continues, the geomatics business community has expressed worry about the ability of the education system to deliver the quality and the quantity of employees required.

b. Public and Crown Sectors

The main geomatics activity of the public sector and the public companies/crown corporations is GIS. Much of the GIS work is now carried out in house, but it will be contracted to the private sector in increasing volumes as the GIS applications become better developed and more mature. The public sector annual budget for geomatics is estimated to be $600 million and the budget for public companies/crown corporations at $300 million.

3. CHANGES IN THE PRIVATE SECTOR

a. Space Technology

Advances in space technology have given geomatics two powerful tools, the Global Positioning System (GPS) and remote sensing. GPS is a system that uses earth-orbiting satellites to determine very accurate positions on land or at sea via a ground receiver and special software. Because it is relatively inexpensive and highly accurate, GPS has revolutionized surveying.

Remote sensing has come of age. Both domestic and foreign markets for remote sensing are expanding rapidly as the demand increases for more and better assessment data on development projects and environmental issues.

b. Geographic Information Systems

Geographic information system (GIS) technology is the rising star of geomatics. At present, the major users of GIS are governments and large corporations, organizations that have large digital data bases that need to be made into useful information.

While the GIS market for software and systems is well developed and expanding, the market for GIS services is still small and expanding slowly. With GIS management the purview of government and large corporations, the long-term role of the geomatics industry in GIS management and marketing is not clear. A strategy for the role of the geomatics industry in GIS management needs to be developed.

4. PRIVATE SECTOR RELATIONSHIPS

a. Private Sector/Government

Both the private sector and government have expressed concern about the cool relationship that exists between them. Since both sectors have a common interest in a strong and healthy geomatics industry in Canada and in exploiting the export market, it is vital that both parties work to improve their relationship at all levels.

b. Private Sector/Academia

The relationship between business and academia appears open and friendly. However, while there is a good understanding of the issues that concern both groups, there is also a lack of real cooperative action to address these issues. Both groups tend to meet, discuss, and agree, and then return to the status quo.

5. GOVERNMENT INITIATIVES

Governments at the most senior level are taking a keen interest in geomatics. They know of the large investments already made in constructing data bases and they recognize the potential of geomatics systems to transform this data into useful information. As a result, governments in most provinces have established unique arrangements, ranging from crown corporations to revolving funds, to manage and market geomatics information.

Governments are clearly recognizing the potential of geomatics, particularly of GIS, to further their economic and social objectives. New Brunswick and Saskatchewan have established crown corporations to manage geomatics and GIS and to generate revenue. Ontario has formed a partnership with the private sector to manage and market GIS data, and Manitoba may follow suit. Both Alberta and British Columbia have established mechanisms to manage and market geomatics products. In all of these different initiatives, the common thread is a vision of the usefulness of geomatics data, both as an important contributor to the economic well-being of the province but also as technology that has strong export potential.

6. RESEARCH AND DEVELOPMENT

Compared to many other industries in Canada, the geomatics private sector spends a considerable part of their gross billings on research and development (R & D). Responses to the questionnaires indicate that for the period 1985-1990, the average expenditures on research and development totalled 6.5% of gross billings.

Because of the high-tech nature of the business and the need to continually develop new applications, the geomatics business community is finding it increasingly difficult to maintain the necessary high level of R & D investment, particularly in the face of competition from foreign firms that are wholly or partly funded by their governments.

The federal government's Unsolicited Proposal (UP) Program was used extensively by geomatics companies during the 1980s and helped maintain industry's international leadership. The UP Program, cancelled last year, was one of the most significant initiatives assisting industry in R & D. The UP Program is sorely missed and should be reinstated.

7. MARKETS

a. Domestic Markets

Although the questionnaire sent to the private sector posed questions on markets and market trends, hard data on marketing is difficult to obtain since few are willing to disclose such valuable information. Nevertheless, some collective observations were drawn.

The domestic market projections for the next five years show no real change in the customer profile other than the expectation that municipal and provincial government markets will grow most quickly. Growth or even stability in the cadastral survey market will depend on an upswing in the housing and construction industry. The present domestic market in remote sensing systems and software is mature. The GIS applications market is expanding slowly as governments and large companies identify their GIS application needs, and the GIS hardware and software markets are expanding more rapidly, as is the GIS data base construction market, particularly provincial digital mapping projects. New and more cost-efficient methods need to be developed for updating digital data bases. This activity has the potential to become an important one for the private sector in both domestic and foreign markets.

The environmental market is increasing as environmental issues receive greater public attention. Governments are reacting to public concerns with initiatives like the federal "Green Plan". Geomatics is a vital ingredient in every phase of an environmental review or study and respondents to the questionnaires projected a growing market for geomatics in environmental protection projects.

b. International Markets

The international geomatics market is being shaped by the way different governments support their national geomatics organizations. In general, the aid that governments give to their private sectors can determine their success or failure at obtaining foreign contracts.

The foreign geomatics market will continue to be strongest in the United States, the ASEAN nations, Latin America, and possibly in eastern Europe. Studies show a large market for modern land parcel record systems at the county level in the U.S. The growth areas in foreign markets are seen as the private U.S. market and international aid organizations such as the World Bank. Business was less optimistic about the potential for external aid contracts through CIDA.

During regional meetings, the private sector expressed two major concerns about the export market.

1. It is most difficult for Canadian geomatics firms to compete in foreign markets against foreign companies that are either sponsored or subsidized by their governments.

2. The private sector has a problem developing new applications of geomatics technology when there is very limited or no opportunity to participate in domestic applications because that need is being met by government capacity. To further exacerbate the problem, the private sector has been criticized for not developing applications of geomatics to meet evolving customer requirements. The response from regional meetings indicated that if the market exists, the private sector will invest in the technology and in skilled staff, as they have in the past. However, if the domestic application of this technology is taken up by government activities, business is unlikely to invest for only the foreign market.

B. RECOMMENDATIONS

Recommendation 1: That the private sector initiate the development of a national geomatics industry competitiveness strategy to include the role of governments, research and development priorities, and domestic and foreign market development.

Recommendation 2: That the private sector closely monitor the implementation of government cost-recovery programs to ensure that the public sector organizations only become involved in those value-added spatial information products and services that are in support of the private geomatics sector.

Recommendation 3: That governments develop a cost-recovery policy that considers the private sector's need to use special facilities and skilled government staff on international projects and on major research and development projects in Canada.

Recommendation 4: That the private sector make representations to the federal government for the re-instatement of the Unsolicited Proposal Program as one of the most significant programs for helping with research and development.

Recommendation 5: That governments review their policies on funding or assisting with funding for development and applications activities that are now seen as the responsibility of the private sector.

Recommendation 6: That when awarding contracts for geomatics technology development, governments consider the demonstrated ability to market the development in Canada and abroad as one of the conditions for awarding the contract.

Recommendation 7: That in response to expanding marketing opportunities with the provincial and municipal governments, the Geomatics Industry Association of Canada review its focus on federal geomatics programs.

Recommendation 8: That the private sector explore ways of increasing the contracting-out work from crown corporations and public companies in utilities, energy, transportation, resources, telecommunications, and similar business.

Recommendation 9: That the private sector develop educational tools (seminars, publications, etc.) designed to explain the use and importance of geomatics to international development agencies such as the Canadian International Development Agency and the World Bank.

Recommendation 10: That the private sector negotiate agreements with federal and provincial agencies that have overseas posts to become the focus for government-to-government requests for geomatics expertise, products, and training.

Recommendation 11: That the private sector re-examine its options for forming alliances in order to develop international markets.

Recommendation 12: That the Geomatics Industry Association of Canada assume a leadership role in ensuring that the recommendations made in this Report are acted upon.

C. PRELIMINARY REMARKS AND OBSERVATIONS

1. INTRODUCTION

Major changes have clearly taken place in the geomatics industry over the past few years, and the speed at which change is occurring is accelerating as geomatics becomes part of the mainstream of the communications and information environment.

No longer is geomatics information restricted to a few specialized users trained to interpret the results. Rather, geomatics data has become part of the everyday information flow within and between companies, governments, and the interested public. The information produced by geomatics is regarded as a valuable commodity by a variety of users, and as a result, geomatics is being pursued by governments as a business opportunity. Governments are establishing

organizations with the clear objective of penetrating the information market with geographically referenced data on the physical infrastructure, the environment, and the many attributes of human activity. The use of networks, the need for data exchange standards, and the need for standards in order to describe data in unambiguous terms are all pressing issues being addressed in anticipation of an expanding market for information of all kinds.

All facets of geomatics are looking to take advantage of the expanding business opportunities resulting from the information explosion. Everyone, from the cadastral surveyor through to the GIS or remote sensing specialist, is looking at the information market to increase business. Right now, many geomatics companies are deeply involved in information markets that for the most part they developed for specific customers, and these markets will surely continue to grow. Companies should not question if they should become involved, but rather when they are prepared to made the investment.

2. THE HEALTH OF THE GEOMATICS INDUSTRY

The responses to the questionnaires distributed to the three main sectors of the geomatics industry indicate that the private sector is continuing to be profitable, even during the recession period of 1990/91. Although profit levels did drop in 1990 from those in 1989, business is optimistic that profit levels will increase in 1993-1995.

A more pessimistic picture of the health of the industry, though, was evident during the discussions at regional meetings. Business levels are down and some firms are struggling to meet payrolls and payments on recently acquired capital investments. Staff reductions are common.

Still, the geomatics industry is not homogenous, and the sectors of the industry react differently to changes in the economy. The responses show, for instance, that cadastral surveying was especially hard hit by the recession since it is a business traditionally dependent on the real estate and construction industry, now in a deep slump. On the other hand, mapping companies that invested in modern capital equipment and software are less affected than cadastral surveyors. While a number are hurting, many are experiencing good profits with ample work. Remote sensing is proving to be a profitable business at this time and the market continues to expand. Likewise, GIS promises to be the expanding business of the 1990s, although the market needs to be better defined. A lack of definition has misled many companies, who leapt pre-maturely into the market, to invest in GIS equipment and software. These firms are having a hard time obtaining work and paying off the capital costs.

One sign of the health of an industry is the number of firms that file for bankruptcy. Although a few geomatics companies have closed their doors, the industry can still conclude that while it is hurting to some degree, it is not as affected by the present economic downturn as are many other industries.

When the last report on the industry was compiled in 1985, the interviews and questionnaires covered the years 1979 to 1983, a period of rapid inflation and deep recession. Many of the concerns expressed at that time vanished with the rapid economic growth of the middle and late 1980s. The same pattern can be expected to evolve as those sectors now feeling the pinch begin to prosper and as economic growth regains its momentum as the 1990s begin.

3. KEEPING UP TO DATE

The technology of geomatics has greatly altered the work place over the past decade. New clients have emerged and new products are now in demand, and even more changes will occur at an ever-increasing pace. Investments in capital, training, and system design will need to be made more frequently, and business will need to find ways of adapting to rapid technological change while staying current with the demands of the market place.

Now, and in the future, education and training will be a costly but necessary investment for those firms that want to prosper. Education and training can also become a growing geomatics business activity that can form a profitable division in a geomatics firm.

4. A NATIONAL GEOMATICS INDUSTRY ASSOCIATION

In the 1985 Task Force Report, David Usher wrote:

> The Task Force has identified many areas of common concern within the surveying and mapping industry that could more effectively be addressed by a national association of surveying and mapping consulting firms. Such an association could be modelled after the Association of Consulting Engineers of Canada....

Usher went on to delineate objectives for the new association and recommended, as a first step, that the association be formed by a merger of the two existing associations, the Canadian Association of Hydrographic and Ocean Surveying Industries and the Canadian Association of Aerial Surveyors. The recommendation was accepted and GIAC was formed.

The formation of GIAC was a first step, as Usher goes on to write:

> The ultimate objective should be to have one surveying and mapping consulting Association that embraces all firms offering surveying and mapping services to the public. Such an association would be able to represent the whole surveying and mapping industry much more effectively.

The pressure for east-west trade in Canada, the foreign competition spurred by trade agreements, the need to strengthen and expand international geomatics markets, all tend to emphasize the urgency of examining the "ultimate objective" of a truly national geomatics industry association. The initiative to form such an association must come from within the geomatics private sector.

II. INTRODUCTION

A. NEED FOR A NEW INDUSTRY REPORT

In March 1984, the Department of Regional Industrial Expansion (DRIE) contracted with the Canadian Institute of Surveying and Mapping (CISM) to undertake a study of the surveying and mapping industry in Canada. The aim of the study was to determine the industry's strengths and weaknesses and to describe the domestic and international constraints and opportunities facing the industry.

The study was conducted by a Task Force under the chairmanship of David Usher, and the Report of the Task Force was published in February, 1985. The Report made some thirty-four recommendations, covering such subjects as organization of the industry, expansion of the export market, education of personnel, spatial information management, and technological change. Since then, many of the recommendations have been implemented, and as a result the Task Force Report has had a long-standing effect on the geomatics industry (see Appendix 1).

In the six years since the Task Force compiled the first-ever comprehensive statistics and information on the industry, major changes have occurred in the geomatics industry. New technology and growing user expectations have especially altered the face of surveying and mapping in Canada. The Geomatics Industry Association of Canada (GIAC) felt that the time had come to re-examine the industry and produce a report that more accurately reflected the current status of geomatics.

B. STUDY SCOPE

In general terms, the purpose of the study was to assess the status of the geomatics industry, particularly its private sector, in Canada and recommend courses of action to encourage further growth and development. More specifically, the study and report provide

1. an update of the important statistical information on the industry, including its size, structure, employment, sales, staff and equipment resources, investments in training, and research and development;

2. an examination of the actions taken as a result of the recommendations of the 1985 Task Force Report;

3. an assessment of the current and prospective markets for geomatics products and services in Canada and abroad;

4. an update of the key issues facing the geomatics sector and ways in which they can be addressed;

5. an assessment of the interaction among the industry's service and supply sectors, government sector, and academic sector, including suggested methods of improvement.

Under the terms of this study, the geomatics industry includes those activities that involve spatially-referenced information. These activities have been grouped into nine general headings:

- consulting,
- G.I.S. data base,
- G.I.S. applications,
- surveying,
- hydrography,
- mapping,
- remote sensing,
- equipment/software development,
- education/training.

The study examined the service and hardware/software supplier sectors of the industry as well as government and crown corporations/public companies involved in geomatics.

C. STUDY PARTICIPANTS

The study was undertaken by the Geomatics Industry Association of Canada (GIAC) in cooperation with five additional national associations:

- Canadian Institute of Surveying and Mapping (CISM)
- Canadian Council of Land Surveyors (CCLS)
- Canadian Hydrographic Association (CHA)

- Canadian Remote Sensing Society (CRSS)
- Canadian Council on Geomatics (CCOG)

The major portion of the funding for this study was provided by the federal Department of Industry, Science and Technology Canada. GIAC and the other five national associations also gave needed financial support.

The Task Force charged with conducting and interpreting the study was comprised of representatives from the public, private, and academic sectors of the geomatics industry:

Ed Kennedy, Chair	Geomatics Industry Association of Canada
John Barber	J.D. Barnes Ltd.
Al Wallace	Wallace, Macdonald & Lively Ltd.
Pierre Gagnon	Université Laval
Ross Douglas	Canadian Institute of Surveying and Mapping
Diane Thompson	Intera Information Technologies Corp.
Gary Sawayama	B.C. Ministry of Crown Lands
Bob Batterham	Energy, Mines and Resources Canada
Ray Moore	Study Consultant

Ray Moore, the study consultant, prepared the discussion documents required by the Task Force and also wrote the final report detailing the study's findings after discussion with Task Force members.

D. DATA GATHERING AND INTERPRETATION

The data presented in this report was gathered during the study through a three-level strategy:

1. A separate questionnaire was developed for each of the main groups concerned in this study:

   - private sector (business)
   - public sector (government)
   - crown corporations/public companies.

   A mailing list was developed from names provided by industry and professional geomatics associations and through consultation with regional representatives and

Task Force members. Peat Marwick Stevenson and Kellogg was retained to send out the questionnaires and tabulate the results in order to ensure confidentiality of the information.

2. Selected senior managers in industry and government and other key personnel were invited to submit briefs outlining their views on the geomatics industry. Quotations taken from these briefs are distributed through the report.

3. Task Force members made visits to 13 cities across Canada and held meetings with 175 representatives from industry, government, and academia.

1. PREPARING THE TASK FORCE REPORT

Using the results of the questionnaires, the results of discussions at regional meetings, the views expressed in the submitted briefs, and discussions with numerous individuals in key industry and government positions, the Study Consultant prepared a series of draft reports for review by the Task Force. A final draft was approved by the membership in September 1991, and after professional rewriting and editing, the report was released for publication and translation in late November of 1991.

2. GEOMATICS HUMAN RESOURCES PLANNING STUDY

In response to concerns in the geomatics community about the lack of a national strategy for human resource development, the Geomatics Industry Association of Canada and the Canadian Institute of Surveying and Mapping established a Joint Adjustment Committee funded by Employment and Immigration Canada. This committee used the questionnaires and the results of the regional meetings to prepare their own findings. A summary of these findings is included in Chapter IX of this Report.

E. ACKNOWLEDGEMENTS

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Lorraine Petzold	Association of Ontario Land Surveyors
C. de Saint-Riquier	Minìstère de L'Energie et des Ressources Québec
L. Sayn-Wittgenstein	Energy, Mines and Resources Canada
S.J. Statham	Marshall Macklin Monaghan Ltd
Gordon Steeves	Canadian Petroleum Association
M.A.E. Toomey	Alberta Ministry of Forestry, Lands and Wildlife
John Turnbull	Saskatchewan Central Surveying and Mapping Agency

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- Canadian Hydrographic Services, Fisheries and Oceans Canada
- Surveys, Mapping and Remote Sensing Sector, Energy, Mines and Resources Canada

III. STATUS OF THE GEOMATICS INDUSTRY

A. GEOMATICS DEFINED

1. INTRODUCTION

In the Winter 1990 issue of the Canadian Institute of Surveying and Mapping Journal, Gagnon and Coleman documented the changes in surveying and mapping that have led to a redefinition of the profession and the introduction of the concept of geomatics.

The term "geomatics" was first used in 1975 by noted French geodesist and photogrammetrist Dr. Bernard Dubuisson and has since been officially recognized by Québec's Banque de Terminologie. "Geomatics" is now used extensively in Canada as a label that covers all the professions - each with its own culture, technology, products, and clientele - that acquire, manage, and disseminate spatially-referenced data. More specifically, geomatics may be defined as the collection of those disciplines that use sensing, mensuration, computer, and communications technology to acquire and manage spatially-referenced information. Note, however, that the term "geomatics" is not yet in common usage outside of Canada.

2. GEOMATICS DISCIPLINES

The growth of the geomatics field since 1985 called for the Task Force to design a series of questionnaires that would address as many disciplines as possible. To accommodate this need, the Task Force grouped all the disciplines under six headings, a move that included bringing most of the traditional professions under either surveying or mapping. A brief description of each heading follows.

a. Surveying

Cadastral Surveying advises on, reports on, supervises or conducts surveys to establish, locate, define, or describe lines, boundaries or corners of parcels of land or land covered with water.

Geodetic Surveying measures and represents the shape and size of the earth, its gravity, and an accurate three-dimensional coordinate system on which all measurement depends. Geodetic surveying provides the basic survey framework for the nation.

Engineering Surveying provides control for the design and development of man-made structures. It is the foundation of all construction and development projects.

Mining Surveying establishes control for the design and development of underground and surface mines, and also for the monitoring of earth movements in the excavations as work progresses. A high degree of survey precision is required to ensure safety as well as mining efficiency.

Hydrographic Surveying measures the topography of the sea bed and the characteristics and dynamics of the sea (tides, etc.). Because of growing concerns for oil and toxic substance spills during sea lane accidents, updating digital hydrographic charts via satellite communication networks is a new and increasingly important activity in hydrography.

Geophysical Surveying positions, in three dimensions, the location and extent of subsurface resources like oil, gas, minerals, etc. The end products are maps, digital terrain models, and reports.

b. Mapping

Photogrammetry is the science and technology of producing maps of the terrain from aerial and space imagery. The products are maps in paper or digital form and digital terrain models. Photogrammetry is usually the first and vital phase of data base construction for geographic information systems (GIS).

Cartography is the art, science, and technology of making maps or charts. The compilation of maps ranging from national atlases to road maps from various sources of information requires the expertise of a cartographer.

c. Remote Sensing

Remote Sensing captures, identifies, classifies, and evaluates objects, areas, or phenomena using data recorded by sensing devices in aircraft or in earth-orbiting satellites. The usual output is digital data in the form of minute cells or pixels of information that can be enhanced and manipulated to form images in computer-aided interpretation systems. Such data is vital for examining changing phenomena like crop growth, forest fires, pollution, and environmental hazards.

d. Geographic Information Systems (GIS)

GIS Data Base is the creation, management and maintenance of data that represents the distribution or placement of features that have spatial location as a main attribute. In graphic form this could be the roads on a road map. In digital form this could be map data, items tied to map data, or layers of information like forest cover, land use, housing, tax base, transportation,

and so on. All of these data bases depend for their effectiveness on a sound digital map base, usually produced by photogrammetry or by remote sensing.

GIS Applications turns digital data into useful information. As a first step, a systems link must be established between the data base and the data application. This is the GIS analysis phase. Once this phase is complete, an appropriate GIS can be defined and installed.

e. Consulting

As result of the wide variety of uses for spatially-referenced data, the process of gathering, manipulating, and managing that data must often be customized to suit particular users. This demand for the custom design of geomatics products and services has spawned a growing consulting sector within the industry.

f. Education and Training

Rapid advances in technology and increasingly effective software have produced a greater need for training and skills updating, both within the industry and its client organizations. Progressive groups are sending their staff to universities, community colleges, and industry itself to keep pace with technological change.

B. GEOMATICS ASSOCIATIONS

1. PROFESSIONAL AND TECHNICAL ASSOCIATIONS

There are a number of professional/technical associations representing the different disciplines in geomatics. Many geomatics practitioners are members of more than one of these organizations.

◦ Canadian Institute of Surveying and Mapping (CISM)	1991 membership	2500
◦ Canadian Council of Land Surveyors (CCLS) Represents all Land Surveyors Associations		
◦ Association of Canada Land Surveyors (ACLS)	1991 membership	370
◦ Canadian Hydrographic Association (CHA)	1991 membership	475
◦ Canadian Cartographic Association (CCA)	1991 membership	400
◦ Canadian Remote Sensing Society (CRSS)	1991 membership	300
◦ Urban and Regional Information Systems Association (URISA)		

- Municipal Information Systems Association (Ontario)
- Association de Géomatique Municipale du Québec (AGMQ) — 1991 membership — 250
- Geomatics Association of Nova Scotia

The provincial land survey associations have memberships as follows:

• Corporation of Land Surveyors of the Province of British Columbia	303
• Alberta Land Surveyors Association	273
• Saskatchewan Land Surveyors Association	90
• Association of Manitoba Land Surveyors	64
• Association of Ontario Land Surveyors	767
• Ordre des Arpenteurs - Géomètres du Quebec	885
• Association of New Brunswick Land Surveyors	102
• Association of Nova Scotia Land Surveyors	294
• Association of Prince Edward Island Land Surveyors	16
• Association of Newfoundland Land Surveyors	103
	2,897

Survey technicians and technologists are represented in Alberta, Saskatchewan, Manitoba, Ontario, New Brunswick and Nova Scotia by the Canadian Association of Certified Survey Technicians and Technologists with a membership of 1300. In Ontario they are also represented by the Institute of Survey Technology of Ontario.

The survey technicians and technologists are represented by other groups in the remaining provinces:

- Society of Engineering Technologists of British Columbia
- Order of Applied Sciences Technologists of Quebec
- Association of Engineering Technicians and Technologists of Newfoundland

Yukon and N.W.T. technicians are members of the Alberta Society of Survey Technicians and Technologists

Many highly qualified people working in geomatics are not represented by the organizations listed in this section and are still seeking a professional voice in geomatics. The existing associations realize that they must expand the breadth of their membership and are even now modifying their traditional structures to include these practitioners.

2. INDUSTRY/BUSINESS ASSOCIATIONS

The Canadian geomatics industry is represented by two business organizations:

- Geomatics Industry Association of Canada (GIAC)
- Geomatics Industry Association of New Brunswick (GIANB)

The Geomatics Industry Association of Canada is a national non-profit business organization representing 80 member firms that provide the complete range of geomatics services and technology in Canada and for export. GIAC's purpose is to promote its member firms as a source of high quality, professional products and services and to raise the profile of the geomatics industry.

The Geomatics Industry Association of New Brunswick is modelled after the national association and has similar aims and objectives for the geomatics industry in New Brunswick. If regional chapters of the national association are formed throughout Canada in future, the New Brunswick association could naturally represent that province.

3. INTERNATIONAL SOCIETIES

The Canadian geomatics community is represented internationally by the Canadian Institute of Surveying and Mapping. CISM is a member association of

- International Federation of Surveyors (FIG)
- International Cartographic Association (ICA)
- International Association of Geodesy (IAG)
- International Society for Photogrammetry and Remote Sensing (ISPRS)
- International Society for Mine Surveyors (ISMS)
- Commonwealth Association of Surveying and Land Economy (CASLE)

C. THE PRIVATE SECTOR

1. INTRODUCTION

No comprehensive list or directory of private geomatics firms exists for the nation. However, the Task Force compiled an extensive list of 1355 firms, an 18% increase over the number listed in 1985, through the membership directories of the associations identified in Section III B. Each of the 1355 firms was mailed a copy of Questionnaire #1, and 245 replies (18%) were received.

The following is an outline of the results received from the respondents to Questionnaire #1 and from discussions at regional meetings.

2. LEGAL

a. Legal Structure

Respondents were asked to indicate the legal structure of their organizations.

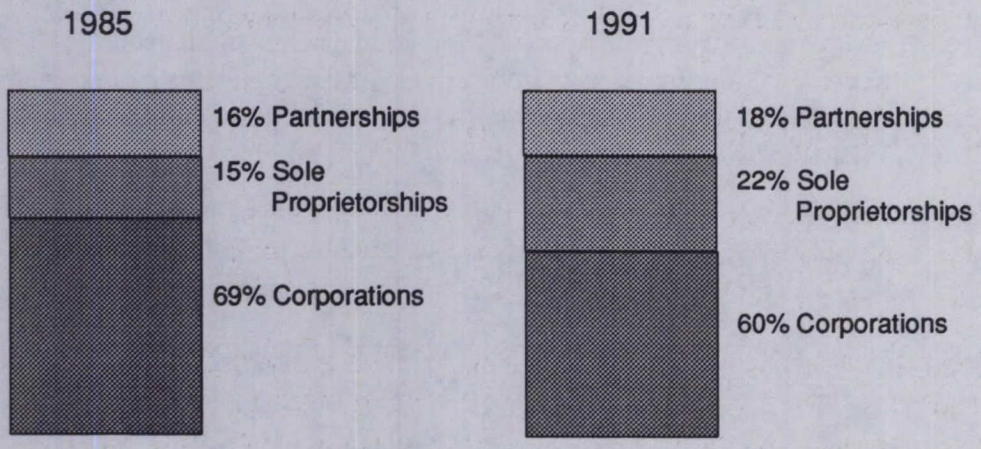

CHART 1
Legal Structure
(expressed as a percentage of total respondents)

If the responses represent a cross-section of the industry, then it can be inferred that there are fewer corporations and more sole proprietorships in the industry in 1991 than in 1985. Nevertheless, incorporation is still the preferred legal structure for all geomatics firms except surveying organizations.

b. Liability Insurance

Respondents were asked to indicate the amount of liability insurance carried by their organizations.

	% of respondents
No Insurance	10%
Less than $500,000	20%
$500,000 to $1 million	36%
$1 million to $2 million	23%
Over $2 million	11%

TABLE 1
Distribution According to Liability Insurance Coverage
(expressed as a percentage of total respondents)

Since this question was not posed in the 1985 survey, comparison is not possible. However, 22 firms reported no liability insurance: 8 in consulting, 2 in GIS applications, 2 in mapping, 3 in remote sensing, 6 in software development, and 1 in surveying.

3. GEOGRAPHIC DISTRIBUTION

Respondents were asked to report the geographic location of their firms and branch offices. The largest increase in the number of firms, as indicated by comparison with the 1985 survey, has occurred in British Columbia, followed by the Prairies and Atlantic Regions.

Geomatics firms range in size from a single practitioner with an assistant to large corporations employing more than 200 people. (The two largest companies competing in the international remote sensing markets are Canadian.) However, geomatics firms as a rule do tend to be small in size.

The majority of geomatics firms located in Canada are owned by Canadians, although there are a number of subsidiaries of foreign companies in Canada supplying both geomatics services and hardware. On the other hand, a number of Canadian companies have purchased firms in other countries in order to extend their market penetration and obtain access to specific technologies.

Region	No. of Geomatics Firms	% in each Region	Population	Firms per 100,000 Population	Change from 1985 per 100,000 of Population
Atlantic Region	135	10.0	2,316,000	5.8	+1.4
Quebec	320	23.6	6,749,000	4.7	+0.2
Ontario	385	28.3	9,699,000	4.0	-0.1
Prairie Region	265	19.7	4,548,000	5.8	+1.3
British Columbia	245	18.0	3,121,000	7.9	+1.7
Yukon NWT	5	0.4	80,000	6.2	-0.8
TOTALS	**1,355**	**100.0**	**26,513,000**	**5.1**	**+0.6**

TABLE 2
Distribution of Geomatics Firms by Region

4. BUSINESS ACTIVITIES

Respondents were asked to indicate their primary business activity and one or more secondary activities. Several interesting trends can be read from the results. The most significant change is the increase to 7% from 1% in 1985 of firms reporting GIS as the major activity. Of all of the geomatics services offered by the private sector, GIS data base construction and GIS applications

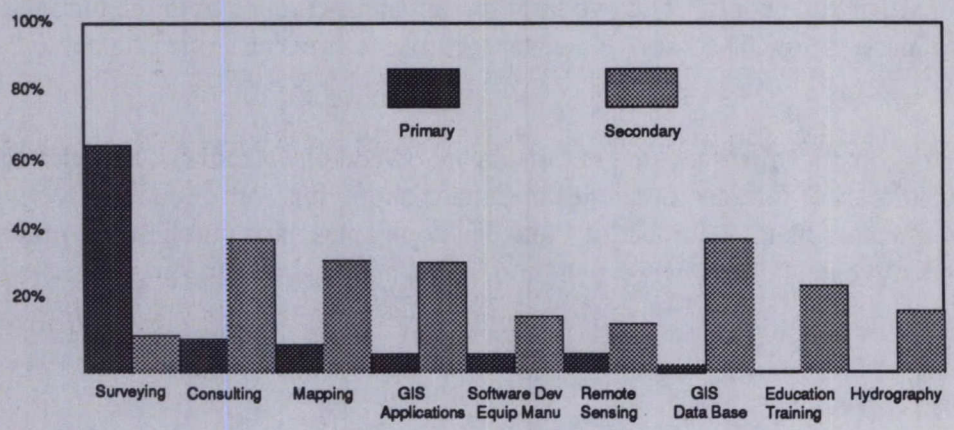

CHART 2
Primary and Secondary Business Activities

are expanding most rapidly. The rise in GIS activity has also spawned an increase in geomatics consulting, another major new trend. Clients with large stocks of digital data are increasingly turning to geomatics consultants to produce systems that will transform this data into useful information.

The growth trend in the private sector corresponds well with the number of years in business. Firms engaged in geomatics consulting, GIS applications, and software development have been in business an average of ten years. Those in GIS data base development have been in business an average of only five years. In contrast, surveying and mapping firms have been in business an average of 18 and 29 years respectively.

A number of large and medium sized firms, already supplying a full range of services from surveying, mapping and hydrography to remote sensing, have more recently added GIS applications and consulting to their portfolios as secondary activities. Large and mid-sized firms specializing in remote sensing and GIS hardware and software have become extremely competitive in the domestic and foreign markets and offer state-of-the-art systems and services world-wide.

Many firms specialize in land and control surveys and project mapping, and offer products in both hard-copy and digital form. Aerial survey and photogrammetry companies have made major capital investments to produce maps and charts in digital form and now have world-class facilities and expertise in digital mapping and data base management.

Finally, the results show that the main business activity of 65% of respondents is surveying, a figure that compares with 71% in 1985. This figure, however, when viewed in conjunction with the actual number of firms indicates not an actual drop in survey firms but rather an increase in the number for firms that offer consulting, software development, and education since 1985.

5. BILLINGS AND EQUIPMENT EXPENDITURES

a. Gross Billings

Respondents were asked to report gross billings for the fiscal year ending 1990. A summary, shown in Chart 3, was made of the number of firms having gross billings in various ranges.

In 1985 the Task Force used average billings for 1979 to 1983. By using the mid-point of 1979-1983, the current Task Force calculated the cumulative inflation rate to 1990 at 69%. During this period the number of companies with billings over $3 million more than doubled, while the number of those with billings less than $250,000 fell by one third. Moreover, while the 1985 Task Force estimated that no more than 10 firms had gross billings in excess of $3 million per year, the 1991 Task Force estimates from the results of the 1990 questionnaire that 17 firms have gross billings in excess of $3 million.

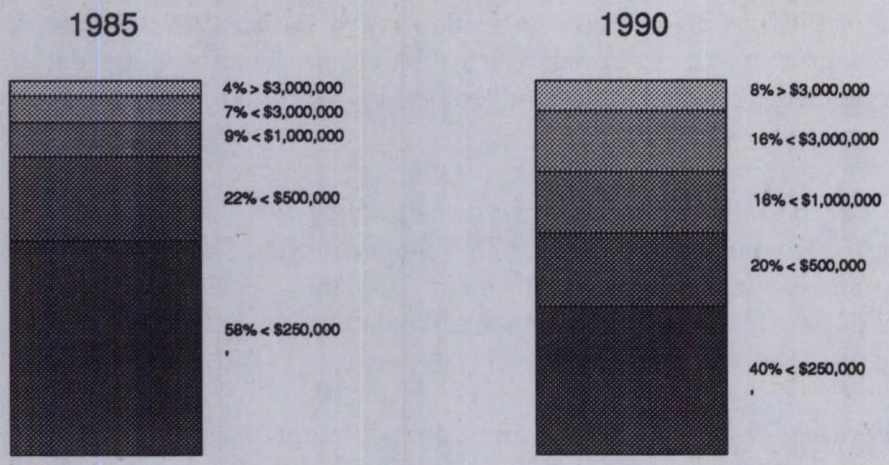

CHART 3
Comparison of Annual Gross Billings in 1985 and 1990

b. Gross Billings for Geomatics Services and Equipment/ Software Sales

Respondents were asked to report gross billings 1989, 1990, and 1991 and to estimate billings for 1993 and 1995. Note that the accumulated value in each year is the sum of the values for those respondents reporting.

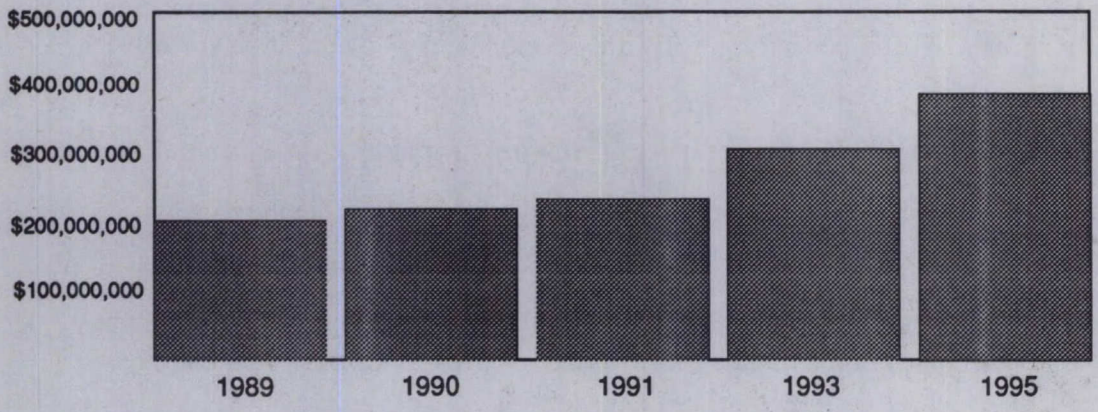

CHART 4
Gross Billings for Geomatics Services and Equipment/Software Sales

c. Percentage of Gross Billings by Geomatics Activity

Respondents were asked to break down reported gross billings for 1990 by activity.

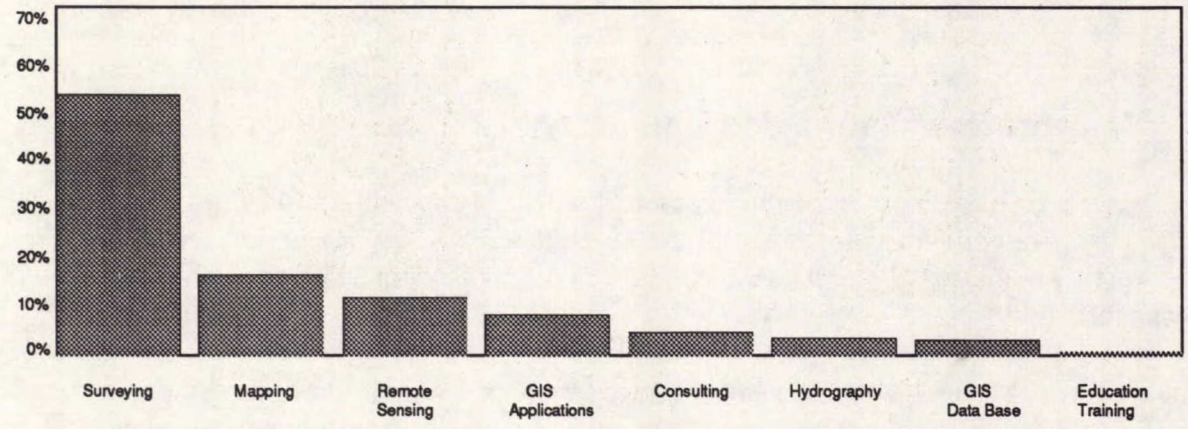

CHART 5
Percentage of Gross Billings by Activity, 1990

Several geomatics categories are different from those used in 1985, and therefore direct comparison can only be made for certain ones. Notably, however, the market share for remote sensing increased from 5% in 1985 to 11% in 1990. GIS data base and applications experienced an even greater expansion, increasing from 1% in 1985 to 11% of gross sales in 1990.

d. Percentage of Gross Billings by Domestic Customer

Respondents were asked to report the percentage of gross billings for each domestic market for the fiscal year ending in 1990.

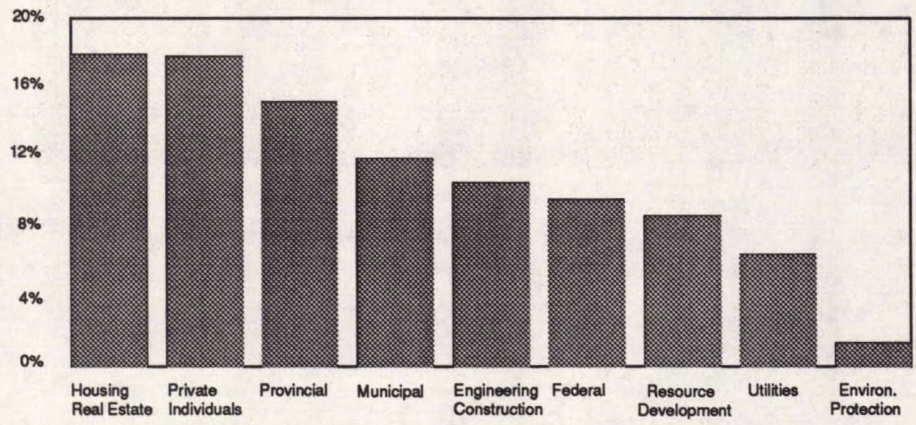

CHART 6
Percentage of Gross Billings by Domestic Market Segment

In general, the client profile of the domestic market has not changed significantly since the 1985 Task Force Report. The major client groups continue to be in the private sector, with housing and real estate leading, followed by private individuals. Government sales show an increase: federal at 9.7% from 7%; provincial at 15.3% from 15%; and municipal at 12% from 11%.

e. Value of New Geomatics Equipment/Software

Respondents were asked to report on their past and projected expenditures on new geomatics equipment/software (not inventory for sale) for 1989, 1990, and 1991 and to project expenditures for 1993 and 1995. Note that the accumulated value in each year is the sum of the values reported.

The capital cost of geomatics equipment and software continues to rise, following the same trend reported in 1985. On average the book value of equipment and software capital investment is now approximately 27% of gross sales. In 1979 the percentage of sales was estimated at 10%, a figure that increased to 26.5% in 1983 and that has remained constantly in the mid-twenties throughout the 1980s. The jump from 10% to 27% occurred largely because digital technology was being introduced to the land survey and mapping sectors of geomatics during the early 1980s.

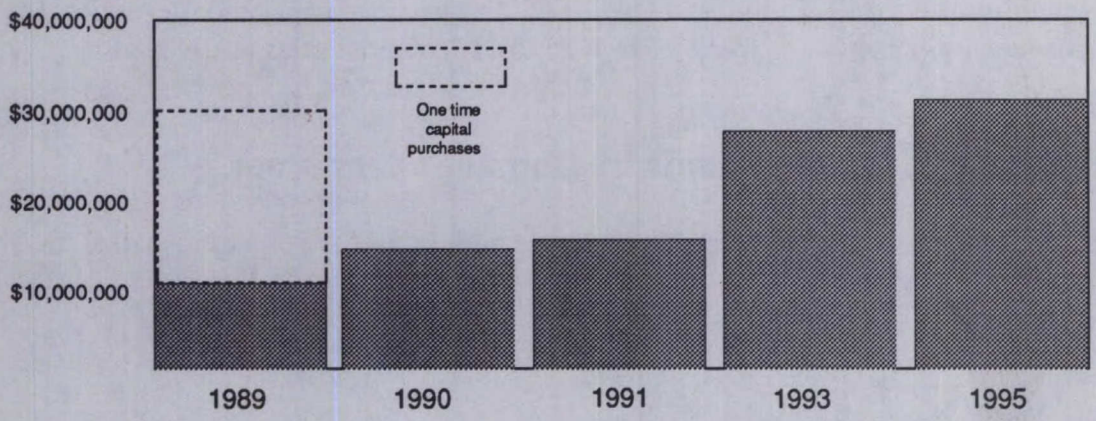

CHART 7
Value of New Geomatics Equipment/Software

The investment in capital equipment over the 1980s has improved the private sector's ability to provide services, especially survey and map products. Technology has also expanded the product line and the range of services and simultaneously reduced the number of employees required to produce the same quantity of work.

As more private sector companies provide GIS and remote sensing services, their computer and software investments will increase rapidly. Some firms have made this investment already, only to find that the market has not developed as rapidly as had been predicted. Nevertheless, the

results of this study indicate that the demand for GIS and remote sensing services is expected to expand considerably over the next decade.

Much of the initial capital investment made during the 1980s will not be repeated, despite the fact that new capital equipment is now much lower in price. Still, savings are generally offset by the ever rising cost of software and software maintenance. Moreover, although the cost of hardware and software is coming down per volume of data processed, the increased demand to transform more and different data to useful information is likely to keep the cost of capital equipment as a significant budget item for geomatics companies.

6. MARKETS AND GROWTH

a. Market Growth

Respondents were asked to indicate where they believed the most rapid growth would occur in both domestic and foreign markets. Results are given in Table 3.

DOMESTIC MARKETS	GROWTH
Municipal and County Government	20.6%
Housing/Real Estate	14.9%
Provincial Government	14.4%
Environmental Protection Industry	14.4%
Resource Development Industry	12.4%
Utilities	6.7%
Engineering/Construction Industry	6.7%
Private Individuals	4.6%
Federal Government	3.6%
Other	1.7%
	100.0%
FOREIGN MARKETS	**GROWTH**
Private U.S.	25.3%
International Aid Organizations (World Bank, ADB, UN etc.)	21.5%
Foreign Government (Non-U.S.)	17.7%
Canadian International Development Agency	12.7%
U.S. Government	11.4%
Private (Non-U.S.)	10.1%
Other Countries' Foreign Aid Agencies	1.3%
	100.0%

TABLE 3
Markets Expected to Have Most Rapid Growth (in next five years)

A total of 20.5% of respondents expect that the most rapid domestic growth will occur in the municipal and county government markets, followed by those who favour the housing (14.9%)and provincial government (14.4%) markets. In contrast, only 3.6% think that the most

rapid growth will take place in the federal government market, a result that shows that this market is considered the least promising over the next five years.

The private sector is not optimistic about export prospects in the US government market. Over a quarter of the respondents chose the American private sector as the market that will experience the most rapid growth. Next came international aid organizations and then foreign non-American government as the most popular choices. The respondents were even less optimistic about the Canadian International Development Agency (CIDA) and the American federal government as promising future export markets.

b. Profits And Expansion

Respondents to the questionnaire reported average profits for the period from 1986 to 1988 and a slight increase estimated at 6% for the year 1989/90. Profit levels returned to a low average for 1991/92. However, respondents did indicate a belief that profit levels for 1993/94 will increase by about 9% over the 1989/90 level and will rise again in 1995/96.

The interviews that were conducted as part of this study added some further observations, notably that some areas of the private sector, as well as firms in some geographic regions, actually experienced profits lower than the averages reported in the questionnaires. And, while many companies have reduced staff to ensure some level of profit, some firms are still in difficulty as a result of large capital investments made on the expectation of expanding business opportunities.

The replies received from the private sector indicated a conservative expansion strategy. The majority of firms have no plans for expansion unless business opportunities increase. Where expansion is being considered, management prefers to enter into joint ventures with other firms rather than merge with or acquire other companies. In addition, the majority of respondents clearly indicated that they prefer future growth to be funded from cash flow rather than from debt or equity.

7. EMPLOYMENT

a. Employment By Region

Responses to the questionnaire indicated the following breakdown of persons employed in geomatics by region.

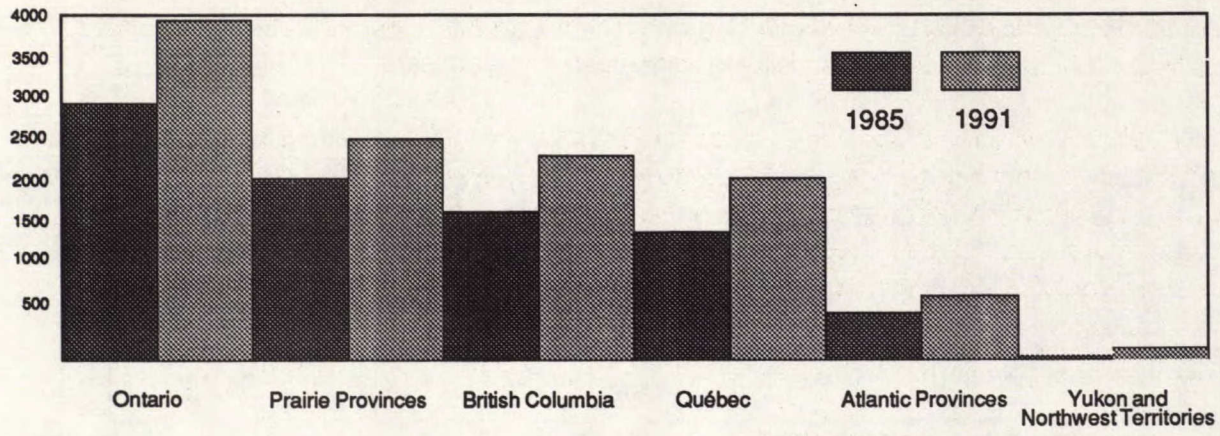

CHART 8
Employment by Region

Comparison with 1985 figures show that the greatest percentage growth has occurred in Québec and the Yukon and Northwest Territories. The total number of employees throughout Canada increased by 3,000 from 9,000 in 1985 to 12,000 in 1991.

b. Percentage of Technical, Professional and Management Personnel

Responses to the questionnaire indicated the following breakdown of technical, professional and management personnel by percentage.

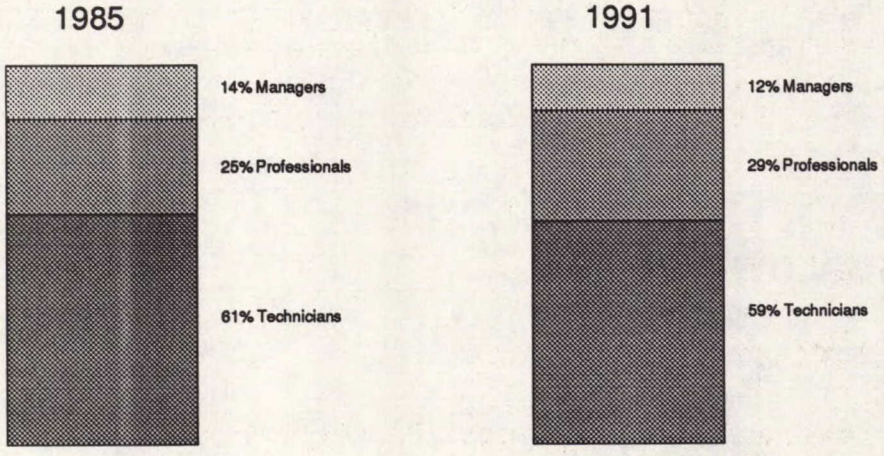

CHART 9
Distribution of Technical, Professional and Management Personnel

A comparison with 1985 figures shows that no great change has occurred in the relative distribution of employees. The most significant change is a 4% increase in the number of professionals employed by the private sector.

	Management	Professional	Technical
GIS Applications	10%	47%	43%
Surveying	10%	19%	71%
Remote Sensing	13%	47%	40%

TABLE 4
Distribution of Technical, Professional and Management Personnel
By Major Geomatics Business Activity
As Reported For The Year 1990.

Table 4 further breaks down the distribution according to major geomatics activity. Note that, as the activity matures, there is less need for professionals but a greater need for technical staff. Professionals in surveying, for instance, only constitute 19% of personnel, while in new activities like GIS and remote sensing, professionals comprise almost 50%. The percentages of managers in all three cases are comparable.

c. Employees by Geomatics Business Activity

Respondents were asked to report the number of employees in their main geomatics business activities for the year 1991. Chart 10 illustrates the change in workforce composition by main activities from 1985.

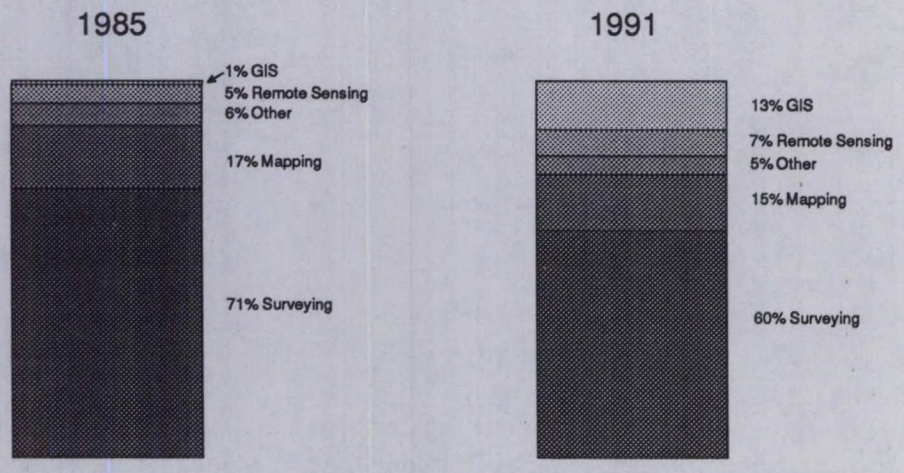

CHART 10
Percentage of Employees by Geomatics Activities

Chart 10 shows that the percentage of employees in surveying decreased by 11% since 1985. However, the 1985 figure is 71% of 9,000 employees, while the 1991 figure is 60% of 12,000 employees, a real increase of more than 800 persons. The major increase occurred in GIS.

d. Highest Academic Qualifications

Respondents were asked to list the highest academic qualification for each employee working in geomatics.

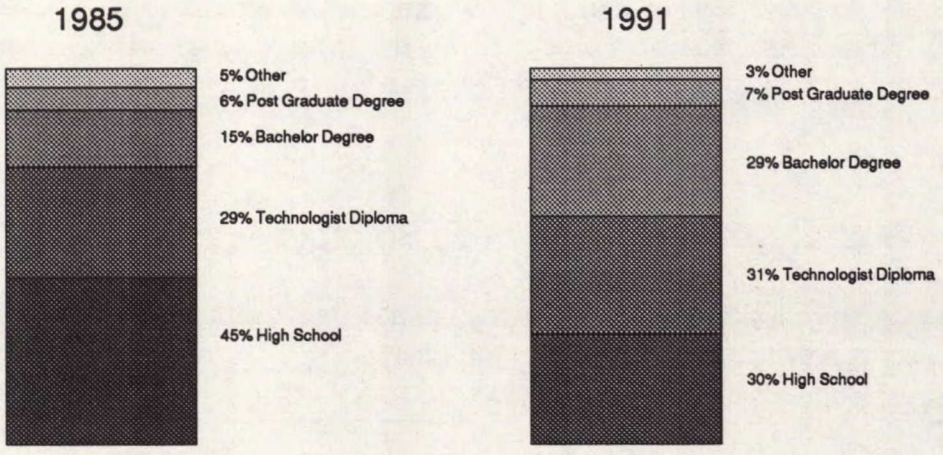

CHART 11
Highest Academic Qualifications of Employees

Comparison with education levels reported in 1985 shows a decrease in the percentage of high school graduates employed by private industry and an increase in the percentage of those with bachelor degrees. The percentages of employees with post-graduate education and with technical training remained largely constant over the six-year period.

e. Managers and Professionals

From the questionnaires, meetings with personnel, and the briefs submitted by interested persons, the Task Force gleaned that a technical background rather than a business or finance background is the normal qualification for managers in the geomatics private sector. Managers generally come from the ranks of professionals who understand the technology and learn the business end as part of on-the-job training. For instance, the registered surveyor has a solid grounding in the technology and ethics of the profession but little formal exposure to business and finance. A lack of business training is also true for managers in all the geomatics disciplines, including mapping and remote sensing. Respondents to the questionnaire indicated that they were very concerned about replacing managers when they retire or leave the firm,

particularly because the educational system, they believe, is incapable of producing the number of skilled staff required.

Without proper training, senior personnel are at a disadvantage. Managers and professionals are especially ill-equipped to communicate with the many different professions that use geomatics services. Historically the surveying sector has strong ties with the legal profession as their clients and with engineering and development firms as their colleagues. As the use of geomatics has expanded, so has the need for specialized geomatics services for particular industries. Environmental work increasingly depends on geomatics, for example, and this in turn creates the need to cooperate with experts in biology, wildlife, fisheries, water quality, waste management, and so on. In the past, involvement in these projects was completed with the delivery of the survey, map, or remote sensing product. Now the geomatics professional is expected to become part of the project team, using his or her expertise to turn data into useful information for decision-making.

f. Sources of New Geomatics Employees Hired in 1990

Respondents were asked to indicate sources of new employees hired in 1990. The results are given as a percentage of new employees in Chart 12

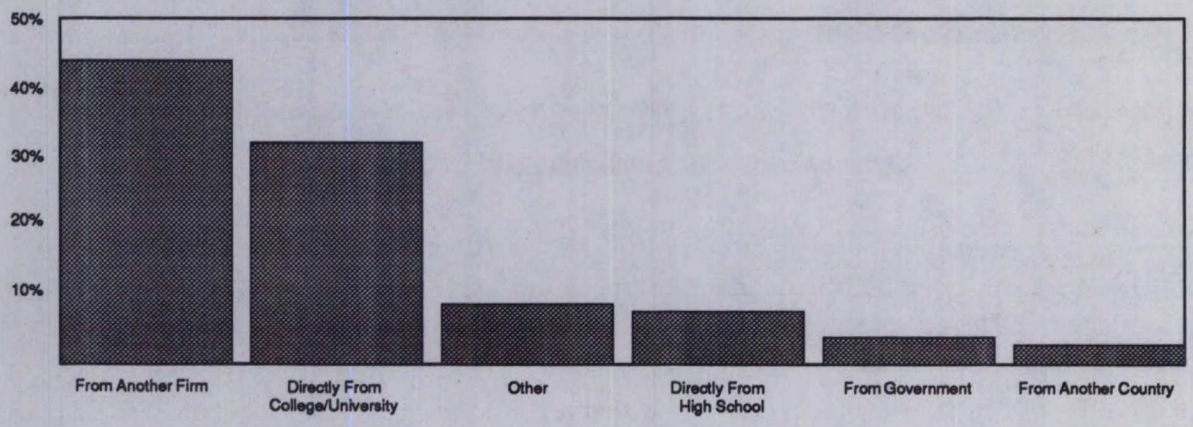

CHART 12
Sources of New Geomatics Employees Hired in 1990 by the Private Sector

Two sources stand out as the most common: directly from university or college and from another firm.

g. Sources of Future Employees

Respondents were asked to predict the source of future employees for the period 1991-1996. The results are given as a percentage of future employees in Table 13.

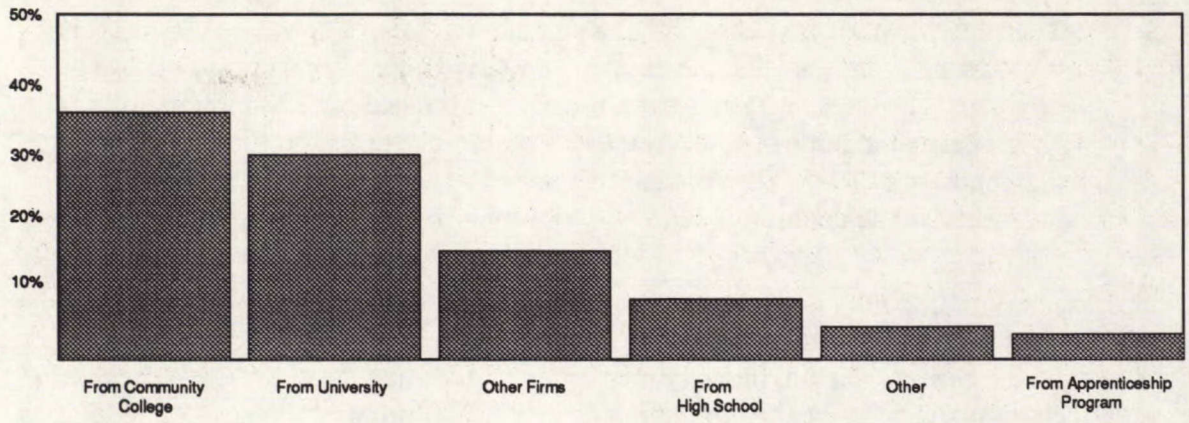

CHART 13
Sources of Future Employees

The private sector does not believe that other firms will continue to be a rich source of new employees. Universities and colleges, with a collective percentage of 66%, were cited overwhelmingly by respondents as the most promising employment pool. High school will remain a minor source at only 9%.

8. OBSERVATIONS

Some general observations can be culled from the results of questionnaire #1 distributed to the private sector.

The results from the questionnaires and the information gathered through interviews show that there are now some 12,000 employees in the geomatics industry in Canada, an increase of 3,000 since 1985. Furthermore, each employee generates between $55,000 and $75,000 in gross billings per year (gross per employee is higher in digital mapping, remote sensing, GIS, and software development). These statistics together produce a gross billing figure of $750 million per year for the private sector, more than double that reported for the 1979-83 period.

However, the recent recession has reduced the gross revenue, particularly of firms in land surveying, and staff layoffs have been substantial. While sales in the other sectors of the industry have been less affected, all parts of the industry nevertheless experienced a drop in profits in 1990.

Market growth is expected to be steady. However, two shifts in market trends are of considerable note.

1. Contracts from provincial and municipal governments are expected to increase quickly, and a slower growth rate is predicted for the federal government market.

2. The export market has changed. The demand for geomatics systems and software has increased and the demand for surveying and mapping services has dropped. The total geomatics export value is estimated at $120 million, an increase in volume but a decrease as a percentage of the gross revenue from that reported in 1985. Respondents displayed a general pessimism about the prospects of the export market.

Trade in Canada has traditionally not been east-west and markets within a province are reserved for local firms. If the predicted market shift away from the federal government does take place and if east-west trade barriers remain, industry members of GIAC may need to review the role and focus of their Association since the present mandate of GIAC primarily focuses on federal programs and external trade.

Discussions with industry, interviews and the results of the questionnaires showed that the major increases in staff were in those companies employing expertise in GIS systems and applications, remote sensing and software development. While the surveying sector has grown, the numbers of registered land surveyors has remained constant over the past five years and the number of surveying employees has not kept pace. The reason for this seeming discrepancy appears to be advances in technology that make it possible for surveyors to do more work with fewer people. A similar increase in productivity and a relative decrease in employees have also taken place in many geomatics activities where new technology has reduced the number of additional staff required as the work-load increases.

However, while the need for sheer numbers may decrease, the demand for highly-educated personnel will continue to rise. A call for well-educated and trained staff is typical of many technology-based industries in the 1990s, including the geomatics industry. Although high schools produced a large portion of personnel in the past, respondents indicated that in the future few with only a high-school diploma will be recruited. Universities and colleges should be aware of the high future demand of knowledge-based industries for trained staff and the pressure that will be brought to bear on these institutions to expand their enrolment, facilities, and staff.

D. GOVERNMENT: THE PUBLIC SECTOR

1. INTRODUCTION

The Public Sector is composed of the three levels of government - federal, provincial and municipal. Questionnaire #2, designed to capture the geomatics profile of the public sector, was sent to 205 organizations. Replies were received from 50 agencies, a 24.4% response rate. Of these replies, 52% came from provincial governments, 24% from the federal government, 24% from local and regional governments. About half reported that they were a branch in a large department, while the other half reported that they belonged to various other levels.

The results of the questionnaire sent to public sector organizations show that about half of those responding are primarily involved in GIS data base and GIS application activities, with 35% of their budgets allocated to these tasks. The total of gross budgets for all levels of government in geomatics is estimated to be $600 million with staff of approximately 7,000 persons.

Contracting out is shown as 37% of budgets at the present time, with a projected increase to 41% in 1995. The value of contracts for geomatics services is estimated to be between $200 and $250 million.

2. PRIMARY AND SECONDARY GEOMATICS ACTIVITIES

Respondents were asked to indicate the primary geomatics activity and to indicate one or more secondary activities if the organizations had major budgets in other categories. Because respondents identified a number of secondary activities, the total for the "Secondary Activity" in Chart 14 is greater than 100%.

Note that the distribution as given in Chart 14 is notably different from that reported by the private sector. GIS applications and data base are the most common primary activity, followed by surveying and mapping, whereas in the private sector the predominant business activity is surveying, followed by mapping, GIS, and remote sensing.

When asked to state which geomatics activity will be of increasing importance to their organization, public sector respondents ranked GIS data base, mapping, and remote sensing as the most important, followed by education and training in geomatics.

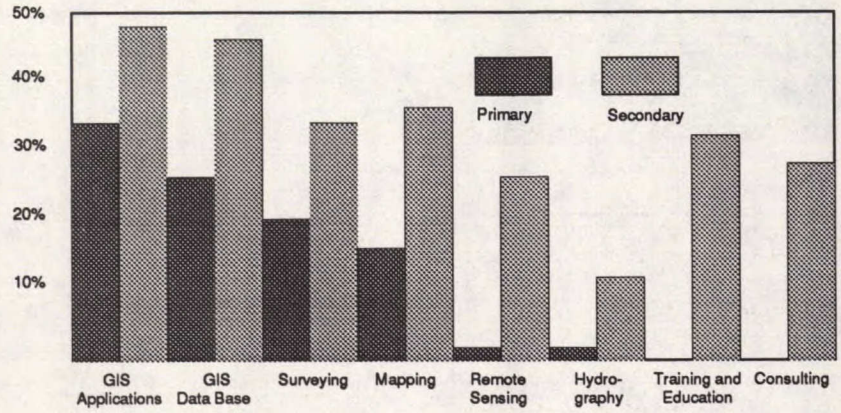

CHART 14
Primary and Secondary Geomatics Activities

In addition, the great majority of those that replied believe that the largest increase in staff will occur in GIS applications, followed by GIS data base and remote sensing. The smallest increase in staff is expected to occur in surveying.

3. GROSS BUDGETS AND STAFF

As a result of the diversity of geomatics activities in governments at all levels, it was not possible to obtain an accurate value of the funds spent producing and purchasing geomatics goods and services, nor was it possible to get an accurate count of personnel. However, estimates based on results from Questionnaire #2 and interviews place the gross value of budgets for geomatics in the public sector in the $600 million range and the number of staff are at approximately 7,000. The current book value of the equipment and software is estimated to be $120 million, and the replacement value of the equipment is estimated to be $130 million.

Of some note is the observation that while the gross geomatics budgets for all governments have increased, the operating and capital budgets for the large geomatics organizations in government have not kept pace with the rate of inflation.

a. Distribution of Budgets by Activity

Respondents were asked to report the percentage of capital and operating budgets allocated to geomatics activity for the fiscal year ending in 1990.

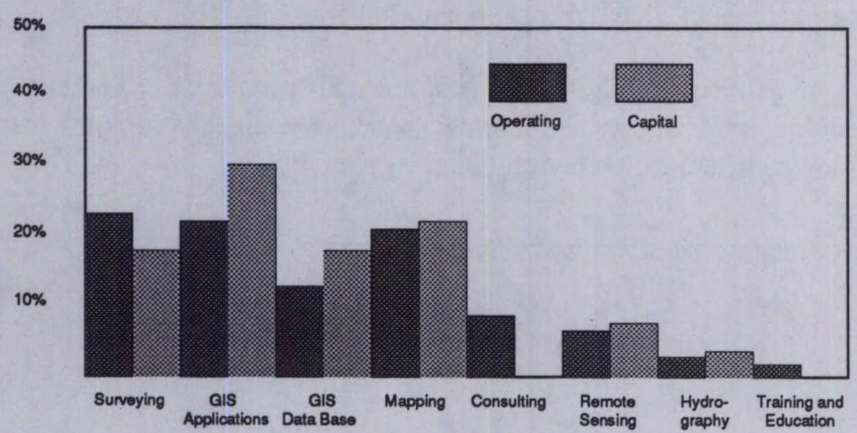

CHART 15
Percentage of Operating and Capital Budgets by Geomatics Activity/1990

The results given in Chart 15 show that the largest single allocation of operating and capital budgets is for GIS, followed by mapping, surveying, and remote sensing. Consulting is also a growing activity in government and now claims 9% of operating budgets.

b. Contracting Out

Respondents were asked to report the percentage of their budgets that were or will be allocated to contracting out services in the fiscal years 1989, 1990, and 1991 and to estimate percentages for 1993 and 1995.

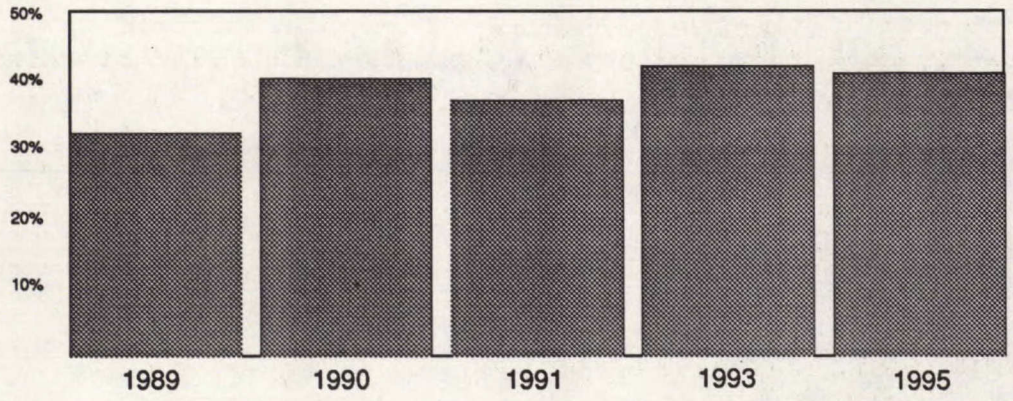

CHART 16
Percentage of Budgets Allocated to Contracting Out Services

Based on the percentages shown in Chart 16, the value of public funds contracted for geomatics is estimated to range from $200 to $250 million per year.

4. EMPLOYEES

a. Highest Academic Qualifications of Employees

Respondents were asked to list the highest academic qualification for each employee currently working in geomatics.

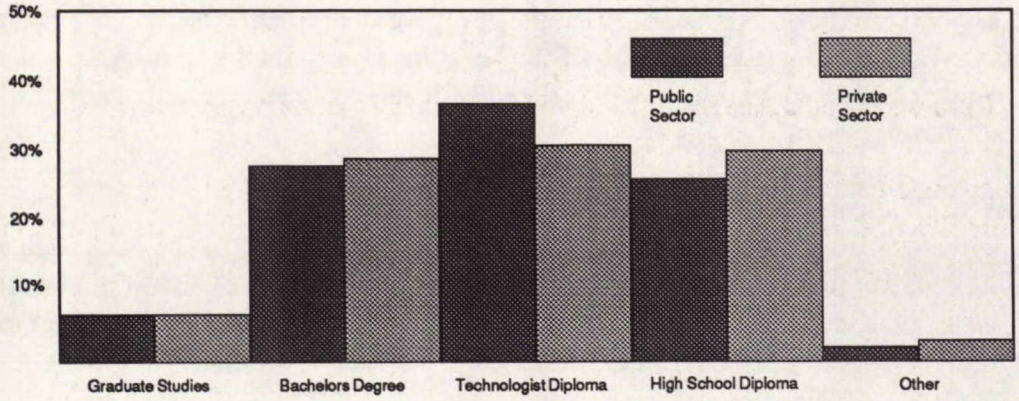

CHART 17
Highest Academic Qualifications of Employees

The results of the private sector's response to the same question are given as well for comparison. Note that the academic qualifications of geomatics employees in the public sector closely parallel those of private sector employees.

b. Sources of New Geomatics Employees Hired in 1990

Respondents were asked to indicate sources of new employees hired in 1990. The results are given as a percentage of new employees.

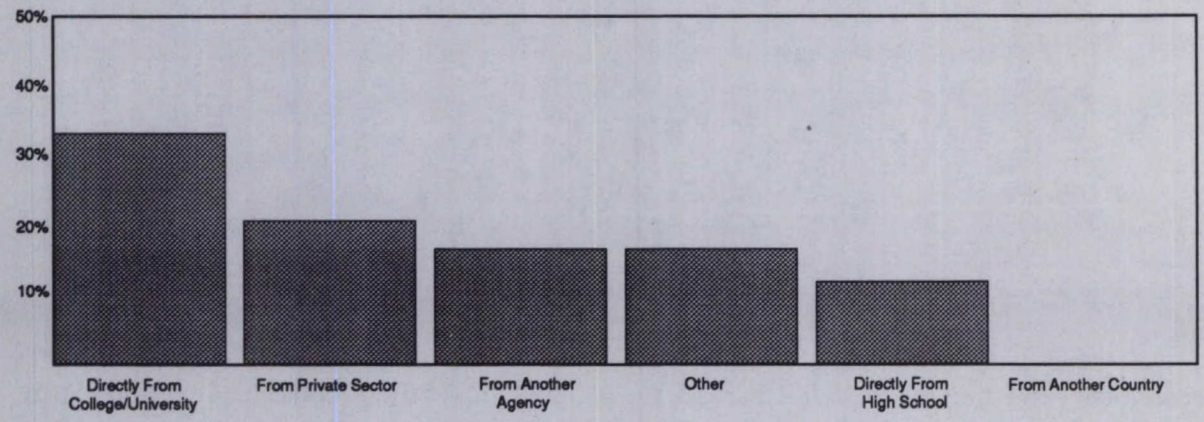

CHART 18
Sources of New Employees Hired in 1990 by the Public Sector

Respondents indicated that an important source of new employees for the public sector is a combination of the private sector and other government agencies for a total of 38%. This compares with the private sector which obtains 44% of new employees from other firms. The percentages of new staff coming directly from high school and university are largely the same in both the public and private sectors.

The public sector has expressed concern about the ability of the present educational system to deliver the quantity and quality of skilled staff they require. When their needs for skilled staff cannot be met by existing educational facilities, respondents indicated a preference for in-house training as an alternative.

Respondents also indicated that they believe that over the period from 1991 to 1995, 33% of new employees will come from universities and colleges, while only 4% will come from high school. This hiring trend is not just confined to geomatics but is common to many knowledge-based industries. As a result, considerable pressure will be placed on colleges and universities as more high school graduates seek post-secondary training and education as a means of ensuring employment.

5. OBSERVATIONS

Governments remain the largest single customer of geomatics services and equipment/software. However, the budgets of established geomatics organizations in government are not increasing, and many government geomatics programs will reach maturity and go into a maintenance mode during the 1990s. In the short term (five years), data base maintenance and management will start becoming a priority and will spawn a need for new services, possibly from a different sector of the geomatics community.

Governments are being hard-pressed to keep taxes down and cut expenses. At the same time there is pressure for the maintenance of the social programs and a growing concern about the environment. Thus, governments are unlikely to initiate major new geomatics programs unless they are linked to direct economic benefits or sovereignty issues like native land claims.

The new expanding business in governments will be in those areas where the private sector can demonstrate that it is cheaper to contract out or that a new service or product can be provided to add efficiency to government data gathering and management.

E. UTILITY/COMMUNICATIONS/RESOURCE COMPANIES AND CROWN CORPORATIONS

1. INTRODUCTION

Geomatics has become an increasingly important activity for a number of crown corporations and large public companies in utilities, communications, resources, and transportation. Although these organizations have developed in-house expertise, they continue to purchase geomatics services from the private sector.

Questionnaire #3, very similar to that sent to the private sector, was sent to 141 public companies and crown corporations. Replies were received from 29 organizations or 20.5%.

2. BUSINESS ACTIVITY

Respondents were asked to report their organizations' main business activities. Note that because respondents were allowed to choose more than one activity, the total is therefore greater than 100%.

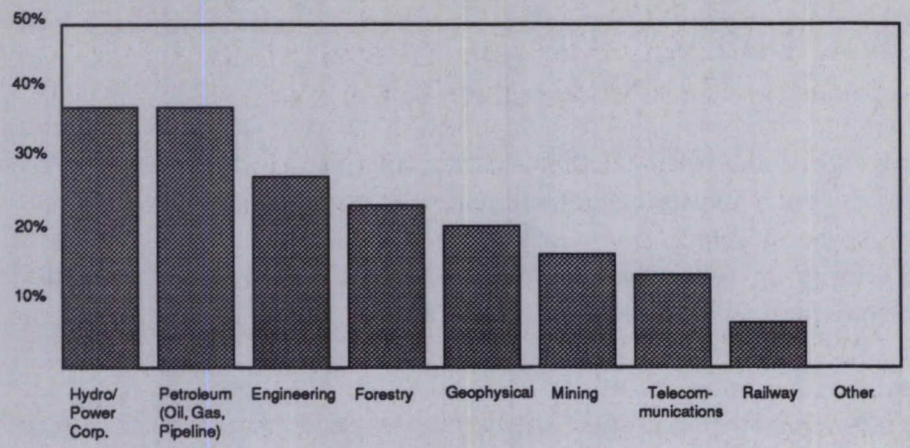

CHART 19
Areas of Business Involvement

3. PRIMARY AND SECONDARY GEOMATICS ACTIVITIES

Respondents were also asked to indicate in which geomatics activities their organizations were involved. Note that because respondents were allowed to choose more than one secondary activity, that total is therefore greater than 100%.

About 30% of the respondents were from independent agencies, and another 30% were members of a branch in a large department. The remainder were in smaller units of a large branch or fell into the "other" category. The majority of the geomatics services provided are on a regional or provincial basis, with about 6% of their market outside of Canada.

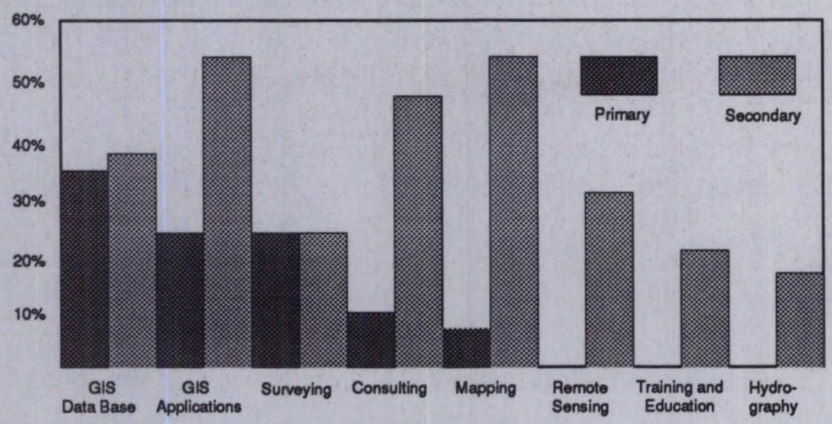

CHART 20
Primary and Secondary Geomatics Activities

The profile that resulted is strikingly similar to that of the public sector, with GIS leading, followed by surveying, consulting, and mapping. The emphasis on GIS reflects the need that public companies and utilities have to transform digital data bases into useful information. A

total of 55% of respondents said that their secondary activities included GIS applications and mapping, while 21% of respondents said education and training.

Respondents rated GIS data base as the geomatics activity of greatest future importance to their organizations, and they also rated education and training, mapping, and consulting as being of increasing importance.

4. BUDGETS

a. Gross Budgets

A number of crown corporations and public companies have in-house geomatics capabilities, and others maintain an in-house advisory capacity in geomatics and contract for services as needed. Based on the results of Questionnaire #3, estimates place the gross budgets of public companies and crown corporations for geomatics at $300 million and personnel at 3,500 persons.

b. Contracting Out

Respondents were asked to report the approximate percentage of budgets allocated to contracting out services for 1989, 1990, 1991 and to estimate percentages for 1993 and 1995.

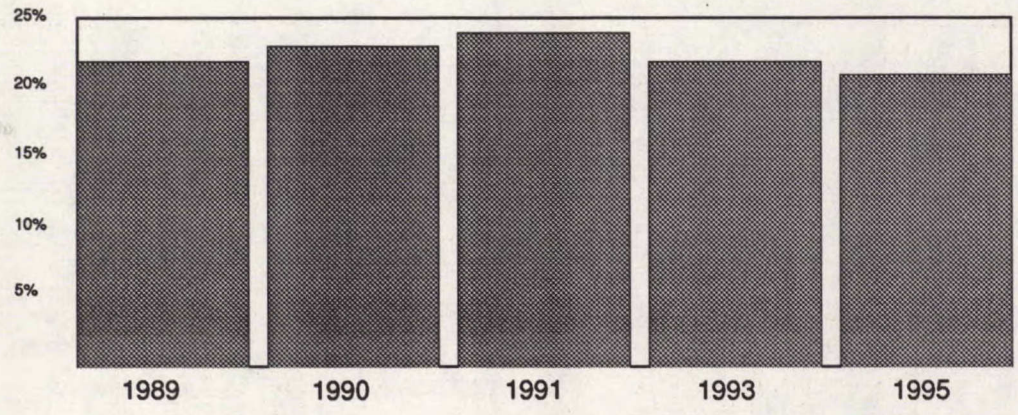

CHART 21
Percentage of Budgets Allocated to Contracting Out Services

The results given in Chart 21 appear to show a slight decrease from 1991 to 1995, although actual dollar amounts may increase depending on the budget increases each year. The percentages here differ notably from the 40% figures for the public sector. Based on the results from Questionnaire #3, estimates place the value of the funds available for contracting out to the private sector at $70 million.

5. EMPLOYEES

a. Highest Academic Qualifications of Employees

Respondents were asked to list the highest academic qualification for each employee currently working in geomatics. The results of the private sector's response to the same question are given in the right-hand column for comparison.

The results are markedly different from those of the private sector. Most notable is the higher percentage of high school-educated employees in public companies and crown corporations, and the correspondingly lower percentage of university or college-trained employees.

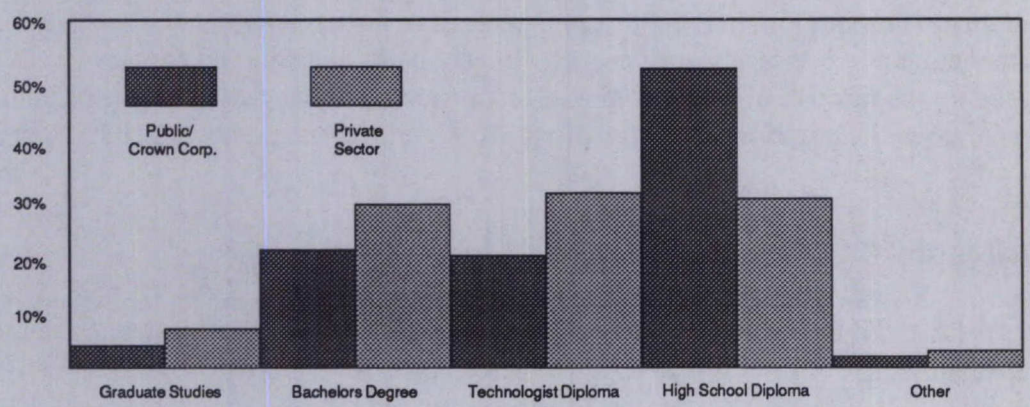

CHART 22
Highest Academic Qualifications of Employees

b. Percentage of Technical, Professional, and Management Personnel by Sector

Respondents were asked to break down technical, professional and management personnel by percentage. Results from both the private and public sectors are also given for comparison.

Sector	Percentage Management	Percentage Professional	Percentage Technical
Private	8%	31%	61%
Public	8%	30%	62%
Crown/Public	8%	24%	68%

TABLE 5
Percentage of Technical, Professional and Management Personnel

The distribution of employees is similar among all three sectors. The only notable difference is the 5-6% drop in the number of professionals employed by public companies and crown corporations.

c. Sources of New Geomatics Employees Hired in 1990

Respondents were asked to indicate sources of new employees hired in 1990. The results are given as a percentage of new employees.

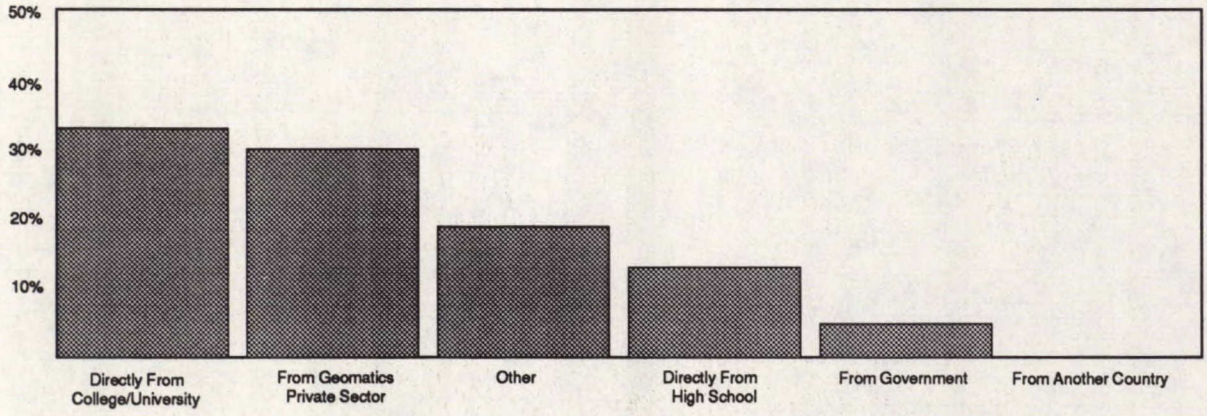

CHART 23
Sources of New Employees Hired in 1990 by Large Public Companies and Crown Corporations

A high percentage of new employees came from universities and from industry. Respondents predicted that in future 45% of new staff will come from universities, 25% from community colleges, 16% from the private sector, and only 8% from high schools.

Like the public sector, the public companies and crown corporations are concerned whether the present educational system can deliver the quantity and quality of skilled staff they require. When their needs for skilled staff cannot be met by existing educational facilities, respondents indicated a preference for in-house training as the first choice alternative and private sector training as the second choice. Respondents did see some difficulty in replacing senior management, but did not consider it a major problem.

IV. CHANGES IN THE PRIVATE SECTOR SINCE 1985

A. INTRODUCTION

While the questionnaires provided a good sense of the quantifiable characteristics of the current status of geomatics in Canada, interviews during the regional meetings and follow-up discussions with experts from the private, public, and academic sectors also produced a wealth of material. These talks were particularly valuable as indicators of change in the private sector since 1985 as well as changes expected over the next several years.

B. RESULTS OF THE RECOMMENDATIONS OF THE 1985 TASK FORCE

1. INTRODUCTION

The 1985 Report of the Task Force contained thirty-four recommendations directed to educational institutions, the surveying and mapping private sector, the government, and professional associations.

While there are many examples of direct action as a result of the recommendations of the 1985 Task Force, the Report's greatest service was pointing the way toward a digital environment of spatial information. The Task Force Report of 1985 (Usher Report) created a new vision of a surveying and mapping industry that is now beginning to take on a concrete shape, and became a guide for the private sector, government, and academia on the future of the industry.

Appendix I of this Report gives a list provided by the Canadian Institute of Surveying and Mapping of the 1985 recommendations and the actions taken in response to each. Although all the recommendations spurred valuable change, four major events have affected the geomatics industry in more general ways.

2. THE ROLE OF THE CANADIAN INSTITUTE OF SURVEYING AND MAPPING (CISM)

The thirty-fourth and last recommendation of the 1985 report was directed to the Canadian Institute of Surveying (now Canadian Institute of Surveying and Mapping):

> That the Canadian Institute of Surveying assume a leadership role in ensuring that the recommendations in this report are acted upon.

In response, the Canadian Institute of Surveying and Mapping in 1986 formed a Task Force Implementation Committee in which government, the private sector, and professional associations were represented. The committee was to focus on the following tasks:

- monitor the implementation of the recommendations of the Task Force;
- organize a meeting of industry leaders to discuss the creation of a surveying and mapping consulting association of Canada;
- organize conferences on R & D and export development.

The CISM has provided a report of their actions which is included as Appendix I to this 1991 Report. GIAC's responses to the recommendations are included in the Appendix as well.

3. NATIONAL CONFERENCE

In response to the recommendations calling for conferences on research and development and export development, a National Conference on the Economic Development of the Surveying and Mapping Industry was held in December 1986 and its proceedings were published by the CISM in February 1987. The Conference addressed recommendations of the Task Force dealing with R & D, new domestic markets, and strategies for the export of industry services and expertise.

4. FORMATION OF GEOMATICS INDUSTRY ASSOCIATION OF CANADA (GIAC)

The 1985 Task Force Report proposed that the Canadian Association of Aerial Surveyors (CAAS) and the Canadian Association of Hydrographic and Ocean Surveying Industries form the embryo of a new Surveying and Mapping Consulting Association. This was implemented in 1987 when the CAAS expanded both its mandate and membership and changed its name to the Geomatics Industry Association of Canada (GIAC). Starting with thirty companies in 1988, GIAC now has eighty private sector members and has broadened its mandate to embrace all sectors of the spatial information business.

CAAS (now GIAC) accepted the responsibility to act on those recommendations of the Task Force Report that required action by the private sector. As a result, the Association's involvement in negotiations with governments has increased the level of contracting out, and a memorandum of understanding was signed with Energy, Mines and Resources Canada to improve industry/government cooperation on a number of fronts. In addition, GIAC has compiled a directory of members as part of a strategy to raise the industry's profile. Canada's foreign trade offices are promoting Canada's geomatics expertise through a geomatics export

data base and a colour marketing brochure produced by the federal government with GIAC support.

Acting on another Task Force recommendation, GIAC, CISM, and Employment and Immigration Canada co-sponsored a Geomatics Human Resources Study that included an assessment of the management skills required in the future. The study results will be used to influence universities and community colleges to modify education programs to better meet the needs of the geomatics industry. A brief discussion of the study and its results can be found in Chapter IX of this report .

5. FOCUS ON EDUCATION

Education figured significantly in the recommendations made by the 1985 Report, and CISM has responded by focusing on the education of its members through seminars on GIS, Global Positioning Systems (GPS), and national issues like the 1983 North American datum. A review of the education standards for technicians has also resulted in a smoother transition for those who would like to move from technician or technologist to licensed surveyor. In addition, there has also been agreement to support the concept of standardized educational requirements at the technician level.

C. REMOTE SENSING COMES OF AGE

1. INTRODUCTION

Several studies have been done in Canada and elsewhere on the remote sensing industry. The most complete is the study of Radarsat. Unfortunately the majority of other studies has been done for private clients and remain unpublished.

Nevertheless, discussion with the staff of Energy, Mines and Resources' Canada Centre of Remote Sensing (CCRS) and with users of remote sensing in industry has provided insight into changes since 1985.

2. REMOTE SENSING AND THE PRIVATE SECTOR

a. Stimulated Growth of Strong Private Sector

Starting with its first high-quality images from space in 1972, the Canada Centre for Remote Sensing, in a partnership with business and academia, has stimulated the growth of a strong private sector capacity in remote sensing.

Over the years a large part of the R & D in remote sensing has been contracted out, and many of these contracts have resulted in commercial products and services developed by private sector companies that now compete in the overseas market.

b. Expansion of Private Sector Capability

A 1984 survey of industry conducted by the User Assistance and Marketing Unit of CCRS identified 34 companies active in remote sensing. By 1987 the number had grown to 73 and today some 120 companies are providing remote sensing products and services. Of these 120 companies, 40 export and the largest of them derive 80% of their income from the export sector of the business.

3. RADARSAT

The Radarsat program of the Canadian Space Agency is designed to monitor land and sea conditions, provide Canada and the world with information for resource management, and perform ice and ocean surveillance. The heart of Radarsat is the Synthetic Aperture Radar (SAR) which enables the satellite to "see" through cloud cover and darkness, scanning the earth in swaths of up to 500 km and covering most of Canada every 72 hours.

Federal and provincial governments (British Columbia, Saskatchewan, Ontario and Québec) and an industry consortium (RADARSAT International Inc.) are sharing the development costs, and the prime contractor for the project is Spar Aerospace Ltd. Radarsat is scheduled for launch in 1994 and should have a working life of five years.

4. MARKETS

Discussions with industry and CCRS revealed that the remote sensing industry expects the market for remote sensing and related GIS to continue expanding as a result of the growing demand for more and better assessment data on development projects and on environment issues.

The domestic market remains the largest single market for the industry. CCRS estimates that Canada has approximately 10% of the world market for remote sensing services and products, and the two largest companies competing in that market are Canadian. The most important export markets are the USA, Southeast Asia, the Middle East, Europe, the Indian sub-continent, South America, and Africa.

D. GEOGRAPHIC INFORMATION SYSTEMS (GIS) - THE EXPANDING ACTIVITY

1. INTRODUCTION

Two Task Force members met with 175 representatives from the private sector, government, and academia during regional meetings in 13 cities across Canada. Much information was gathered during these meetings about the place of GIS and the future role that the technology will play as geomatics continues to develop in Canada.

2. GIS AND GEOMATICS

Geographic information systems are computer systems for compiling, updating, analyzing, and displaying large amounts of geographically referenced information. By automating manual techniques and by extending analytical capabilities, a GIS enables users to digest geographic information efficiently, thereby accelerating the decision-making process. A further advantage of a GIS is that compiled, updated and otherwise manipulated information can be graphically displayed on the computer screen and on hard copy. Graphic demonstrations of information presented by a GIS have proven to be extremely effective in making complex issues readily understood in the board room or in a public meeting. GIS is the unifying technology of geomatics and makes it possible for geomatics to make an important contribution to the information and communication-based society in which we live.

a. A Tool Of Many Professions

Where GIS was once the purview of the resource manager, the cartographer, and the surveyor, it is now becoming a vital tool for many professions. The demand for GIS training from professionals like economists, lawyers, engineers, environmentalists, accountants, and so on is a clear indicator that GIS has become a known and widely appreciated resource tool. Its ability to transform data into usable information has moved GIS into the mainstream of everyday decision-making.

b. Link With Communications Industry

In the past, one of the barriers to using GIS was the prohibitive cost of effectively transmitting large data sets to users. With the advent of fibre optics for rapid communication, digital data can now be sent anywhere quickly and at a reasonable cost, and as its use increases, GIS will become one of the major users of the national communication networks, both in volume and in frequency.

The trend in business applications of geomatics through the 1990s will be real-time interaction with conventional "base map" data and, just as importantly, with the geo-referenced business data constructed within it. Since the business activities supported by GIS are conducted among national, provincial, and regional levels, communication networks will be essential.

In order to facilitate the exchange of data, digital data base working groups from federal and provincial agencies are developing national standards. So far, the participation of the private sector has been minimal, and its concerns should be heard.

E. CHANGING USER NEEDS

1. INTRODUCTION

Changes in technology necessarily affect users and in turn modify user needs. GIS has had an especially large effect on the geomatics industry and on users of geomatics services and products. The continuing growth of GIS, its links to other geomatics activities, and its pervasive influence on all the professions in geomatics promise to go on influencing user needs throughout the next decade.

Because user needs change dynamically and are a more subjective and less quantifiable aspect of geomatics use, much of the information used in this section was gathered during discussions at regional meetings, and not from published reports and papers.

2. THE DIGITAL ENVIRONMENT

a. Evolution of the Digital Environment

Early in the 1980s automated cartography, designed to improve the efficiency of map and chart production, evolved into the use of digital data bases on which to build geographic information systems (GIS). This evolution occurred largely because users realized that the real payoff in automated cartography was not in map production but in manipulating and analyzing digital map data in order to transform it into useful information.

By the mid-1980s government organizations had responded to this realization by creating major programs for topographic and geographic digital data base construction. As blocks of digital topographic data became available and the cost-effectiveness of computers increased dramatically, new groups of users could for the first time afford the hardware and obtain the digital data. GIS became an affordable technology and interest in its use rose rapidly. Today, GIS is the growth industry in geomatics.

Other digital-imaging systems, especially for remote sensing from aircraft and satellite, fitted in well with the digital GIS environment. Remotely-gathered digital data could go directly into a

GIS for manipulation and analysis, bypassing the need to first digitize the data as is the case with most map and image data. Consequently, the immediate acceptance of GIS by remote sensing users accelerated its use generally in the geomatics community. Just as the remote sensing applications expanded to new fields, GIS followed suit by opening up the technology to a large group of users who had data that needed to be transformed into information. The result was a whole new family of users of geomatics products, and in time some of these new users also became the producers of value-added products as their GIS skills developed.

As GIS rapidly gained ground, hardware and software development kept pace with the needs of industry and government, resulting in a new hi-tech support industry. This segment of the geomatics industry expanded rapidly in the late 1980s as more and more customers switched to the digital environment for geomatics products.

To meet the expanding need for digital topographic data, the air survey and photogrammetry companies moved to the digital environment with new capital equipment and skilled staff. Maps are now delivered on disks that contain multiple layers of information and digital terrain models for topographic use.

b. The Digital Environment and the Cadastral Surveyor

Cadastral surveyors have also felt the effects of the digital environment. The advent of the Total Station for land surveying, combined with the demand for digital plans and drawings, led to large capital outlays for most cadastral survey offices. However, this investment has paid off since cadastral survey offices have increased their output by as much as 30% to 50% with no increase in staff.

Yet, despite advanced technology, cadastral surveying in most parts of Canada still requires surveyors to interpret evidence as the principal means of positioning boundaries between land parcels. In those parts of Canada where the survey fabric is more uniform, survey coordinates may in time take precedence over evidence, but this shift will not happen quickly. Thus, while technology will continue to make land surveying more efficient, the end product required by the customer and the courts is not likely to change in the near future.

Traditional customers like utility, oil exploration, and transportation companies are increasing their use of geomatics products and services and have a growing need for remote sensing, GIS, and modern positioning systems like GPS. Since many of the projects being conducted by these types of companies concern rights of way, leases, and easements, the cadastral surveyor is also a key supplier of products and services. The geomatics industry is well-equipped with capital equipment and expert staff to meet the increased demands from these traditional customers.

c. Multi-Disciplinary Regional Projects

Environmental basin studies such as those recently carried out in the St Lawrence River Basin by Environment Canada and Québec signal the birth of a new activity in environmental protection that involves many facets of geomatics, including hydrography, remote sensing, and GIS. The environmental assessment studies required by governments, industry, and the public demand accurate scientific data, including geographic location. Furthermore, geomatics techniques are being increasingly used for site-specific projects as part of the total management process. This trend requires that the geomatics expert become a member of a team creating an integrated information product, rather than just the provider of the initial digital input.

d. Updating Digital Data Bases

Discussions with government have revealed that they are unlikely to repeat or initiate mass digital coverage programs like the Ontario Base Mapping Program. Rather, energy and monies will be directed to updating existing digital data bases on a selected basis using a mixture of technologies. New remote scanning techniques are being developed, and remotely-sensed digital data captured from aircraft and/or satellites can go directly to the digital data base for update. While these procedures are not yet fully developed, they have immense potential. The result will likely be the displacement of aerial photography and photogrammetry as the favoured methods for updating digital files. When this shift occurs, conventional digital mapping techniques will have to find other markets.

V. PRIVATE SECTOR RELATIONSHIPS

A. GOVERNMENT

1. INTRODUCTION

While conducting regional interviews across the country, representatives of the Task Force met separately with government geomatics program managers and with the geomatics private sector. From these meetings and from comments received from briefs, Task Force members clearly perceived that while some improvement has been made in the trust and understanding between the private sector and government, there is still room for improvement. In all jurisdictions, both domestic and foreign, trade patterns are forcing closer cooperation between the public and private sectors. The Task Force, therefore, felt that an examination of the current interaction between the two sectors was necessary and that ways of improving relationships should be identified.

"There should be more alliances formed between the public and private sectors; the current Canadian model does not appear to be very effective in enhancing our high technology industries."

2. THE RELATIONSHIP

Throughout Canada the private sector and governments are concerned about their relationship. At worst the relationship is viewed as increasingly distant to the point of distrust; at best it is judged as satisfactory with room for improvement.

"There's a lack of a national consensus as well as a long-term strategic plan for the development of the Canadian geomatics industry. By having its own individual views and plans, the actions of each partner (individual firms, industry and professional associations, academic institutions, federal and provincial governments) are often uncoordinated and do not always lead to the synergy that we could expect from the association of resources"

There are reasons for this pessimism - some real and some perceived. Many government programs have reached maturity and so the opportunities for contracting out are reduced. While some federal and provincial agencies have developed programs in geomatics that form a

domestic market for the private sector, others have no such programs or do much of the geomatics work with in-house resources. In some cases, governments have found the private sector unresponsive to potential overseas opportunities that they have identified. All these problems are exacerbated by budget cutbacks by government and industrial customers in the present economic downturn.

"There is a need for the geomatics industry to take a clear leadership role in the entire field of geographic information systems. Governments should be assisting in this by providing technical standards wherever government funding is involved. There are still too many geographic information systems being developed, particularly in municipalities, without the proper recognition of the need for accurate baseline data."

From the private sector's point of view, government should focus on planning and managing national spatial information infrastructures and associated national standards. Production tasks associated with the development of these infrastructures and standards should be contracted to private firms, and the work should be packaged in such a way as to foster the development of internationally competitive Canadian companies. Governments can also support the development of value-added applications in the domestic market, the private sector believes, by making the data within the infrastructure available at a minimal cost.

Government can also play an important role, in partnership with the private sector, in increasing Canada's competitiveness in foreign markets. Assistance from government that would be welcomed by private enterprise includes

- developing formal government-to-government relations in key target countries;
- providing access to specialized equipment and expertise within government; and
- providing optimal loan, bond, and financing terms.

"The goal should be to have GIAC as the initial contact point of government/industry communication and to have GIAC recognized as the voice of all the industry. We also need to address attention to departments other than Energy, Mines and Resources."

3. POLICY ISSUES AND NATIONAL STRATEGY

Regardless of the reasons for these perceptions on both sides, this cool relationship, if allowed to continue, will not serve the country well through domestic programs or developing foreign markets. Much of the interaction between government and the private sector so far has been limited to discussions about contracting out, and little attention has been paid to policy issues or long-term planning. Likewise, no overall national geomatics strategy is being officially discussed or even contemplated, even though such a strategy could more clearly define the issues both groups face now and in the future. A national strategy would also clarify roles and responsibilities and lead to a common national approach when dealing with both internal and external trade.

Recommendation 1: **That the private sector initiate the development of a national geomatics industry competitiveness strategy to include the role of governments, research and development priorities, and domestic and foreign market development.**

"Interaction between government and the Geomatics Industry has been essentially limited to discussions about contracting of work, with minimal attention being paid to any policy or planning activities. GIAC has been successful in influencing government policy on make versus buy; however, this has been done, by and large, in the absence of any overall strategy."

B. ACADEMIA

As the private sector expanded their geomatics activities in the 1980s, academia expressed the need for a sense of strategic direction from the industry, a need that is mentioned again in the first recommendation resulting from the Geomatics Human Resource Study (See Chapter IX). As the sector that provides the education and training for the industry, the academic community needs the input and support of both the private and government sectors in order to continue with its job.

Advisory boards and committees set up to bring academia and the private sector together have received mixed reviews. The exchange of senior staff would greatly improve the understanding of issues by both groups, but this exchange has been difficult to put into practice because of differing skill levels and some reluctance to move, even temporarily, to a new environment.

The academic world, in general, is facing severe constraints now, and industry seems to be sensitive to these systemic problems that are making it difficult for universities and colleges to react to changing education and training needs. These constraints, combined with the difficulty

of obtaining adequate capital budgets, severely restricts academia's ability to fill the education and training needs of the geomatics industry.

Interaction and understanding are first steps but the process has to go further. The geomatics private sector must help academia make the case for resources and flexible education and training objectives, particularly as the demand for continuing education and retraining increases.

VI. GOVERNMENT INITIATIVES AND THE PRIVATE SECTOR

A. INTRODUCTION

Provincial governments have begun setting up various mechanisms for developing and using geographic information, and these have spawned a substantial number of geomatics projects. Several provincial initiatives are having an affect on the geomatics private sector and the way it does business. While there are many different provincial programs throughout Canada, a select handful has the potential to actually change relationships between the private sector and its clients.

- New Brunswick and Saskatchewan have both created crown corporations that are expected to pay their way by offering services to data base users.

- Ontario's Teranet government-industry partnership will foster a strong local business sector that will work as a team with government on the POLARIS project and on selling this experience on the international market.

- Manitoba is reviewing the advantages of forming a government-business partnership to create a world-class GIS-based Land Related Information System.

- Alberta has established Land Information Alberta as a business entity within the province's LRIS network to market land data and geomatics services to private users.

- British Columbia's CLISP project made it possible for local business to introduce state-of-the art geomatics systems and develop expertise in data base construction and management.

This consolidation of GIS on a regional basis has prepared the way for the next stage of the technology's use. As the major creators and users of GIS data bases, governments are now needing to manage their GIS data bases and applications, and the private sector has a strong history of supplying these services to government under contract. However, it is not clear what role the private sector will have in the management and marketing of information from government data bases. The Teranet/POLARIS agreement may provide the industry with a good model of a private sector/government partnership.

The next generation of value-added products from government GIS data bases ideally can and should be developed and marketed by the private sector. However, such an ideal may not be reached since public sector managers are being pressured to develop products that will generate or enhance revenues through a cost-recovery approach to geomatics projects. Two issues must be explored in tandem by the public and private sectors:

1. The role of the geomatics private sector in the management and marketing of information from government data bases.

2. The private sector's concern that governments will develop and market value-added products, thereby depriving the private sector of domestic and export opportunities.

B. NEW BRUNSWICK GEOGRAPHIC INFORMATION CORPORATION

1. PURPOSE

The New Brunswick Geographic Information Corporation was established in 1989 by the Government of New Brunswick as a result of a major policy review of the collection, storage and dissemination of geographic information. The Corporation is responsible for effectively managing geographic information in support of economic development and is also expected to be financially self-sufficient. Ongoing Corporation activities that involve land registry and assessment consume a large part of the budget.

2. METHOD OF OPERATION

Because the Corporation is expected to pay its own way, priority is given to projects that generate revenues or save money. These revenues are then used to finance the development of other types of information that are essential to fill the resource and environmental management needs of the Province.

Other projects, such as urban mapping and the maintenance of the topographic mapping data base, require that the responsibilities and costs be shared among provincial government departments, municipalities, and utilities.

3. RELATIONSHIPS WITH PRIVATE SECTOR

The Corporation uses private sector partners or sub-contractors as much as possible on projects and for development activities. A significant result of this involvement is the access that it

provides to data bases, giving the private sector an excellent opportunity to develop value-added products. In addition, the private sector will be in a good position to market and export the expertise gained by working on systems for the Corporation.

C. TERANET LAND INFORMATION SERVICES INC. (ONTARIO)

1. GOVERNMENT - PRIVATE SECTOR PARTNERSHIP

In February of 1991 the Government of Ontario announced a partnership with Real/Data Ontario Inc. to produce a land-related information system. The partnership resulted in the formation of a jointly-owned company called Teranet Land Information Services Inc. charged with implementing the province-wide land information system and developing an internationally competitive land-information service.

The agreement specifies that the province owns the land information and that Real/Data is licensed to provide access to the data for users for ten years. Teranet will have a thirteen-member board of directors, five members to be appointed by the two partners jointly and four members to be appointed by each of the partners.

2. POLARIS PROJECT

The Province of Ontario Land Registration and Information System (POLARIS) forms the basis for the Teranet agreement. POLARIS consists of two computerized data bases, the Title Index Data Base and the Property Mapping Data Base. The Title Index Data Base is a computerized land registration index organized by property ownership. Information is accessible through on-line terminals by property identification number, address, and owner's name. The Property Mapping Data Base displays property maps, boundaries, and unique property identification numbers. While the original plan allowed fifteen years for completion of total provincial coverage, the time has been shortened to eight years.

The alliance between industry and government established by Teranet is designed to

- improve information products and services,
- accelerate the implementation of POLARIS and improve its usefulness,
- provide cost-recovery market access to government data bases, and
- improve Ontario industry's competitiveness at home and abroad.

3.. THE TERANET MODEL

All levels of government are establishing mechanisms to manage their GIS data bases and applications. Firms that supply the GIS systems and those that produce the data bases have supplied much of these services to government under contract. Now, as government data bases near completion, the need for service will shift to GIS applications, systems software, and updating. The private sector, however, is not clear about the role it will play in managing and marketing information from government data bases.

In light of these uncertainties, the Teranet/POLARIS agreement will provide both the public and private sector with an excellent potential model for the operation of an industry/government partnership.

D. LAND AND RESOURCE INFORMATION BRANCH (ONTARIO)

In an initiative separate from Teranet, the government of Ontario reorganized many of the provincial resource data bases under professional geomatics management.

1. THE CHANGING MANDATE

The mandate of the Surveying, Mapping and Remote Sensing Branch in the Ontario Government was expanded recently to include the management of Ontario's natural resources data base inventory. Included are the Forest Management Information System, the Ontario Fisheries Information System, the Natural Heritage Information System, and the Ontario Land Inventory. To more accurately reflect the Branch's work in surveying, mapping, remote sensing, and resource inventories, the branch's name has been changed to the Land and Resource Information Branch.

2. A NEW MODEL OF GEOMATICS IN GOVERNMENT

The Branch's mandate is to ensure the integrity, production, integration, and availability of information on Ontario's land mass and resources. To fulfill that mandate, the Branch will establish data-capture standards, guidelines, and methodologies as well as administer and manage the land and resource data bases. Furthermore, the creation of many of these data bases will require the Branch to enter into partnerships with other organizations, ministries, and the private sector.

This mandate forms a new and complete model of geomatics in government since it embraces all the geomatics functions, from creating standards and providing consulting through to servicing end users.

E. MANITOBA LAND RELATED INFORMATION SYSTEM

The Manitoba Land Related Information System (MLRIS) is a coordinated approach to developing and managing a province-wide computerized data base of land-related information for use by the public and private sectors.

1. STRATEGIC PARTNERSHIP

While the MLRIS development is currently under review by the Manitoba government, it would be driven as a strategic partnership of six members if launched as it is now perceived: LINNET Graphics International Inc. as the private sector manager and developer of the infrastructure, and the Province, the City of Winnipeg, Manitoba Hydro, Manitoba Telephone System, and Centre Gas as the users. This effort is a unique private sector initiative that deserves careful analysis and consideration.

2. LINNET PLAN OF OPERATION

The operating philosophy of the MLRIS holds that the cost of preparing reference mapping should be shared among its users. Preparation of a mapping package would only begin once 75% of the cost has been gathered through contracts with individual users to purchase the mapping. On the basis of those contracts, LINNET would then finance the mapping and manage its production. The original contract purchasers would then take delivery and become "foundation owners" of the data, entitled to royalties on its future sale.

The mapping would be produced as a corrected photo-base overlain by the cadastral map with digital terrain models. The control for the maps would be produced by Global Positioning System technology and the north and central parts of the Province would be mapped using SPOT satellite imagery.

3. INFORMATION UTILITY

As part of the strategic partnership, an Information Utility would be developed in stages. The cost of designing and building the data base structure and input/output systems would be financed by LINNET and its partners, offset by revenue generated from contracts between the Utility and the individual users.

Users would be responsible for the design and implementation of their data processing and analysis applications systems, while LINNET's role would encompass consulting on applications and system development and converting existing data.

F. LAND INFORMATION ALBERTA

Land Information Alberta (LIA) was established in September 1991 as a business entity to operate within Alberta's Land Related Information System (LRIS) Network. Financially it will operate within a Revolving Fund of Alberta Forestry, Lands and Wildlife rather than as a Crown Corporation.

1. BUSINESS ACTIVITIES

The principle business activities of LIA will be four-fold:

- marketing land-related information and services,
- brokering land-related information for government and the private sector,
- selling land-related information and services to customers,
- creating and selling interpreted data products and services.

To support these business activities, LIA will

- operate the LRIS Gateway system,
- provide technical support to data owners,
- provide technical and educational support to customers,
- facilitate telecommunications with the LRIS network.

2. COST RECOVERY

LIA will recover operating costs and fund LRIS development by placing a surcharge on the new products and services that will become available with the LRIS Network.

3. ORGANIZATION

LIA will be organized into two units - customer relations and corporate services- and will be headed by a Board of Directors consisting of senior executives from the provincial government, the private sector, and municipal governments.

G. CORPORATE LAND INFORMATION STRATEGIC PLAN (CLISP) FOR BRITISH COLUMBIA

1. PURPOSE AND OBJECTIVES

The province of British Columbia is developing a corporate approach to the management of its land related data through the Corporate Land Information Strategic Plan (CLISP). At the heart of this approach is the need to share its diverse data holdings for better response to cross-sectoral issues like integrated resource management and native land claims negotiations.

Because CLISP will address issues of sharing and integration, the project is being overseen by an inter-ministerial committee chaired by the Ministry of Lands and Parks. The project itself involves the development of a set of data management policies and procedures as well as the physical Land Information Infrastructure (LII) that will move all GIS data among an array of clients and users.

The subject data, moreover, is not restricted to topography or cadastre, or even graphic data for that matter, although the topographic and cadastral data sets have been recognized as corporate, cross-government sources. LII will move thematic resource and socio-economic data, attribute data, and graphic data in vector and raster forms that may be time-tagged. The LII is being designed to conform with the national Standard Archive and Interchange Format (SAIF). The topographic coverage is being developed under the Terrain Resource Information Management (TRIM) project.

2. PRIVATE SECTOR PARTICIPATION

MacDonald Dettwiler and Associates is the prime contractor on the LII project, and the $3 million contract will close with the delivery of the prototype by spring of 1993. The TRIM program is being delivered by some fifteen companies in two major consortiums and will cost a total of $72 million on completion in 1997.

3. ROLE OF BRITISH COLUMBIA GOVERNMENT

The role of British Columbia's government is to communicate its requirements as the client and then to coordinate the projects, ensuring that quality and accuracy standards are met. As the products are delivered, government ministries will gradually incorporate them into their business information systems.

4. GEOGRAPHIC INFORMATION TECHNOLOGY DEVELOPMENT PROGRAM

The Geographic Information Technology Development Program of the Federal Surveys, Mapping and Remote Sensing Sector has provided cost-sharing funds to TRIM for modest areas of the province where there is a mutual interest. The data is produced to a common standard for both federal and provincial programs.

5. OUTPUTS AND DELIVERABLES

The LII will provide an operational prototype of an on-line data access and delivery system to meet land related information requests. Eventually, LII will link about 1000 user-access terminals in government. TRIM will provide coverage of the entire province through some 7,000 map sheets with common accuracy and content standards in one homogenous map series.

H. COST RECOVERY TRENDS

1. FEDERAL POLICY

In the recent policy release entitled "External User Charges for Goods, Services, Property, Rights and Privileges" the Federal Treasury Board stated that this government policy related to three of its objectives:

1. Fairness in shifting the burden from taxpayers generally to those who benefit most;

2. Improved management of resources by introducing a degree of market-type discipline;

3. Deficit reduction.

The paper goes on to say "while most government services generate broad public benefits, many are provided primarily for the benefit of specific groups...." Incentives will be offered to

managers to implement the policy. Treasury Board does caution against broad-brush treatment and directs that a careful analysis be made of the cost recovery on program delivery, access to information, and additional administrative expenses.

2. CONCERNS OF PRIVATE SECTOR

As a general principle, the private sector supports recent actions taken by federal and some provincial governments to recover the cost of goods and services that benefit specific groups. However, this move to recover costs has caused some concern for both the private supplier and the user of geomatics products and services.

For instance, the decision in some regions only to survey and map areas for which there is a demand is viewed by the private sector as inefficient and costly, particularly since it will result in products of only limited use to others.

Business also worries that government managers, pressured to meet unrealistic program targets because of recent budget cuts, will look for revenue-generating activities in value-added product lines that have traditionally been the bread-and-butter of the private sector. Pressuring government managers to act like entrepreneurs will put them and governments in conflict with the private sector. Ideally, the next generation of value-added products created from government GIS data bases can and should be developed and marketed by the private sector. However, as public sector managers watch their bottom lines with a wary eye, such ideals will likely lose out to the reality of generating revenues to compensate for smaller budgets.

***Recommendation 2*: That the private sector closely monitor the implementation of government cost-recovery programs to ensure that public sector organizations only become involved in those value-added spatial information products and services that are in support of the private geomatics sector.**

3. COST RECOVERY FOR GOVERNMENT FACILITIES AND EXPERTISE

Many in the private sector would welcome the chance to use special capital equipment and/or expertise in government laboratories on a cost-for-service basis. For example, computer systems and software could be most efficiently evaluated at government facilities that have a number of these systems that can be compared.

A cost-recovery policy for the private sector's use of specialized government staff on complex technical contracts overseas would also be welcomed by business. If properly done, cost recovery could further foster the bridge-building necessary between government and the private sector as they form alliances in pursuit of foreign markets in geomatics.

***Recommendation 3*: That governments develop a cost-recovery policy that considers the private sector's need to use special facilities and skilled government staff on international projects and on major research and development projects in Canada.**

VII. RESEARCH AND DEVELOPMENT

A. RESEARCH AND DEVELOPMENT INVESTMENT

We are constantly reminded that Canada as an industrial nation spends too little on research and development and that our ability to compete in world markets is being weakened. Yet, for the period 1986 to 1990, over 60% of respondents reported R & D expenditures, and these investments, per respondent, averaged 6.5% of gross billings. Certain segments of the geomatics private sector, particularly the large high-technology companies, spend even larger amounts on R & D, well over the national average.

"Since Canada is perceived to be a leader in the field of both remote sensing and GIS technology, it is difficult for one to suggest that adequate research and development in the field of geomatics has not taken place. The real question one must ask is at what cost to the viability of these Canadian companies, has this research and development been undertaken?"

B. UNSOLICITED PROPOSAL PROGRAM

The federal Unsolicited Proposal (UP) Program was one of the most significant programs for helping industry with research and development. This program, however, was cancelled by the government last year.

The UP program was used extensively by geomatics companies during the 1980s and helped industry maintain its international leadership in geomatics systems and services. Discussions with the private sector have revealed that the UP Program is sorely missed in all parts of the country and by all groups of the geomatics private sector.

***Recommendation 4*: That the private sector make representations to the federal government for the reinstatement of the Unsolicited Proposal Program as one of the most significant programs for helping with research and development.**

"The loss of the unsolicited proposal fund from DSS was a major loss to geomatics."

C. RE-ASSESSING GOVERNMENT FUNDING POLICIES

As all levels of government reduce expenditures, the private sector worries that the funds for R & D will quickly dry up at a time when it is already struggling to maintain its world leadership and when the cost of development is skyrocketing. Moreover, those funds that are available seem to be directed to research rather than to the development of applications of research. The private sector believes that government considers applications development the role of the private sector and are thus reluctant to allocate funds to assist in this part of R & D. Since market success is determined by well-designed and researched applications, governments should review their policy of R & D assistance.

***Recommendation 5*: That governments review their policies on funding or assisting with funding for development and applications activities that are now seen as the responsibility of the private sector.**

> **"In all likelihood there is a need for more research and development but it should become more clearly focused. Current research and development appears to be focused on technology while not enough is done on real end user applications of the technology. More research and development is required which is focused on better determining user needs and good solutions rather than simply on the tools."**

D. MARKETING GOVERNMENT-FUNDED RESEARCH AND DEVELOPMENT

The private sector expressed concern during discussions that Canadian governments have not taken an active role in marketing the results of publicly-funded R & D conducted by the private sector. They pointed out that many R & D contracts with United States government agencies contain agreements that give the contractor the right to market the product to industry on completion of the contract.

While this sort of agreement does get included in contracts with Canadian governments from time to time, it is more the exception than the rule. Thus, much of publicly-funded R & D is not made available to the private sector or is delayed through formal channels, and this delay in technology transfer can render the results obsolete.

***Recommendation 6*: That when awarding contracts for geomatics technology development, governments consider the demonstrated ability to market the development in Canada and abroad as one of the conditions for awarding the contract.**

"There has not been adequate research and development in the geomatics field in Canada. More dedication from the private sector and from government is required. In addition, the culture must change as many agencies do not have the right mix of personnel to carry out and apply the necessary applied research and development."

E. GOVERNMENT-INDUSTRY ALLIANCES

The international competition is quite formidable for Canadian geomatic firms. Although research and development is being done in Canada, Canadian firms are competing with foreign companies that are supported by special tax concessions and government grants in developing geomatics products. As a result, Canadian companies are finding it very difficult to compete.

Much of the early work on GIS and remote sensing was carried out in Canada, and as a result Canada now has world-class capabilities in both systems hardware and software design. These capabilities, moreover, have provided Canada with an excellent position in world markets. To maintain that market share, though, new patterns of business-government alliances need to be considered so that a strong research and development foundation can be built to support the competitiveness of Canadian geomatics products and services.

"I would say that research and development in the field in Canada has been inadequate, partly due to the parochial attitudes of provincial governments. What we need is more cooperation between governments and more specialization in our educational institutions, so that meaningful research is shared, in a logical way, across Canada. There is currently too much concentration of research and development funding within each province, with the result that work being done in one institution may be duplicated in another."

VIII.MARKETS

A. INTRODUCTION

Of all the issues facing the private sector, the most pressing are the present state of the market place and determining where the best opportunities will be in the future.

The results of the questionnaires did give some broad indication of which geomatics markets are expected to grow most rapidly. However, those attending the regional meetings often expressed concern over trends in the domestic market and the problems of east-west trade barriers. As well, the private sector has indicated that it is worried about pressures in foreign markets exerted by geomatics industries sponsored by governments.

B. DOMESTIC MARKET TODAY

1. DIGITAL MAP PRODUCTS

In the past, traditional surveying and mapping have been sustained to a considerable degree by provincial and federal contracting-out policies. While this support has not been uniform across the country, these government programs have supplied a base work-load to the private sector and helped develop digital map products as a foundation for future GIS activity.

Over the last five years a gradual shift has occurred away from traditional surveying and mapping toward remote sensing and to spatial information management using GIS. The shift to GIS has especially changed the nature of the market. Uniquely Canadian (GIS) systems such as PAMAP, CARIS, SPANS, System 9, and so on were developed, while the private sector also established in-house data base production capacities large enough to meet the demand and provided the capital and trained staff. As a result, the Canadian geomatics industry boasts a world-class digital mapping capability.

2. CADASTRAL SURVEYING

a. Surveying Marketplace

Over the past decade the cadastral surveyor operating a small office in a local community has gone from feast to famine. During the real estate and construction boom of the mid-to-late 1980s, the cadastral surveyor was pressed to meet the demands of customers. Now, though, the recession has called a halt to real estate activity, and the cadastral surveyor is pressed to stay solvent. The surveyor's business woes can be largely attributed to an over-dependency on a

single industry -- real estate/construction. Many have realized this problem and have begun looking at GIS users, particularly municipal governments, as a potential market for their skills.

"Adoption of GIS technology by municipalities will create a demand for cadastral boundaries and title records to be computerized. GIAC members should ensure they are equipped with the skills to address the market."

b. Global Positioning System (GPS)

The introduction of Global Positioning System (GPS) technology has presented both opportunities for work and concern for market loss to the cadastral surveyor. On the one hand, as capital costs come down, GPS may prove to be very cost-competitive with conventional survey methods. On the other hand, GPS is not that complex to use, and traditional cadastral survey customers may choose to buy and use the GPS equipment themselves rather than purchase the service from the surveyor.

3. REMOTE SENSING MARKET

The Canadian market for remote sensing systems and software has reached maturity. The high performance turnkey systems bought in the early and middle 1980s are still in use and purchases are now limited to upgraded peripheral devices and applications software. Customers are also now seeking low-cost systems that require limited software to run on a PC.

4. BUY LOCAL PREFERENCE

One of the barriers in the domestic market is the "buy local" preference. For most of this century, cadastral surveying has been governed by provincial legislation, and this is unlikely to change. The practice of awarding surveying and mapping contacts, except those for the federal government, has followed the provincial pattern.

"Inter-provincial trade barriers are an impediment to market growth in Canada. It is very much easier for me to do business in the USA."

Local preference is seen by many as a just and fair procedure. If a company pays local taxes and has local employees, it is given preference providing its prices are reasonable. As a continuation of this local focus, the private sector is starting to form provincial geomatics associations.

The practice of using only local businesses limits growth as local markets are usually not large. It can also lead to duplication of skills, if not overcapacity, and hinders the development of strong companies outside the major metro areas in less populated areas where there is an insufficient market to sustain growth.

Recently, provincial governments have increased their support of local geomatics business so that they can enter the international market. This support is not direct, but rather works through alliances or out-sourcing on major provincial geomatics projects. All of these regional groups seem to be developing the same technology and applications, and as a result, will be competing for the same work in the international market.

It is possible to rationalize the formation of strong geomatics capabilities in the five regions of Canada for domestic service, but without some east-west inter-regional competition it may be difficult to produce "world-class" geomatics companies that can compete in the international markets. At the same time as there is reluctance to open up the Canadian market, foreign multi-national firms operating under the Canada/U.S. Free Trade Agreement will provide considerable competition in local markets.

Clearly, the reluctance to participate in east-west trade in Canada may work to the advantage of foreign firms and to the disadvantage of the Canadian geomatics industry.

C. DOMESTIC MARKET TRENDS

1. MARKET OPPORTUNITIES

a. Updating Digital Data Bases

As noted earlier, large provincial digital mapping programs are drawing to a close, and new programs are not likely. However, these data bases will require updating in future through digital scanning technology that will feed images collected by aircraft or satellite directly into the digital data base.

Updating techniques will become increasingly important, and developing an efficient and cost-effective updating system for digital data bases is a high priority for GIS managers. A successful system would also find a ready world-wide market.

b. GIS

i) GIS Markets

The Persian Gulf conflict was the first highly visible international test of GIS technology. Precise geographical information on the terrain and on the man-made infrastructure was hard-wired into missles and guided them to their targets with unerring accuracy. The use of advanced concepts of pattern recognition was also clearly demonstrated during this conflict.

The Gulf War put GIS on the world stage, and helped make many aware of the expanding GIS market. The possibilities of GIS technology are beginning to be realized, and the growth of a healthy market is certain. The first phase of GIS development, the construction of digital data bases, has produced huge quantities of data awaiting GIS processing. The second phase, turning that data into information, has just begun.

"I see tremendous opportunity in the overpowering requirements for more and better land information. Overwhelming public demand for participation in a comprehensive and reasoned resource allocation process, combined with technological evolution, will lead to growth opportunities for the industry."

The expansion of the GIS market, though, will challenge those Canadian geomatics firms now active and prominent in GIS to maintain their leadership in the technology.

ii) GIS Applications

Turning data into useful information will involve the private sector in the next GIS growth business, designing and building applications systems for particular users needs.

"The GIS technology is changing the nature of the market. There are many opportunities in the delivery of services related to GIS application development, plus continuing data acquisition and data conversion to the traditional market as well as to the new mass market."

This new trend in GIS markets, though, is creating conditions that the geomatics industry must address. A decade ago GIS was a sleeping technological giant tended by mappers, cartographers, and geographers. Now the giant is awake and getting the attention of many professionals that use data with location as an attribute. As a case in point, technical schools and

universities are reporting an overwhelming demand for GIS courses by professionals like lawyers, engineers, and architects who want to apply the technology to their work.

Because other professions are becoming involved in GIS, building specialized applications is seen as requiring an expert in GIS technology and the professional who is an expert in the attribute data used by the application. This requirement is a response to concerns over a lack of understanding about the reliability of data sets and inappropriate confidence in the final product. Too often people forget the adage "garbage in garbage out" and believe it to be "garbage in gospel out," showing a naive faith in the veracity of anything that comes from a computer. To offset these concerns, the GIS expert must play the lead role in all GIS data base construction as he or she brings the necessary skills and geographical understanding to the GIS process.

The need for GIS experts to develop good systems will increase, particularly as systems become easier to use and their price decreases. But the private sector must be aware that competition for the Canadian market will come from foreign companies, and that the competition is expected to increase above the already substantial level of market penetration. For those whose business is the application of GIS and other geomatics technologies, the future will likely be very bright but also highly competitive.

"Although Canadian based companies are well positioned in the geomatics sector, I believe that as technology expands, so will the opportunities for Canadian based companies to develop new products and services. If I looked for trends, I would expect the Canadian based companies will continue to develop application specific software rather than developing hardware."

iii) A GIS Caution

Throughout the regional meetings the main topic was geographic information systems (GIS). Organizations with data that has location as an attribute see GIS as a means of extracting useful information from this data. Those in surveying and mapping see GIS as a way of increasing their business activity. Still other groups in geomatics see GIS as a tool that has to be integrated as part of a delivery system.

Often the process of introducing GIS into an organization starts with an existing computer, followed by the purchase of an inexpensive software package and the start of the learning curve. This procedure has the advantage of keeping capital costs low at first. However, a serious GIS effort will find the technology expensive, time-consuming, and frequently redundant since it often produces information that is already known and gives an end product unlikely to meet the information requirements of the organization. The regional interviews clearly revealed concern that even well-established organizations should be making more effective use of GIS.

Those that were successful in making effective use of GIS have been able to treat it as part of a system, from data entry to the final use of the information for decision-making. This is not a straight-forward or easy process. The client cannot always define the decision-making process that will use the GIS data, and will instead simply express a wish to "make better use of existing data bases" and assume that GIS is the answer.

The need to correctly design and implement effective GIS is giving rise to a specialist group in GIS applications. They do not sell hardware or software, but rather consult with management to define an appropriate GIS for the organization. Those attending the regional discussions clearly stated that if an organization is serious about acquiring and using GIS, it would be very wise to hire the services of a GIS applications specialist.

While GIS is no doubt one of the expanding activities in geomatics, the initiative still lies with the clients; they own the data bases and are attempting to develop a strategy to turn the data into useful information. The business opportunities are just starting, and are not yet being fully realized. This became evident during discussions in which participants related instances of geomatics firms making major GIS hardware/software purchases only to find that there was little demand for the service. Other geomatics firms have used time and resources to develop GIS applications for specific clients, and contracts are beginning to appear.

c. Government Activities

i) Native Land Claims

One of the growing surveying activities in Canada is the demarcation of native land claims. The first phase of settling claims involves gathering reconnaissance levels of resource and demographic data to help form negotiating policy, and geomatics plays a major role in this. The second phase involves surveying and demarcating the boundary. Here again new geomatics technology will play a large part because conventional survey techniques will probably not be able to do the job within a reasonable time and cost. New technologies like GPS and satellite imaging will likely be integrated into an automated system for surveying land claims.

ii) Environmental Projects

The Federal Government has developed the Green Plan as a blueprint for cleaning up the Canadian environment, and monies and programs are starting to flow slowly from this initiative. The first goals of the Green Plan are clean air, water and land, all ideal projects for geomatics services.

Both government and business are moving to clean up the environment in coastal zones, on major water routes, and at major pollution sites. Recently a Request for Proposal was issued for GIS systems as part of a low-level radioactive-siting project with the federal government. Environment assessment projects will require the full range of geomatics services to build the

foundation for responsible environmental management.

> **"Governments are key recipients of geomatics services since they have a wide range of land related business functions. The best role the government can play is to have ongoing programs which generate a solid workload for industry rather than doing work inhouse. Other markets will be developed by industry if they have a solid base of profitable work at home."**

iii) Provincial and Municipal Markets

The need to turn large data bases into useful information is pressing for both provincial and municipal governments. Provincial governments are becoming increasingly active in geomatics projects as they continue to build data bases, develop applications, and develop various alliances and cost-recovery strategies. Municipal governments, who use a great deal of the data supplied by provincial data bases, are also beginning to use GIS as a tool for more effective government. Indeed, according to the questionnaire responses, the private sector views the provincial and municipal governments as the two markets that will grow most rapidly over the next five years. The federal government market, respondents said, would have the slowest growth. Yet, the private sector in the past has put more of its effort into cultivating the federal market than the provincial or municipal markets. The geomatics business community should re-assess its government marketing strategy and begin focusing attention on the growing provincial and municipal arenas.

***Recommendation 7*: That in response to expanding marketing opportunities with the provincial and municipal governments, the Geomatics Industry Association of Canada review its focus on federal geomatics programs.**

2. MARKET CONCERNS

a. Easy and Available Technology

The availability of relatively inexpensive digital mapping workstations puts mapping tools into the hands of traditional purchasers of mapping services. As mentioned above, GPS technology is also readily and easily available to the traditional buyers of cadastral surveying services. Traditional markets could erode even further as other professions adopt modern geomatics technology and find that they have a surplus capacity to sell. Although the effect that this trend will have on future markets is impossible to predict, technology is becoming easier to use and capital costs are falling, and many present day customers may become future producers of geomatics services.

"The expansion of the geomatics industry to include other technologies or services to other professions is quite obviously the way to expand our own horizons. But we must realize that those other industries and professionals are also looking for expansion to their horizons and our industry/services are their hunting ground. Moving into the realm of new services to new clients is the most risky but has potentially the greatest return."

As noted in the response to the questionnaires, many crown corporations and large publicly-held companies are developing in-house geomatics abilities rather than purchase the service from the geomatics private sector. Indeed, the percentage of budgets allocated to contracting out by this group is expected to decline over the next five years. This market deserves further examination with an eye to encouraging contracting-out as a viable choice for these large organizations.

Recommendation 8: **That the private sector explore ways of increasing the contracting-out work from crown corporations and public companies in utilities, energy, transportation, resources, telecommunications, and similar business.**

b. Waiting for the Phone to Ring

In Canada, professionals who advertise or seek to openly market their professional services are frowned upon. Lawyers, doctors, surveyors, and others wait for the phone to ring and for business to come to them. And as a result, large groups in the geomatics private sector, particularly surveyors, have not developed marketing skills. With increasing competition in the domestic market place, and with surveyors turning to other geomatics activities to broaden their business base, those traditional professionals must develop keener marketing skills in order to prosper.

D. FOREIGN MARKETS

1. INTRODUCTION

Foreign markets have been developed by a relatively small group in the geomatics private sector. Only 13.6% of private sector respondents reported foreign billings for the year 1985, and 22% reported foreign billings for 1990.

Discussions at regional meetings and private enquiries gave some insight into the state of foreign markets, despite traditional reluctance not to share valued market information.

2. CHANGING FOREIGN MARKETPLACE

The world market for geomatics has changed, and those markets funded by aid programs probably most of all. In the 1970s and 1980s there was still a demand for mapping and surveying as the basic foundation for development. This demand will lessen considerably through the 1990s as aid organizations change their strategy to concentrate on regional development projects with objectives like establishing irrigation, producing pure water, providing transportation, supplying food, and so on in which surveying and mapping are less important. This is an unfortunate trend since traditional surveying and mapping projects opened the door to other private sector firms on work in the host country. Fortunately, many nations still recognize the benefits of beginning aid programs with infrastructure surveys and map products.

***Recommendation 9*: That the private sector develop educational tools (seminars, publications, etc.) designed to explain the use and importance of geomatics to international development agencies such as the Canadian International Development Agency and the World Bank.**

3. INTERNATIONAL COMPETITION

The international geomatics market is being shaped by the support that governments give their geomatics industry. As examples, both the Swedish space agency and the French SPOT Image compete openly in the international geomatics market, and both are government sponsored and are given funding when necessary for product and market development. These and other government organizations have become formidable competitors, cutting into potential markets for Canadian geomatics products and services, particularly in Asia. Potential markets targeted as having good growth potential, notably the USA, the ASEAN nations, and Latin America including Mexico, are available to the Canadian private sector, but competition will still be strong from other nations.

> **"The major constraints in selling into the international market are not technological in that Canada and Canadian companies in the geomatics sector are perceived to offer state of the art solutions that can compete very well against products from around the world. The major constraint for Canadian companies is the ability to compete when market conditions are being driven by foreign aid programs, both commercial and military."**

The Canadian geomatics industry was a key player on the international scene until about 1980. Then during the 1980s Canadian companies began to face strong competition on almost every overseas project. Foreign industry became very competitive, particularly when sponsored by their governments and national aid organizations. Moreover, preference in many nations to deal

directly with other governments has also limited the access of the Canadian geomatics industry to overseas markets.

***Recommendation 10*: That the industry negotiate agreements with federal and provincial agencies that have overseas posts, to become the focus for government-to-government requests for geomatics expertise, products, and training.**

4. EASTERN EUROPE OPPORTUNITIES

The recent move to a market economy by the USSR and countries in eastern Europe has created the need for the demarcation of private land holdings for the first time in decades. There is a great potential market for an effective and efficient cadastral system of land tenure. The main difficulty at this time is the lack of hard currency to pay for the service; barter may be the answer.

5. ROLE OF GOVERNMENTS

Relatively new companies with new products find it difficult to enter the international market unless the worth of the technology has first been proved in Canada. Governments should provide contract opportunities to develop applications of new technology in Canada and thus demonstrate to overseas customers the capabilities of both the new products and the geomatics firm. Government involvement in testing and proving new technology is particularly important to the development of GIS applications.

"Governments can help in many ways. They can showcase Canadian technologies and serve as a window on the marketplace (though international travel and consulting/advice). They can help identify and then secure development bank contracts."

6. THE PRIVATE SECTOR APPROACH TO FOREIGN MARKETS

The private sector should re-examine its approach to the foreign market place. Smaller companies find it exceedingly difficult to compete, even when in partnership with other firms for a particular project. Much of the problem lies with the dedicated, full-time effort that it takes to develop foreign markets, a sustained push that small firms cannot manage. Marketing skills must be acquired, foreign languages and cultures must be learned, financial structures must be established, and government aid must be sought and maintained. While independent initiatives will continue to bring results, small organizations will be at a huge disadvantage in sustaining market share in the face of competition from large integrated firms.

"It is not good enough today to have a technologically superior product! In order to sell into the international market, companies must understand the country culture, the country political situation, be prepared to market your products against foreign Government intervention, and accept the fact that your marketing thrusts may be circumvented by a foreign aid program or total grant of some sort."

Industry should re-think its internal relationships as well as its relationship with governments. New alliances need to be formed and new innovative financing and taxing arrangements should be explored. The recent partnership between the government of Ontario and Real/Data Ontario Inc. on the POLARIS Project is a good example of a government-industry alliance.

"Too often there is dialogue with industry *after* government has decided what they will do, and generally that focus is not on geographic locations that badly need our services to assist in survival, but in places flooded with competition ...."

***Recommendation 11*: That the private sector re-examine its options for forming alliances in order to develop international markets.**

"Another aspect of federal and provincial jurisdictions is the sometimes overlapping trade promotion activities by the two levels of government. GIAC should coordinate all international trade initiatives by federal and provincial governments and should take a leading role in directing government efforts."

E. CANADA - USA FREE TRADE AND THE NORTH AMERICAN FREE TRADE TALKS

1. THE US MARKET STUDY

The US Market Study prepared by the Cabot and DPA Groups for the Geomatics Industry Association of Canada showed that the geomatics market in the US is large and growing and that there are real opportunities for Canadian firms. Target areas to consider are the 39,000 local governments with jurisdictions containing average populations of 50,000. The study estimated that less than 10% of the medium and large local governments in America were using GIS technology. There are particular opportunities as well with county governments that need to

modernize parcel land record/registry systems, a task for which Canadian firms have developed unique expertise.

Canadian firms have excellent experience in large digital mapping contracts in Canada and abroad, and they should be able to compete favourably on price and technology with American firms for US federal mapping, electronic charting, hydrographic survey, and thematic mapping contracts.

The study pointed out that there are many large scale multi-year GIS projects underway for utility organizations (communications, electric, and gas) that view GIS as a cost-effective way of managing aging infrastructures. These projects should be considered as prime market targets for Canadian geomatics expertise.

2. MARKETING TO AMERICAN GOVERNMENTS

It takes time to develop the US government market. From the time the first contact is made to the first contract may take two years. Companies can find out what agency is buying their products by reading *Commerce Business Daily* and *Commerce Business Weekly*.. These publications show all proposed procurements above $25,000. Canadian firms contemplating sales to the US federal government should also study the Canada/US Free Trade Agreement and the regulations that govern purchasing, such as the US Federal Acquisition Regulations and the Buy America Act.

In the local government market, Canadian companies have successfully established working relationships with local geomatics firms or those in other businesses, such as consulting engineers, who are active in the market. By developing business alliances, Canadian companies not only gain access to the US market but possibly international markets as well .

Estimates show that less than 20% of export contracts in geomatics have been in the US. This export market is very competitive and is perceived as having parochial contracting practices. A number of Canadian companies in GIS, software, and remote sensing have made real market penetrations and others are set to follow. Interestingly, many companies find it is easier to participate in north-south trade than in the east-west domestic market.

3. NORTH AMERICAN FREE TRADE TALKS

The recent North American Free Trade Talks (NAFTA) have been watched with interest by the geomatics private sector. Mexico is well-equipped in the technology, has a well-trained staff, and considers geomatics a strategic activity. With the opening up of north-south trade, Mexico will be in a position to challenge Canadian geomatics expertise both in Canada and in the world markets. Rather than ignore this new player, the private sector should respond by considering ways of opening up potential markets in Central and South America.

IX. HUMAN RESOURCES

A. INTRODUCTION

This section of the Task Force Report summarizes the findings of the Geomatics Human Resources Planning Study prepared by the Joint Industry Adjustment Committee with funding from Employment and Immigration Canada.

The Committee, chaired by Dr. John McLaughlin, worked closely with the Task Force and participated in the preparation of the questions on human resources contained in the questionnaires sent out to industry, the public sector, and to public companies and crown corporations. The returned questionnaires formed the basis of the Committee's report on human resources.

1. BACKGROUND

The geomatics community has long been concerned by the absence of a national strategy for human resource development. The demand for qualified staff has been growing as the use of geomatics has expanded, especially through GIS technology and the ever increasing number of digital data bases. At the same time, however, there has been a decline in enrolment and a termination, or at least a significant reduction, in some of the technician/technologist training programs.

2. FOCUS OF THE COMMITTEE

The purpose of the human resource study was three-fold:

- to conduct an industry-wide human resources survey;
- to assess the ability of existing education/training facilities to meet industry needs;
- to develop an industry consensus.

In defining "industry," the Committee agreed to include government agencies for the purposes of statistical gathering and problem definition but to differentiate clearly between the public and private sectors.

B. ISSUES

Estimates based on the survey results show that employment in the geomatics industry will grow by about 25% over the next decade and that most of this growth will be for positions requiring post-secondary education.

Respondents were concerned about the ability of the existing education system to produce graduates with the necessary training to meet future requirements, particularly computer literacy and an understanding of geomatics technologies. Other skills that respondents felt need greater emphasis included organizational skills like strategic planning and project management, as well as individual communication and leadership skills. Respondents also predicted that there will be considerable difficulty in replacing senior geomatics managers.

In an effort to offset deficiencies in education, the private sector is considering alternatives like in-house training and private training facilities. These two options are especially attractive now because of the availability of current staff knowledgeable enough to act as trainers and the ability to tailor the training to specific needs and to the "real world" environment.

Technicians, too, face a number of problems, not the least being their lack of recognition and status within the industry. Other issues of concern to the Canadian Association of Certified Survey Technicians and Technologists include the difficulty of attracting students to the college programs in geomatics and the general health of technician and technologist education in Canada. The urgency of these questions was reinforced by a Canadian Institute of Surveying and Mapping report, *Survey of the Current Status of Technician and Technologist Training in Canada*, that chronicles the difficulties colleges have in attracting students, the consequent cutbacks in staff and resources, and the curtailment of programs.

Interestingly, the problems besetting technicians in most other provinces do not appear to exist in Québec, where, the study reports, "technicians are well organized almost to the point of having their own union, which negotiates salaries, benefits and conditions for individual technicians."

C. EVOLUTION OF GEOMATICS EDUCATION - LAVAL UNIVERSITY EXPERIENCE

1. INTRODUCTION

Laval University, located in Québec City, was one of the leaders in making the transition from traditional survey education to the expanded concept of geomatics education. The result has been a major change in emphasis and in course content at Laval University. While other universities have also made changes, the redirection of Laval's courses toward geomatics marked a turning point in survey education in Canada, and a brief examination of these changes may help determine the future direction of geomatics education.

a. Background

The Laval University survey program began in 1907 and continued unchanged until the mid-1960s when it was reorganized to accommodate geodetic science, which was recognized as a distinct discipline by the Canadian scientific community. Likewise, rapid changes in the industry over the previous decade forced the university into a major re-evaluation and re-thinking of their program during the mid-1980s.

2. BUILDING A GEOMATICS PROFILE

Laval decided that the most objective way to re-evaluate the program was to build a profile of geomatics based on functions rather than on disciplines. Geomatics would thus be defined, not according to discipline or mere knowledge, but by the main functions that characterize the activities of a university graduate working in geomatics. The resulting profile consisted of seven main functions:

- data capture,
- data processing,
- data structuring and storage,
- data interpretation and analysis,
- data representation,
- data distribution,
- data management.

3. THE NEW STRUCTURE OF GEOMATICS EDUCATION

The sweeping re-evaluation of the survey program of Laval University clearly demonstrated that a major restructuring of the program was necessary. Three factors were used to define the new program:

1. The scientific disciplines that should be included in an undergraduate geomatics program (basic and specific formations);

2. The types of engineering and management activities that might be performed in practice;

3. The qualifications necessary for graduating students as determined by the needs study and from other studies.

The new program structure, implemented in 1986, consists of a Bachelor of Applied Sciences degree in geomatics that requires 112 credits and is based on a systemic approach that integrates the different disciplines that are related to the collection, processing, structuring, storing, analysis, and management of spatial data and the production of spatial information.

X. A LAST WORD

As noted earlier, the final recommendation made in the 1985 Report of the Task Force called for the Canadian Institute of Surveying to ensure that the other recommendations were carried out.

Since that report, the Geomatics Industry Association of Canada has been formed and has accepted the responsibility of speaking for "the business interests" of the private sector. Indeed, GIAC was created in response to recommendations from that seminal 1985 Report. Thus, it is fitting that this Report now call upon the Geomatics Industry Association of Canada to ensure that the recommendations made here are acted upon as well.

***Recommendation 12*: That the Geomatics Industry Association of Canada assume a leadership role in ensuring that the recommendations made in this report are acted upon.**

APPENDIX I

A. TASK FORCE ON THE SURVEYING & MAPPING INDUSTRY IN CANADA IMPLEMENTATION REPORT

In 1985, the Canadian Institute of Surveying and Mapping (CISM formerly CIS), formed a Task Force Implementation Committee to ensure that maximum benefit was derived from the Report of the Task force on the Surveying and Mapping Industry in Canada as soon as possible. Government, private industry, and professional associations were represented on the committee, chaired by W.D. Usher. The following specific tasks were assigned to the committee:

1. Monitor implementation of the Task Force Study recommendations;

2. Organize a meeting of industry leaders to discuss the creation of a Surveying and Mapping Consulting Association of Canada;

3. Organize a national conference on research and development;

4. Organize a national conference on export development.Three main thrusts represent the actions undertaken in response to the recommendations:

    a) The National Conference on the Economic Development of the Surveying and Mapping Industry was held on 12-13 December 1986, in Ottawa, and was sponsored by the Canadian Institute of Surveying and Mapping, with co-sponsorship from the National Advisory Committee on Control Surveys and the Canadian Association of Aerial Surveyors. The conference brought together leaders from industry, government and the educational institutions for the purpose of discussing national strategies that would contribute to the future growth and development of the Canadian surveying and mapping industry. The conference addressed recommendations dealing with the need to more effectively coordinate research and development initiatives, to explore new domestic market opportunities, and to develop new strategies for the export of the industry's services and expertise.

    b) CISM consulted surveying and mapping companies in preparation for the formation of the Surveying and Mapping Consulting Association of Canada, and proposed that the Canadian Association of Aerial

Surveyors form the embryo of such a consulting association.

c) Numerous letters were sent to provincial ministers of advanced education, heads of post secondary institutions and federal government agencies concerning the relevant recommendations.

Recommendation 1: That surveying and mapping firms should provide opportunities for management personnel to attend courses on business management.

It was decided that this recommendation should be referred to the new Surveying and Mapping Consulting Association of Canada, which is now the Geomatics Industry Association of Canada.

The Geomatics Industry Association of Canada (GIAC) is co-sponsoring, with the Canadian Institute of Surveying and Mapping and Employment and Immigration Canada, a Geomatics Human Resource Planning Study. One area of assessment that will be used to influence the management component of higher education programs is management skills required in the future.

Recommendation 2: That government allocate supplementary funding to surveying and mapping educational programs to enable educational institutions to cope with rapidly changing technology.

i) The President of CISM wrote to the appropriate ministers of advanced education, enclosing a copy of the report and drawing their attention to the relevant sections of the report.

ii) To our knowledge this has not been acted upon in any significant way except for a few rare cases of major equipment grants from NSERC.

Recommendation 3: That educational institutions make full use of advisory committees in the development of closer ties with industry with respect to (1) utilization of industry technical equipment and expertise on a part time basis for educational purposes, and (2) the development of on-the-job training and experience for educators in government surveying and mapping agencies and in private firms.

i) The President of CISM wrote to the appropriate heads of post secondary school educational programs, enclosing a copy of the report and drawing their attention to the relevant sections of the report.

ii) On-the-job training programs face major difficulties in times of recession. Most of these programs are currently reviewing their commitment to such training.

Recommendation 4: That educational institutions place greater emphasis on giving students a sound background in the development, management and utilization of information systems, and that curricula stress the integration of multiple sets of data into spatial information systems.

Refer to response to recommendation 3(i).

Educational institution curricula have been changed to emphasize information systems. Some institutions have re-oriented their total program around spatial information systems. Those educational institutions that have not changed have had a severe decline in enrolment or have closed their program. At the time of study (1985), there were 24 technical level educational institutions. In 1990, this number fell to 19.

Recommendation 5: That educational institutions place greater emphasis on the development of communication skills at both professional and technical levels.

Refer to response to recommendation 3(i).

Communication courses are offered as an option. Communication skills are emphasized as part of the total curricula eg. report writing.

Recommendation 6: That both the professional and technical curricula of educational institutions reflect the growing reality of a multi-disciplinary approach to surveying and mapping.

Refer to response to recommendation 3(i).

Universities and most colleges have implemented this approach. Those colleges that have not, have either deleted the program or are suffering from a severely declining enrolment.

Recommendation 7: That educational programs for surveying and mapping be revised to give more emphasis to the applied geography dimension, especially in providing some understanding of the information needed by resource managers and explaining how to disseminate and present this information effectively.

Refer to response to recommendation 3(i).

Recommendation 8: That federal and provincial government funding for research and development in the field of surveying and mapping be increased to 5 per cent of surveying and mapping budgets.

This was addressed at the National Conference on the Economic Development of the Surveying and Mapping Industry. Refer to response to Recommendation 10.

Recommendation 9: That the National Research Council establish a standing committee on research and development in surveying and mapping with representation from government, industry and education. The committee would be responsible for the identification of research and development priorities, for the co-ordination of research programs and for the development of standards for surveying and mapping and spatial information systems.

The CISM President wrote to the President of the National Research Council, enclosing a copy of the report and drawing attention to the respective recommendations. NRC has been restructured and no longer exercises such functions.

Recommendation 10: That a conference on research and development strategies for surveying and mapping be initiated and organized by the Canadian Institute of Surveying with participation by other organizations such as the Canadian Council of Land Surveyors, the Canadian Association of Aerial Surveyors, the Canadian Association of Hydrographic and Ocean Surveying Industries, the Canadian Hydrographers Association, the Canadian Cartographic Association, the National Advisory Committee on Control Surveys and Mapping, the Canadian Council on Surveying and Mapping, the universities and all government and private surveying and mapping research agencies.

A conference was held on 12-13 December 1986, in Ottawa, entitled the National Conference on the Economic Development of the Surveying and Mapping Industry, and sponsored by the Canadian Institute of Surveying and Mapping, with co-sponsorship from the National Advisory Committee on Control Surveys and Mapping, and the

Canadian Association of Aerial Surveyors. Proceedings were published for distribution and sale.

The conference brought together leaders from business, government and the educational institutions for the purpose of discussing national strategies to contribute to the future growth and development of the Canadian surveying and mapping industry. This conference was in direct response to recommendations in "Report of the Task Force on the Surveying and Mapping Industry", specifically those dealing with the need to coordinate research and development initiatives more effectively, to explore new domestic market opportunities, and to develop new strategies for the export of the private sector's services and expertise.

Recommendation 11: That governments, universities and industry, co-ordinated by the Canadian Institute of Surveying, jointly develop a strategy whereby the transfer of new technology could be achieved by moving people from one sector to another. The development of this strategy could be discussed at the proposed conference on research and development strategies (see Recommendation 10).

Discussed at the Conference on the Economic Development of the Surveying and Mapping Industry. See response to Recommendation 10.

Recommendation 12: That the surveying and mapping industry avail themselves of government sponsored research assistance programs such as the Industrial Research Assistance Program (IRAP) and the Program for Industry Laboratory Projects (PILP) administered by the Industry Development Office of the National Research Council.

Refer to response to Recommendation 1. CISM has also actively sought information on government-sponsored research assistance programs for industry, such as the Technology Outreach Program for coordinated research assistance to small surveying firms.

GIAC keeps its members informed of changes in existing government research assistance programs and new program initiatives through its monthly newsletter.

Recommendation 13: That curricula in university surveying and mapping programs reflect the need for the development of management skills for the high tech environment.

Refer to response to Recommendation 3(i). Management courses are offered as options.

Recommendation 14: That government agencies substantially increase the level of contracting out of surveying and mapping projects to the private sector.

Refer to response to Recommendation 1.

GIAC, formerly the Canadian Association of Aerial Surveyors (CAAS), has continually lobbied for increased contracting-out. These efforts have been rewarded with the recent reinstatement of Energy, Mines and Resources' (EMR) program of person-year conversions to contracting-out, which will result in an additional 150 person-years worth of contracting-out work by 1996-97. In addition, the association helped the mapping private sector in Ontario and British Columbia to establish contracting-out of the digital OBM and TRIM programs, respectively.

Recommendation 15: That governments and industry work together to develop revised contracting out procedures that are satisfactory to both parties and that will, in the longer term, be beneficial to both government and industry.

Refer to response to Recommendation 1.

GIAC has negotiated changes to EMR's contracting-out procedures for surveying services, including pre-qualification of contractors and more equitable risk sharing. Consortia arrangements have been negotiated by the mapping private sector in several provinces for completion of digital mapping programs, which have benefitted both the private sector and the government clients.

Recommendation 16: That governments clearly enunciate contracting out policies, and establish longer term (five years or more) surveying and mapping programs to enable industry to make the necessary commitments with respect to personnel and technical equipment.

Refer to response to Recommendation 1.

Although there has been little progress on the establishment of multi-year contract policies, many provincial governments have established long-term programs that have given business stronger assurances of continuing contract work.

Recommendation 17: That governments contract out substantially more of their research and development requirements to the private sector and to universities.

Refer to response to Recommendation 1. Otherwise, there has been little progress in this area.

Recommendation 18: That the surveying and mapping industry develop performance standards which members would be expected to conform to, and that a mechanism be established to ensure that these standards are enforced.

Refer to response to Recommendation 1.

The Association of Ontario Land Surveyors has opened its membership to practitioners in photogrammetry, geodesy, and hydrography, and several other associations are planning this type of expansion. L'ordre des arpenteurs-géometres du Quebec have had an expanded profession in place for many years. Performance standards will gradually be established as the number of non-cadastral members in these professional associations increases.

GIAC members adhere to a general code of business practice, but this does not extend to technical, or professional standards.

Recommendation 19: That the Ministry of State for Science and Technology conduct an evaluation of the Science and Technology contracting out policy which was enunciated in 1978, and that the policy be reaffirmed and fully implemented.

This was addressed at the national conference on the economic development of the surveying and mapping industry. Refer to response to Recommendation 10.

Recommendation 20: That the federal and provincial governments provide increased support to the industry in the development of the export market for surveying and mapping services.

Refer to response to Recommendation 1. Also, this was addressed at the National Conference on the Economic Development of the Surveying and Mapping Industry. Refer to response to Recommendation 10.

A Memorandum of Understanding was signed between GIAC and EMR in November, 1987 which covers, in addition to other topics, cooperation in the development of export markets. A number of joint initiatives have been undertaken, including an business-government proposal for a comprehensive training program to the Saudi Arabia Ministry of Defense and Aviation.

Provincial government agencies have become much more active in supporting industry's export development efforts. Programs at the provincial level are designed to complement the programs of federal agencies such as External Affairs and International Trade Canada (EAITC), the Export Development Corporation (EDC), and the Canadian Commercial Corporation (CCC).

Recommendation 21: That the surveying and mapping industry avail itself more of the funding available through the Program for Export Market Development (PEMD) to send executives as industry representatives to international trade symposia and on market identification trips.

Refer to response to Recommendation 1.

PEMD support is well-known to and used by geomatics exporting firms. GIAC is taking advantage of the broadened rules for support of trade association export initiatives. One GIAC application for support was approved in 1990 and another one in 1991.

Recommendation 22: That the member firms of the surveying and mapping industry communicate on a regular basis with sector specialists at the Department of Regional Industrial Expansion and with the geographical desk officers at the Department of External Affairs to keep them informed of their capacities and capabilities and their participation in projects both in Canada and abroad.

Refer to response to Recommendation 1. Also acted upon indirectly through CISM by targeting special publications concerning Canada's expertise.

External Affairs and International Trade Canada, Energy, Mines and Resources Canada, and GIAC have cooperated in the production of a colour marketing brochure entitled "Geomatics Sector Overview". This brochure will be used in conjunction with the recently established database of geomatics exporters, available in floppy diskette format, to promote Canada's geomatics expertise. These resources will be used by officers in Canada's foreign trade posts and will be distributed at international conferences and tradeshows.

Recommendation 23: That the Canadian Institute of Surveying invite representatives from industry, governments, and universities to participate in a seminar on the development of a national policy and a unified strategy for the export of surveying and mapping services.

Refer to response to Recommendation 1. Acted upon at the National Conference on Economic Development of the Surveying and Mapping Industry. See response to Recommendation 10. Also responded to by the Halifax seminar on free trade.

Recommendation 24: That the surveying and mapping industry co-operatively prepare a comprehensive directory of Canadian surveying and mapping companies which have the interest and capacity to participate in foreign markets. The directory should give a detailed description of each firm and should be distributed widely to trade commissioners, embassies, consulates and any other Canadian federal or provincial offices overseas.

Refer to response to Recommendation 1.

Refer to GIAC's response to Recommendation 22 as well. GIAC also publishes a Directory of Member Firms which is distributed to prospective clients of the industry in Canada and the US, and also to Canada's foreign trade posts.

Recommendation 25: That a National Administrative Centre for Surveying and Mapping be organized by the Canadian Institute of Surveying, with membership consisting of the CIS, CCLS, CAAS, CAHOSI, CHA, CCA, CACSTTO and any other surveying and mapping organization which might qualify for participation.

CISM spearheaded the creation of a National Administration Centre for Surveying and Mapping (NACSM). October 27, 1989 marked the beginning of the NACSM, which is a corporate type partnership between CISM, CCLS and ACLS, to deliver central services to the three constituent members. Other associations have been approached and have either declined to participate or are cautiously examining the option. Associations approached are GIAC (formerly CAAS), CHA, CCA, CACSTTO, CRSS, OICC, ACMLA and C-Q.

Recommendation 26: That those private sector firms that offer surveying and mapping services to the public form the Surveying and Mapping Consulting Association of Canada.

CISM consulted surveying and mapping companies in preparation for the formation of the surveying and mapping consulting association of Canada, and proposed that the Canadian Association of Aerial Surveyors form the embryo of such a consulting association.

In the Fall of 1987, the Canadian Association of Aerial Surveyors changed its name to the Geomatics Industry Association of Canada, and broadened its mandate to include all spatial information businesses. Membership has grown from 30 to 80 firms.

Recommendation 27: That the Canadian Institute of Surveying, the Canadian Council of Land Surveyors and the Canadian Association of Certified Survey Technicians and Technologies jointly explore mutually acceptable ways of making provisions for the official recognition of technicians and technologies.

The implementation committee requested that the Canadian Council of Land Surveyors take the lead role in initiating discussion on this recommendation.

CISM continues to officially recognize surveying and mapping technicians and technologists through the provision of scholarships to colleges, surveys and reports on national technicians and technologist education, recommendation on Employment and immigration occupational descriptions, etc.

A national strategy for geomatics human resources development will include the technician and technologist, specifically to formulate a strategy for implementation of uniform technical education minimal standards.

CCLS established a committee on technician and technologists. They have been reviewing education standards with the objective to ensure a smooth continuum for individuals who would like to change from the technician and technologist role to a licensed surveyor. They have agreed to support the concept of a standardized educational requirement at the technician level. As least one provincial association (AOLS) has promoted the use of a certified surveying technician and technologist to their members. Given the current climate between the professional and the technicians/technologists, exemplified by the legal court cases between associations, substantive headway has been gained.

Recommendation 28: That the Canadian Council on Surveying and Mapping should take a lead role in co-ordinating the development of spatial information systems and distributed information networks, and that it should give special attention to the need to develop standards for the exchange and effective utilization of spatial information.

CISM has spearheaded the annual national conference on geographical information systems which addresses the development of spatial information systems, distributed information networks, development of standards for exchange, etc.

Recommendation 29: That the private sector surveying and mapping firms focus their resources on the transition from their traditional role to one of more involvement in spatial information management.

Refer to response to Recommendation 1.

GIAC is promoting the concept of the private sector as a supplier and seller of "spatial information" products and services. There is considerable empirical evidence to suggest that the private sector as a whole is making this conceptual shift and transition.

Recommendation 30: That the Canadian Institute of Surveying take an active role in encouraging and assisting the surveying and mapping industry to become more involved in spatial information systems by publishing relevant papers, sponsoring seminars, organizing educational courses, and generally creating an awareness of the need to become involved.

CISM has

- organized or sponsored an annual national GIS conference (Ottawa), an annual GIS seminar (Toronto), bi-annual geomatics seminars (Montreal), branch seminars on automated data collection (eg. Edmonton);
- published proceedings of GIS conferences and seminars;
- published a special GIS issue of the *CISM Journal ACSGC* with a large distribution (10,000) nationally and internationally; and provided an award for the best GIS paper in the *CISM Journal ACSGC* (ACDS).

Recommendation 31: That universities and technical institutes review and revise their undergraduate and graduate programs to emphasize and focus on the objective of shifting the role of the surveying and mapping community to one consisting of the development, maintenance and management of spatial information systems.

Refer to response to Recommendation 3(i).

Recommendation 32: That universities and technical institutes develop courses on the development, maintenance and management of spatial information systems for practising surveyors and mappers in both the public and private sectors.

Refer to response to Recommendation 3(i).

Recommendation 33: That the Canadian Institute of Surveying assume responsibility for the development and co-ordination of continuing education programs in the science of spatial information management.

Refer to response to Recommendation 30. In addition, CISM representatives attend advisory boards of educational institutions.

Recommendation 34: That the Canadian Institute of Surveying assume a leadership role in ensuring that the recommendations in this report are acted upon.

Responded to through the accomplishments of individual recommendations.

APPENDIX II

SAMPLE SURVEY

Survey of Geomatics Industry

Geomatics is defined as "the field of scientific and engineering activities involved in the application of computer and communication technologies to the capture, storage, analysis, presentation, distribution and management of spatial information to support decision making." Throughout this questionnaire ***SERVICES*** *denotes resources used for the provision of geomatics services, and* ***EQUIPMENT/SOFTWARE*** *denotes resources used for the development and/or marketing of geomatics equipment or off-the-shelf software products.*

This survey is sponsored in part by Industry, Science and Technology Canada, and Employment and Immigration Canada.

All questionnaires should be mailed back directly to the survey company, Peat Marwick Stevenson & Kellogg. Your responses will be incorporated into aggregate statistical form, and your questionnaire will then be destroyed by the survey company. Only the aggregate statistical data will be released.

Access to the aggregate data is governed by the provisions of the Access to Information Act. This collection has been officially registered with Statistics Canada as registration number IST/IST-635-04159.

All participants in the survey will be mailed a copy of the survey results.

Please complete only one questionnaire for your entire organization, and return by ***April 12, 1991*** *in the accompanying self-addressed, postage-paid envelope to:*

Ms. Eva Tom
Peat Marwick Stevenson & Kellogg
Tower B, Place de Ville
112 Kent Street, 21st floor
Ottawa, Ontario
K1P 5W6

Telephone: (613) 787-3664
Fax: (613) 238 3698

Company Name: _____

Company Address: _____
(Street)

_____
(City)

_____
(Province/Postal Code)

Business Telephone: _____ Fax: _____

Contact Name: _____

Contact Title: _____

Ce questionnaire est aussi disponible en français.

Part I—General Information

1. Thinking of your company's overall geomatics business, please indicate the **primary** geomatics business activity, and indicate one or more **secondary** activities if your organization has major billings or budgets in other categories. *(Please circle only one response in the first column and as many responses as appropriate in the second column)*

	Primary	Secondary
Consulting (user needs analysis, product design, systems selection and implementation activities)	1	1
G.I.S. Data Base (creation, management and maintenance)	2	1
G.I.S. Applications (the use of G.I.S. to produce information products for different users, e.g., forestry, land use, environment, water resources, municipalities, etc.)	3	1
Surveying (land, geodetic, engineering, mining and geophysical (on land))	4	1
Hydrography (surveying and charting in water bodies)	5	1
Mapping (photogrammetry and cartography)	6	1
Remote Sensing (aerial photography, airborne and space imaging and photo/image interpretation and analysis)	7	1
Software Development/ Equipment Manufacture (all development and manufacturing activities related to geomatics technologies)	8	1
Education/Training (any activity related to developing new skills or abilities)	9	1
No secondary activity	NA	1

2. In which geographic area(s) do you have offices? *(Circle all that apply)*

Atlantic provinces	1
Québec	1
Ontario	1
Prairie provinces	1
British Columbia	1
Yukon/Northwest Territories	1
United States	1
Other Countries	1

3.a) What is the legal structure of your organization? *(Please circle one)*

Corporation	1
Partnership	2
Sole Proprietorship	3
Other *(please specify)* _____	4

3.b) How many years has your organization been in existence? *(Please specify number)*

Number of years in existence:_____

3.c) Approximately what percentage of your organization's gross billings is in geomatics services and equipment/software development and/or marketing? *(Please specify)*

% of business in geomatics :_____

4. For each of the following business activities in your organization, what level of growth do you forecast over the next five years? *(Please circle one for each)*

Services	Decrease	No Change	Increase	Not Applicable
a) Consulting	1	2	3	9
b) G.I.S. Data Base	1	2	3	9
c) G.I.S. Applications	1	2	3	9
d) Surveying	1	2	3	9
e) Hydrography	1	2	3	9
f) Mapping	1	2	3	9
g) Remote Sensing	1	2	3	9
h) Education/Training	1	2	3	9
Equipment/Software				
i) G.I.S.	1	2	3	9
j) Surveying	1	2	3	9
k) Hydrography	1	2	3	9
l) Mapping	1	2	3	9
m) Remote Sensing	1	2	3	9

5. In your opinion, what has been the impact of the Canada/United States Free Trade Agreement on your overall geomatics business activities? *(Circle one for each)*

	Negative	No Impact	Positive	No Opinion
a) Services	1	2	3	9
b) Equipment/Software sales	1	2	3	9

Part II—Human Resources Information

*In Part II, **employees** means all staff members of your organization, including permanent, temporary or project, and seasonal staff. If your organization is engaged in businesses other than geomatics, a proportional number of administrative staff are to be included.*

6. How many employees in your organization have been/will be engaged in geomatics during each of the following years (include administrative support staff)? *(Please specify number)*

		Number of Employees
a)	1989	_____
b)	1990	_____
c)	2000	_____

7. How many employees are currently working for your organization in each of the following regions? *(Please specify number)*

	Number of Employees
Atlantic provinces	_____
Québec	_____
Ontario	_____
Prairie provinces	_____
British Columbia	_____
Yukon /Northwest Territories	_____
United States	_____
Other countries	_____
Total	_____

8. How many employees currently working in geomatics have the following academic qualifications? Count the highest qualification only. *(Please specify number)*

Highest Qualification	Number of Employees
Graduate Studies	_____
Bachelor Degree	_____
Technologist Diploma	_____
High School Diploma	_____
Other *(please specify)*_____	_____

9. In 1990, how many employees worked for your organization in each of the following categories? Count each person only **once** in his/her main activity. *(Please specify number)*

	Management	Professional	Technical
Consulting	_____	_____	_____
G.I.S. Data Base	_____	_____	_____
G.I.S. Applications	_____	_____	_____
Surveying	_____	_____	_____
Hydrography	_____	_____	_____
Mapping	_____	_____	_____
Remote Sensing	_____	_____	_____
Software Development/Equipment Manufacture	_____	_____	_____
Education/Training	_____	_____	_____
Sub-total	_____	_____	_____
Total Management, Professional & Technical		_____	
Administrative staff in support of above		_____	
Grand Total		_____	

10. For each of the following business activities, do you expect the number of employees in your firm who work in geomatics to decrease, stay the same or increase over the next five years. *(Please circle one for each)*

		Decrease	Stay the Same	Increase	Not Applicable
a)	Consulting	1	2	3	9
b)	G.I.S. Data Base	1	2	3	9
c)	G.I.S. Applications	1	2	3	9
d)	Surveying	1	2	3	9
e)	Hydrography	1	2	3	9
f)	Mapping	1	2	3	9
g)	Remote Sensing	1	2	3	9
h)	Software Development/Equipment Manufacture	1	2	3	9
i)	Education/Training	1	2	3	9

11. Over the next five years, do you expect the ratio between the following types of your employees who work in geomatics to decrease, stay the same or increase? *(Please circle one for each)*

		Decrease	Stay the Same	Increase	No Opinion
a)	Management to Professional	1	2	3	9
b)	Professional to Technical	1	2	3	9
c)	Management to Technical	1	2	3	9

12. Over the last year, to what extent has your firm had **difficulty** in recruiting employees for geomatics-related positions? *(Please circle the appropriate number on a 7-point scale, where "1" refers to "no difficulty" and "7" refers to "very great difficulty")*

No Difficulty						**Very Great Difficulty**
1	2	3	4	5	6	7

13a) How many new geomatics employees did you hire in 1990? *(Please specify number)*

New geomatics employees hired in 1990: _____

13b) How many of these new employees were hired at entry-level positions, i.e., at the lowest level of each job classification category? *(Please specify number)*

New employees hired at entry-level in 1990: _____

13c) Of the new geomatics employees hired in 1990, where did they come from: *(Please specify number)*

Hired in 1990	**Number of Employees**
Directly from high school	_____
Directly from college/university	_____
From another firm	_____
From government	_____
From another country	_____
Other *(please specify)* _____	_____
Total	_____

13d) Would you say that a shortage of qualified geomatics workers caused you to hire **fewer** new workers in 1990 than you wanted?

Yes	1	
No	2	→ Go to Q.14
Not Sure/No Opinion	9	→ Go to Q.14

13e) How many more employees did you want to hire? *(Please specify number)*

Number of additional employees: _____

14. What percentage of your future employees will come from the following sources over the next five years? *(Please specify)*

Source	% of Future Employees
University	_____ %
Community college	_____ %
High school	_____ %
Other firms	_____ %
Apprenticeship program	_____ %
Other *(please specify)*_____	_____ %
Total	100 %

15a) Do you think the present education system can deliver the graduates with the **proper skills** to meet your future job requirements?

Yes	1
Partly	2
No	3

15b) Do you think the present educational system can deliver the **number** of skilled graduates to meet your future job requirements?

Yes	1
Partly	2
No	3

15c) **If you answered No or Partly to Q.15a) or 15b),** what alternative training options would you consider using and why? *(Circle all that apply and specify why)*

	Consider?	Please explain
In-house training	1	_____
		_____
Private sector training facility	1	_____
		_____
Import trained people from abroad	1	_____
		_____
Professional Associations	1	_____
		_____
Other *(please specify)* _____	1	_____
_____		_____

16. To what extent do you believe it is important in the long term for your **management and professional employees** to have skills in each of the following areas? *(Please circle one on a 7-point scale)*

Technical Skills	**Not At All Important**						**Very Important**	**No Opinion**
a) Computer operation	1	2	3	4	5	6	7	9
b) Trouble shooting, repair and maintenance, etc	1	2	3	4	5	6	7	9
c) System integration/ equipment configuration	1	2	3	4	5	6	7	9
d) Other *(please specify)* _____	1	2	3	4	5	6	7	9
_____								
Organizational Skills								
e) Entrepreneurial	1	2	3	4	5	6	7	9
f) Strategic planning	1	2	3	4	5	6	7	9
g) Operational planning	1	2	3	4	5	6	7	9
h) Supervisory	1	2	3	4	5	6	7	9
i) Project management	1	2	3	4	5	6	7	9
j) Marketing and sales	1	2	3	4	5	6	7	9
k) Financial management	1	2	3	4	5	6	7	9
l) Other *(please specify)* _____	1	2	3	4	5	6	7	9
_____								
Individual Skills								
m) Ability for teamwork	1	2	3	4	5	6	7	9
n) Communications: written, oral, listening skills	1	2	3	4	5	6	7	9
o) Logical thinking, problem solving	1	2	3	4	5	6	7	9
p) Motivational, leadership, interpersonal & group dynamic skills	1	2	3	4	5	6	7	9
q) Negotiating skills	1	2	3	4	5	6	7	9
r) Ability to learn	1	2	3	4	5	6	7	9
s) Other *(please specify)* _____	1	2	3	4	5	6	7	9
_____								

17. To what extent do you believe it is important in the long term for your **technical employees** to have skills in each of the following areas? *(Please circle one on a 7-point scale)*

Technical Skills	**Not At All Important**						**Very Important**	**No Opinion**
a) Computer operation	1	2	3	4	5	6	7	9
b) Trouble shooting, repair and maintenance, etc	1	2	3	4	5	6	7	9
c) System integration/ equipment configuration	1	2	3	4	5	6	7	9
d) Other *(please specify)* _____	1	2	3	4	5	6	7	9
_____								
Organizational Skills								
e) Entrepreneurial	1	2	3	4	5	6	7	9
f) Strategic planning	1	2	3	4	5	6	7	9
g) Operational planning	1	2	3	4	5	6	7	9
h) Supervisory	1	2	3	4	5	6	7	9
i) Project management	1	2	3	4	5	6	7	9
j) Marketing and sales	1	2	3	4	5	6	7	9
k) Financial management	1	2	3	4	5	6	7	9
l) Other *(please specify)* _____	1	2	3	4	5	6	7	9
_____								
Individual Skills								
m) Ability for teamwork	1	2	3	4	5	6	7	9
n) Communications: written, oral, listening skills	1	2	3	4	5	6	7	9
o) Logical thinking, problem solving	1	2	3	4	5	6	7	9
p) Motivational, leadership, interpersonal & group dynamic skills	1	2	3	4	5	6	7	9
q) Negotiating skills	1	2	3	4	5	6	7	9
r) Ability to learn	1	2	3	4	5	6	7	9
s) Other *(please specify)* _____	1	2	3	4	5	6	7	9
_____								

18. Looking to the long term, to what extent do you think your organization will have difficulty in finding replacements for your senior geomatics management personnel as they retire or leave your firm? *(Please circle the appropriate number on a 7-point scale, where "1" refers to "no difficulty" and "7" refers to "very great difficulty")*

No Difficulty						**Very Great Difficulty**
1	2	3	4	5	6	7

Part III Financial Information

19. On the basis of gross billings, what was the approximate percentage breakdown of your organization's geomatics activities in each of the following regions in your fiscal year ending in 1990? *(Please specify)*

Region	% of Gross Billings
Atlantic provinces	_____ %
Québec	_____ %
Ontario	_____ %
Prairie provinces	_____ %
British Columbia	_____ %
Yukon/Northwest Territories	_____ %
United States	_____ %
Other Countries	_____ %
Total	100 %

20. What approximate percentage of your organization's gross billings for geomatics products and services were/will be for **export** in your fiscal year ending in the following calender years? Note: include sales to CIDA. *(Please specify)*

		% of Gross Billings
a)	1985	_____ %
b)	1990	_____ %
c)	1995	_____ %

21. In your fiscal year ending in 1990, what was the approximate percentage of your organization's gross billings for geomatics activities in each of the following domestic and foreign markets? *(Please specify)*

Domestic Markets	**% of Gross Billings**
Federal government	_____ %
Provincial government	_____ %
Municipal and county government	_____ %
Resource development industry	_____ %
Environmental protection industry	_____ %
Utilities	_____ %
Housing/Real Estate	_____ %
Engineering/construction industry	_____ %
Private individuals	_____ %
Other *(please specify)* _____	_____ %
Sub-total	_____ %

Foreign Markets	
U.S. Government	_____ %
Foreign Government (non U.S.)	_____ %
Private - U.S.	_____ %
Private (non U.S.)	_____ %
Canadian International Development Agency (CIDA)	_____ %
Other Countries' Foreign Aid Agencies	_____ %
International Aid Organization (World Bank, ADB, UN, etc.)	_____ %
Other *(please specify)* _____	_____ %
Sub-total	_____ %
Total	**100 %**

22. Indicate in the first column all markets where growth for your business will occur in the next five years. In the second column indicate one domestic and one foreign market where the most rapid growth will occur.

Domestic Markets	**Growth in Next 5 Years**	**Most Rapid Growth**
Federal Government	1	1
Provincial Government	1	2
Municipal and County Government	1	3
Resource Development Industry	1	4
Environmental Protection Industry	1	5
Utilities	1	6
Housing/Real Estate	1	7
Engineering/Construction Industry	1	8
Private Individuals	1	9
Other *(please specify)* _____	1	0

Foreign Markets (including U.S.)	**Growth in Next 5 Years**	**Most Rapid Growth**
U.S. Government	1	1
Foreign Government (non U.S.)	1	2
Private - U.S.	1	3
Private (non U.S.)	1	4
Canadian International Development Agency (CIDA)	1	5
Other Countries' Foreign Aid Agencies	1	6
International Aid Organization (World Bank, ADB, UN, etc.)	1	7
Other *(please specify)* _____	1	8

23. Please give an estimate of the past and projected gross billings for geomatics services and the equipment/software sales for your fiscal year ending in the following calendar years. *(Please specify in thousands of dollars)*

		Services (000s)	**Equipment/Software (000s)**
d)	1989	$ _____	$ _____
e)	1990	$ _____	$ _____
f)	1991	$ _____	$ _____
g)	1993	$ _____	$ _____
h)	1995	$ _____	$ _____

24. For your fiscal year ending in 1990, please report estimated total gross billings (domestic and foreign combined) for your organization in each category of geomatics services and/or equipment/software sales. *(Please specify in thousands of dollars)*

	Services (000s)	Equipment/Software (000s)
Consulting	$ _____	NA
G.I.S. Data Base	$ _____	$ _____
G.I.S. Applications	$ _____	$ _____
Surveying	$ _____	$ _____
Hydrography	$ _____	$ _____
Mapping	$ _____	$ _____
Remote Sensing	$ _____	$ _____
Education/Training	$ _____	NA
Sub-total	$ _____	$ _____
Total Billings		$ _____

25. For each of the following periods, how do you assess your organization's past profitability, and its future profitability prospects? *(Please circle one on a 7-point scale)*

		Very Poor						Very Good	No Opinion
a)	1986-88	1	2	3	4	5	6	7	9
b)	1989-90	1	2	3	4	5	6	7	9
c)	1991-92	1	2	3	4	5	6	7	9
d)	1993-94	1	2	3	4	5	6	7	9
e)	1995-96	1	2	3	4	5	6	7	9

26. What was/will be the value of the **new** geomatics equipment/software (used for provision of services only, not inventory for sale) for your fiscal years ending in the following calendar years? *(Please specify in thousands of dollars)*

		New Geomatics Equipment/Software (000s)
a)	1989	$ _____
b)	1990	$ _____
c)	1991	$ _____
d)	1993	$ _____
e)	1995	$ _____

27. What is the current book value of all your organization's geomatics equipment/software (used for provision of services only, not inventory for sale)? *(Please specify in thousands of dollars)*

Current book value of geomatics equipment/software: $_____ (thousands)

28. What is the approximate current replacement value of your organization's geomatics equipment/software (used for provision of services only, not inventory for sale)? *(Please specify in thousands of dollars)*

Replacement value of geomatics equipment/software: $_____ (thousands)

29. What approximate percentage of gross billings has your organization invested and does it plan to invest in research and development? *(Please specify)*

		% of Gross Billings invested in R & D
a)	1986-1990	_____ %
b)	1991-1995	_____ %

30. How much liability insurance does your organization carry? *(Please circle one)*

Do not carry liability insurance	0
Less than $500,000	1
$500,000 - $1,000,000	2
$1,000,000 - $2,000,000	3
More than $2,000,000	4

31. How many days in total did your employees spend attending internal and external training courses/programs in 1990? *(Please specify number)*

Total number of days : _____

32a) If your organization is planning to expand its scope of activities (i.e., increased penetration of existing markets or movement into new business areas) during the next five years, which growth strategy(ies) will be used? *(Circle all that apply)*

No plans to expand	1
Increase in staff	1
Increase in equipment	1
Purchase of other companies	1
Mergers with other firms	1
Joint ventures with other firms	1
Other *(please specify)* _____	1

32b) How will future growth be financed? *(Circle all that apply)*

Equity	1
Cash Flow	1
Debt	1
Other *(please specify)* _____	1

_____

Thank you for your cooperation.
Please mail in the accompanying stamped, self-addressed envelope.