Canada

COMING TO GRIPS WITH CHANGE

A Report on the Canadian Consulting Engineering Industry

Government of Canada
Regional Industrial Expansion

Gouvernement du Canada
Expansion industrielle régionale

Coming To Grips With Change

A REPORT ON THE CANADIAN CONSULTING ENGINEERING INDUSTRY

PREPARED FOR THE

DEPARTMENT OF REGIONAL INDUSTRIAL EXPANSION

IN CO-OPERATION WITH THE

ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

BY

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Ms. A. Kristina Liljefors
Director General
Service Industries Branch
Regional Industrial Expansion
235 Queen Street
Ottawa, Ontario
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Dear Ms. Liljefors:

We are pleased to submit the results of our study on the consulting engineering industry in Canada. Before proceeding, we would first like to review the background of the study, discuss our approach to the work and outline the contents of the following report.

BACKGROUND OF THE STUDY

This is the third study which our firm has carried out on the consulting engineering industry in Canada. In 1978 and again in 1981 we carried out studies of the consulting engineering sector in Canada for the former Construction and Consulting Services Branch of the Department of Industry, Trade and Commerce along with the Association of Consulting Engineers of Canada. Each of these studies presented both an analytical profile and a qualitative assessment of the industry and its problems. The considerable changes which have occurred in the industry since 1981 and the recent publication of the results of the 1982 Statistics Canada survey of the industry, made this an appropriate time for a fresh look at the industry.

Our first two reports covered the general performance and prospects of the industry, highlighting key issues which needed to be addressed. With this study we examine the recurrent industry issues and in addition, we address some critical emerging issues for the industry:

- The impact of new technology
- Canadian competitiveness in the export market
- The potential for regional expansion.

OUR APPROACH

We first met with the Steering Committee set up for the study which consisted of representatives of the Association of Consulting Engineers of Canada and members of the Service Industries Branch. With this group we reviewed key issues, and interview guides for use in our interviews across the country.

During the course of the study we met with over 50 individuals in the consulting engineering community. We interviewed companies in twelve cities across the country including Vancouver, Edmonton, Calgary, Regina, Winnipeg, Toronto, Ottawa, Montreal, Fredericton, Moncton, Halifax, and St. John's, Newfoundland. The firms interviewed ranged from the industry's largest down to small one and two-man firms. A key component of these interviews was understanding what had happened to the consulting engineering industry since 1982 - the time of the Statistics Canada survey. We also met with some clients, both public and private, and key government representatives. For our examination of the international market, we travelled to Washington where we interviewed key people in the World Bank and the Inter-American Development Bank.

A major component of the study was the interpretation of the 1982 Statistics Canada survey. Once this data became available, we conducted an analysis, and augmented it with some special cross-tabulations. Reconciling this information with the interview results was a critical step in the interpretation of the data. In addition, given that we now have three surveys from Statistics Canada (1974, 1978, and 1982) we took the opportunity to review and rationalize some of the data in our earlier reports.

From this work, we believe we have developed a good understanding of the industry and its new and old problems. But one caution, the industry is a diverse and complex one with many issues. We have tried to address

the perspectives of the multiple audiences of this report - the Department of Regional Industrial Expansion, the Association of Consulting Engineers of Canada, and individual firms of all sizes. This naturally required much "balancing" of the content, and generalizations had to be made. Many of the issues could be in-depth studies by themselves, as we have noted in our conclusions.

OUTLINE OF THE REPORT

The following report contains four chapters and appendices.

1. An Industry in Transition briefly describes the industry, its place in the Canadian economy, and key changes which have occurred in the industry structure and performance since our last report as well as the impact of new technology.

2. The Domestic Market - Performance and Prospects examines the cyclical behavior of the domestic market highlighting the effects of the recession on the industry as a whole. The performance and prospects for the twelve basic sectors of the consulting engineering industry are discussed in detail.

3. The Export Market - Tough Challenges focusses on Canadian competitiveness abroad in the consulting engineering industry and reviews key changes in export activity by region, sector and funding sources.

4. Looking to the Future pulls together the key challenges facing the industry in the future, and discusses potential actions which might be taken by government, the industry and individual firms to meet these challenges.

In the appendices, we include a possible approach to the process of strategic planning which firms might find helpful. In addition we include a detailed breakdown of the 12 sectors of consulting engineering as defined by Statistics Canada.

* * * *

To conclude, we would like to thank the members of the Steering Committee for the study which included Chris Charette, Max Smith, John Wickes, and John Dauvergne from the Service Industries Branch and Colin Smallridge, Don Welch, Derek Holloway and Roger Pinault from ACEC. Their encouragement and constructive comments have been most helpful. In addition, we would like to thank the Merchandising and Services Division of Statistics Canada for their advice and cooperation. Finally, we appreciate the time and energy which the consulting engineering community took to meet with us in our interviews across the country.

This has been a most challenging and interesting assignment for us. We have appreciated the opportunity to continue our close involvement with the consulting engineering industry. We hope that our work will be of assistance to the industry in coming to grips with the changes it is undergoing.

Respectfully submitted,

Peter Barnard Associates

TABLE OF CONTENTS

EXECUTIVE SUMMARY

An Industry in Transition

1. Consulting engineering remains a large and important service sector in the Canadian economy. Fee income in 1984 is estimated at $2.1 billion, with total industry employment at 41,000. The industry contributes to the economy in a variety of ways: promoting economic efficiency, stimulating technological development and transfer, helping to generate export business for other sectors such as manufacturing and construction, and investing in human capital through skills development of its members.

2. The recession shook the industry and fee income declined. A long term growth trend was broken in 1982 and fees are estimated to have declined by 13 percent in the 1982-84 period. The domestic recession was the major factor, but a tougher export market also contributed to the industry's difficulties. However, there are signs that the industry has "bottomed out" and firms are cautiously optimistic in most parts of the country.

3. The structure of the industry has undergone a major change. The number of firms has increased considerably to 2,700 from the 1,700 range in 1980, reflecting the start-up of many new, smaller companies. At the other end of the spectrum, three firms - Lavalin, SNC and Monenco - each with billings over $100 million - are now more than twice the size of the next largest firms. Those most hurt by the recession have been the medium-sized and regional firms with fee incomes in the $1-10 million range.

4. Technology is having an impact on the industry in several ways. Firms use computers extensively for administration and for engineering analysis and data manipulation. Computer-aided drafting and design systems have been installed by some firms but, in general, the industry is awaiting more prosperous times before investing further. The industry, while having capabilities and interests, has not been actively involved in R & D but would like to see more opportunities in the future.

The Domestic Market

1. The early 1980's has been a seesaw experience. In the late 1970's and up to 1982 the industry enjoyed strong growth domestically, and there was a steady shift in the distribution of work towards western-based firms. Since 1982, overall domestic business has declined by 15 percent, and there has been a shift back to increased shares for firms based in Ontario and Quebec. Across the country, firms made substantial staff cuts and look forward to a return to profitability in the coming year, primarily due to lower overhead and improved productivity.

2. Overall outlook is for slower growth. Continued economic uncertainty coupled with anticipated reductions in government work point to slower growth for the rest of the 80's compared to the pre-1982 period. Estimates of real growth rates are, at best, half those of the earlier period.

3. Some sectors likely to fare better than others. Municipal, power, buildings and the resource-based sectors of agriculture, fisheries, forestry and mining have been declining in importance and real income levels. On the other hand, plant process is likely to be a good growth sector, along with smaller sectors such as air and seaports and telecommunications. The "miscellaneous" category should also continue to grow, as engineers extend their services into new fields.

The Export Situation

1. The industry's export performance has faltered. Export fee income for 1984 is estimated at $340 million, down in real terms since the late 1970's. The worldwide recession and greatly increased competition overseas are the main causes. The export picture from 1982 through 1984 has been mixed. Declines in 1982 and 1983 export fee income were followed by a relatively good year in 1984. While the "big three" firms are amongst the world's leading exporters of consulting engineering services and several other firms are active in the export field, the majority of Canada's total effort is in the hands of relatively few - perhaps a dozen or so firms.

2. However, there are some positive signs. Canada ranks fourth in the export of consulting engineering services to developing countries, behind the U.S., U.K. and France. Canadian firms' share of World Bank funded projects has more than doubled recently. As well, there are a large number of firms interested in export work.

3. The focus of export activity is shifting. Africa is now Canada's leading source of exports, followed by the United States. There are indications that Canada's market shares in the Middle East, the Far East, and Latin America are declining. Canadian firms have diversified the financing sources for their projects and are now less dependent on Canadian funds. Power, plant process, and resources based sectors continue to be the main export services.

4. Firms are facing major new competitive forces. Abroad, Canadians must cope with strong firms from other industrialized countries, often able to provide turnkey projects. Competitors from lesser developed countries (such as South Korea, India, Brazil and the Philippines) are providing lower cost services in many, less technically advanced fields. As well, there are increased pressures from world funding agencies to transfer a higher percentage of work to local firms in the underdeveloped countries. Finally a major potential irritant to the industry is the entry of other Canadian organizations into the export consulting field, including both crown and other corporations, public sector agencies, research institutes and universities.

5. There are tough challenges ahead. Engineers will have to compete harder in the future and respond to a wider variety of services being required overseas. Training, operation and maintenance, and more complete construction-related services including turnkey are important growth areas to which Canadian firms should respond, whether directly or through joint venture with other partners. Keeping up to date technologically, and continuing to innovate in financing will also be important.

Looking to the Future

1. Overall outlook is less encouraging than in the past. The key to consulting engineering industry growth is a healthy economy. Since the industry is predominantly a creature of capital investment, everything possible needs to be done to increase investment and remove disincentives. Even economic improvement, however, will not return the industry to rates of growth experienced in the 1970's. With predictions of generally slower growth rates, competition within the industry will increase, and firms will have to take steps to compete more effectively.

2. The new industry structure needs to be recognized in planning. Both government and association activities must accommodate an increasingly diverse industry with a wide range in types and sizes of firms, and in needs. Design of programs may need to be divided to accommodate both the very large and the very small firms.

3. Several steps should be taken to maximize the domestic opportunity. With difficult times ahead, now is the time for the industry to take conclusive action on a number of long-standing barriers to increased profitability and growth, by

   - Improving government contracting procedures to reduce burdens of present procurement practices, including more emphasis on ability and experience than on price

   - Carrying out an in-depth assessment of opportunities for increased contracting out by developing a defensible economic rationale, assessing the real extent of in-house work and then planning specific strategies for some target organizations

   - Collecting evidence of the extent of directly competitive work being done by crown corporations, government agencies and private industry, then working to reduce that competition at the same time as looking for opportunities to cooperate with these organizations in new service areas, including export

- Continuing efforts to develop capabilities for import replacement of consulting engineering services

- Taking steps to promote expansion of the consulting industry on a regional basis by agreeing on a national regional preference policy and building provisions for technology transfer to local firms into the terms of reference of main contractors.

4. The export challenge: Become number three in the world. Over the next five years Canadian firms should set their sights to move ahead of France to become the third ranked consulting engineering export country. In addition to more aggressive marketing, the industry will have to:

   - Increase expertise in emerging high demand services including training and technology appropriate to underdeveloped countries, the latter helped by increased federal R & D support

   - Continue to innovate in securing financing for projects in underdeveloped countries

   - Develop ways of working with the consulting arms of public and private organizations who have complementary strengths in pursuing export work

   - Work with government to reassess Canada's export strategy and supporting programs, assisted by a review of government support programs in key competing countries

   - Encourage the entrance of new firms into the export market, particularly those with specialties of value to the developing world.

5. Firms need to take steps to cope with cyclicality and uncertainty. These include the running of their businesses with minimum cost exposure and taking steps to improve productivity. The latter includes taking further steps to incorporate computer technology into the business, especially CADD, and beginning to focus on ways of making people more productive. Finally, now is the time

for a significant push by the profession into a greater participation in technological development, including R & D. Overall, firms need to adopt a more strategic approach to their businesses.

EXHIBIT 1.1

SERVICES AND SECTORS

Services	Sectors
1. Feasibility Studies	1. Municipal
2. Planning and Design Development	2. Buildings
3. Detailed Design	3. Petroleum and Natural Gas
4. Construction Supervision	4. Power
5. Project Management	5. Mining and Metallurgy
6. Engineering, Procurement and Construction Management (EPCM)	6. Plant Process
7. Turnkey/Design/Construct	7. Transportation
	8. Forestry, Agriculture and Fisheries
	9. Dams and Irrigation
	10. Air and Seaports
	11. Telecommunications
	12. Miscellaneous

1. AN INDUSTRY IN TRANSITION

The Canadian consulting engineering industry, like many other sectors of the Canadian economy, is undergoing a critical transition. The realities of slower growth, deficit budgeting, and the influences of modern technology are affecting capital investment projects and changing the volume and nature of services required from consulting engineers by their clients in government and industry. Other key sources of change have occurred including intensified competition internationally and intensified competition at home from other private and public sector bodies.

Although many characteristics of the consulting engineering industry remain constant since our earlier reports*, certain critical changes have occurred. Consulting engineering remains an important service sector in the Canadian economy. However the industry has undergone some important structural changes in the early 1980s. Long term growth trends have been broken, and new challenges have emerged, including how to deal with the impact of new technologies.

A DYNAMIC SERVICE SECTOR

The Canadian consulting engineering industry is composed of professional engineers in private practice whose main source of income is derived from the provision of engineering services. The range of services provided extend from the beginning to the end of a project cycle. Exhibit 1.1 illustrates the spectrum of services provided by the industry. The first five services shown in Exhibit 1.1 are the traditional services provided by most firms. Many firms have extended their services in recent years to provide a more complete range, adding services often more associated with the construction industry. Some now have significant EPCM services and growing business in design/construct/turnkey projects.

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* Peter Barnard Associates "Consulting Engineering in Canada - Towards A Strategy For The Industry" 1978; and "Consulting Engineering in Canada - An Update" 1981; both studies undertaken for Industry, Trade and Commerce, and the Association of Consulting Engineers of Canada.

Consulting engineers work in a broad range of resource-related and infrastructure-related projects. Statistics Canada has distinguished 12 basic sectors of consulting engineering. These are described in Exhibit 1.1 and a full description of the fields covered in the 12 sectors is included in the Appendices to this report.

The consulting engineering sector contributes directly and indirectly to the growth of the Canadian economy in a number of ways:

- Employs approximately 41,000, fees of $2.1 billion. Our estimate of total industry fees for 1984 is approximately $2.1 billion of which approximately $340 million comes from export work*. Employment across the industry is estimated at 41,000 including both professional and non-professional personnel. This employment figure also includes part-time and contract employees. From our interviews it is evident that the proportion of temporary employees to permanent is increasing rapidly - as firms tend to hire on contract to increase their flexibility.

- Stimulates technological development and transfer. The consulting engineering industry is a key national resource of technological and managerial skills. Through its role in the development of Canadian infrastructure and industry, this sector has facilitated innovation, rationalization, and the design and management of development. Increasingly, through their work in the international marketplace and across Canada, Canadian consulting engineers have increased their skills and knowledge base. This expertise has been transferred to the various regions across the country, and is also being transferred internationally as part of the consultants' export work.

- Invests in human capital. The consulting engineering industry differs significantly from other industries in its focus on human capital rather than physical or financial capital. The industry is both a major resource of human capital and a major training ground for the

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* See Explanatory Note 1 at end of this chapter.

development of skills. Its capital is primarily invested in its people rather than in other more traditional areas of capital investment - equipment, buildings, etc.

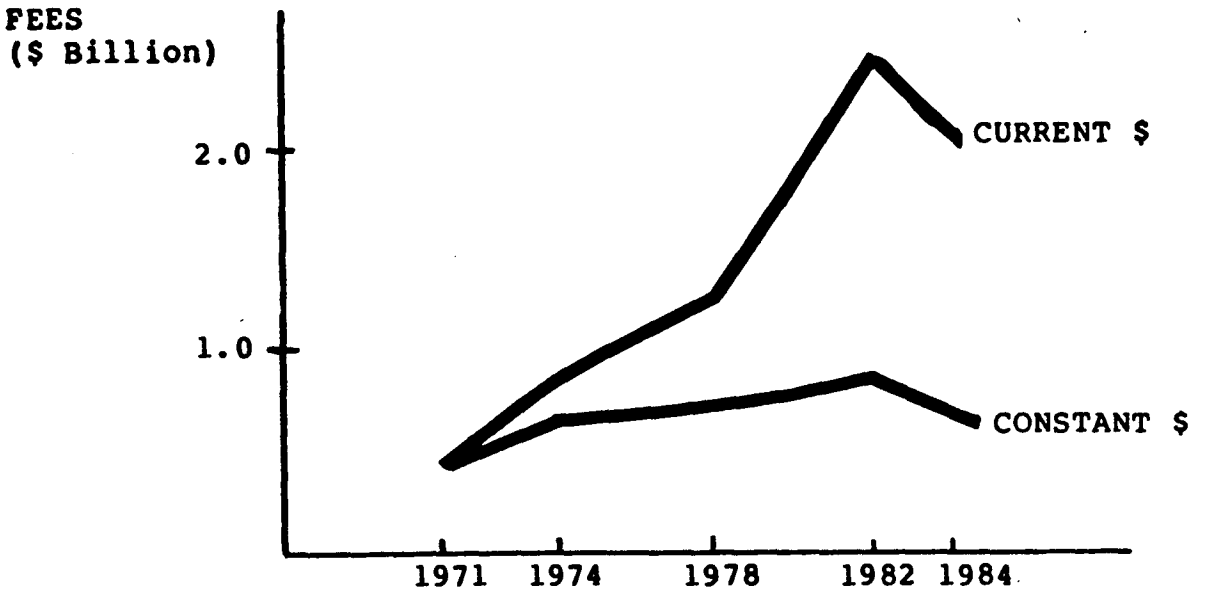
- Contributes to economic efficiency. Although no definitive studies have been undertaken, it is widely believed that contracting out for services connected with development of capital projects is more efficient for the economy as a whole than maintaining in-house capability. Particularly for organizations without a continuous stream of similar project work, the ability to use consulting engineering services decreases the need for in-house staff and generally improves access to the skills and experience needed to undertake the work. Engineers are also an important factor in the efficiency by which the economy expands through the efficiency of designs they prepare and their responsibilities during the construction phases.

- Generates business for other sectors. The export of consulting engineering services results in opportunities for follow-on sales for Canadian suppliers. Although the precise ratio of follow-on sales to the original consulting contract is difficult to determine, it is generally agreed that the multiplier will fall within the range of 2:1 to 10:1. The multiplier is affected by many factors such as the source of financing, the project location, and the Canadian capability in the particular equipment and materials required. Regardless of the precise multiplier, consulting engineers export services contribute to the country's balance of payments and aid both construction and manufacturing sectors.

In summary, the Canadian consulting engineering industry contributes to the economy in a variety of ways. By its role in capital projects, it directly affects the development of Canada's resources and its infrastructure and generates business for other sectors of the economy.

EXHIBIT 1.2

LONG TERM INDUSTRY GROWTH
TRENDS HAVE BEEN SHAKEN



	Estimated Industry Fees		Compound Annual Average Growth Rate	
	Current $M	Constant $M(1971)	Actual (ie. based on current $)	Real (ie. based on constant $)
1971	417 million	417		
			+27%	+16%
1974	850	644		
			+ 9%	+ 1%
1974	1220	664		
			+19%	+ 7%
1982	2430	880		
			- 7%	-11%
1984	2114	693		

Source: Figures derived from Statistics Canada sources and industry interviews - for further details see Explanatory Notes 1 and 2 at the end of this chapter.

GROWTH TRENDS SHAKEN DURING RECESSION

Almost since the Second World War, the consulting engineering industry has experienced what might be known as "growth without major adversity". Spurred by significant investment in industry, resource and energy development, the industry has grown from a very small number of firms to a large service sector. However, in the early 1980's the trend was reversed. From 1982 to 1984 the industry has gone through extremely difficult time.

Overall Decline In Fee Income

An examination of estimated industry fees in the late 1970's and early 1980's reveals a pattern of mixed growth. From 1978 to 1982 many firms grew and industry fees as a whole increased. Most firms were hit by the effects of the recession in late 1982. From 1982 to 1984 fee income dropped (Exhibit 1.2).

The drop in fee incomes is indicative of both the weak domestic market and intensified competition in the export field. In real terms the industry has dropped back to fee income levels similar to the mid 1970's.

Domestic Market Sluggish

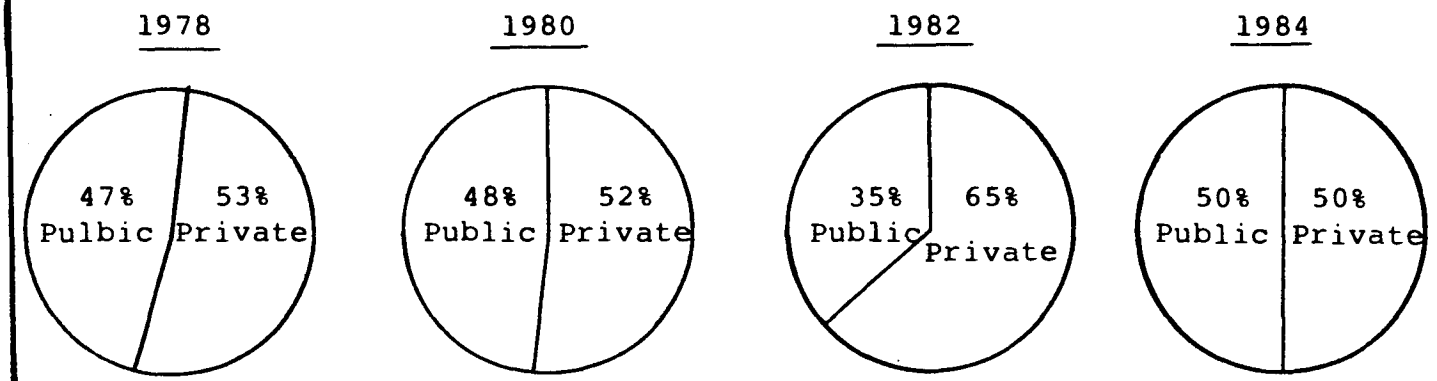
During the late 1970's and early 1980's, Canadian consulting engineers benefitted from a period of growth. Projects which had been delayed for various reasons came to fruition. Major capital investment was being undertaken in the western part of Canada due primarily to energy and resource-related projects.

In late 1982 the decline for the consulting engineering industry set in. From 1982 to 1984 consulting engineers suffered. Critical factors in the decline of the industry at this time were:

- Lack of private sector investment
- Government restraint toward capital projects
- Influence of the National Energy Program
- Excess capacity in certain sectors

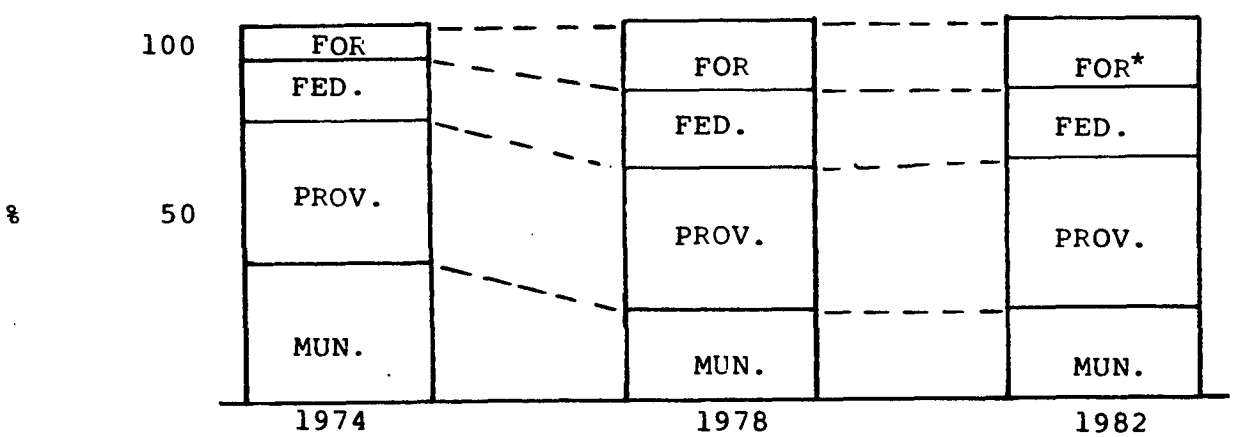
EXHIBIT 1.3

PUBLIC/PRIVATE WORK SPLIT



Source: Based on figures from Statistics Canada Surveys, 1978 and 1982. Figures for 1980 and 1984 based on industry interviews.

PUBLIC SECTOR CLIENT MIX



Source: Based on figures from Statistics Canada Survey 1974, 1978 and 1982.

* Includes Canadian and Foreign Government projects in foreign countries.

From our interviews with firms across the country, 1984 has generally brought the "bottoming-out" of the downturn started in 1982 and most firms are looking forward to better, although slower growth ahead. A detailed discussion of the domestic market trends and outlook is provided in Chapter 2.

Export Market Becoming Tougher

In recent years, the export market has been for some firms a source of growth and for others a means of maintaining their position in the industry during the domestic slump. However, some firms have also withdrawn from foreign activities due to the risks and costs involved, while others have experienced increased competition and a lower success rate in the international marketplace. Although the influence of changes in export fee income on total industry growth is relatively minor, a decline in the export market may be highly influential on the growth prospects of the largest firms as well as the highly specialized export-oriented firms.

The major factor influencing Canadian consulting engineering firms in the export market has been their relative competitiveness compared to the new entrants into the export market. These new competitors have included the consulting arms of public and private corporations, firms from lesser-developed countries, indigenous consulting firms in the host country and firms from other industrialized nations. A detailed analysis of the problems and propects in the export market is provided in Chapter 3.

Shifting Client Base Reflects Health of Economy

The client base of consulting engineers fluctuates over time in concert with the general state of the economy, investor confidence and public sector spending priorities.

1. Public sector work of increased importance since 1982. Until 1982 there was an overall increase in private sector work with minor fluctuations (see Exhibit 1.3). From 1980 to 1982 in particular there was a boom in private sector investment particularly in Western Canada. Our industry interviews then show signs of a major

drop-off in work for the private sector from 1982 to 1984. In many areas, public sector investment during this time became the major source of sustenance. Government investment programs such as Special Capital Recovery Projects were critical sources of fee income for consulting engineering firms.

2. Within public sector, relatively constant client mix. The client mix within the public sector has remained fairly constant since 1978. A slight increase in direct funding of projects by the provinces is more likely a result of redistribution of federal funds to the provinces than increased activity by the provinces themselves (see Exhibit 1.3).

INDUSTRY STRUCTURE UNDERGOING CHANGE

The changes occurring in the consulting engineering industry reflect the economic realities of the times. As with many other Canadian industries in recent years, the industry has been restructured by a variety of forces. At the top end of the industry there has been increased concentration, and at the same time there has been a proliferation of smaller firms.

In Total, Approximately 2,700 Firms

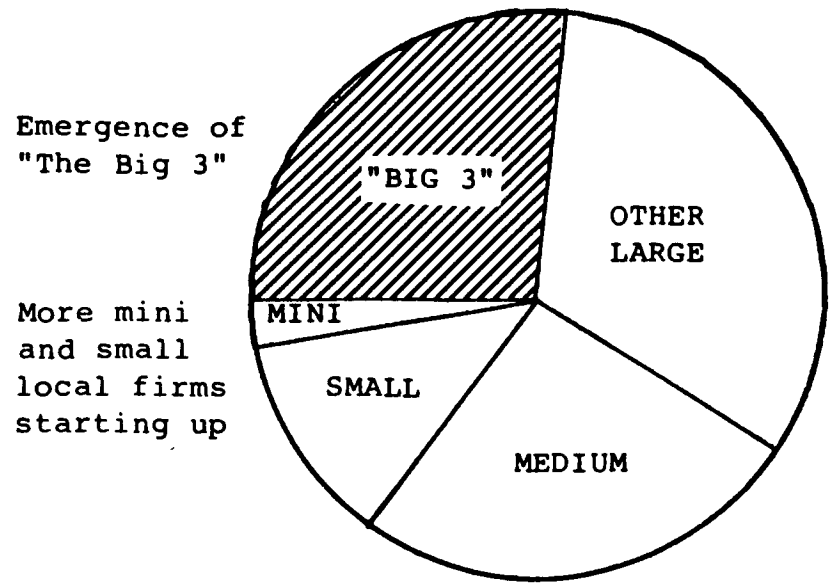
The number of firms in the industry has grown steadily over the years. The total of 2,700 firms estimated to be in the industry at present is substantially up from the total of 1,600 estimated in 1977 and 1,700 in 1980.

Consulting engineering firms range in size today from one-man operations to large corporations with more than 4,000 employees. Through the recession some firms laid off employees and retrenched, while others grew through diversification and acquisition. In our previous reports, we identified four basic types of firms:

- Large heavy engineering firms
- Medium-sized municipal/transportation firms
- Specialty firms
- Small local firms

EXHIBIT 1.4

AN INDUSTRY STRUCTURE IN TRANSITION



Note: Pie share based on approximate proportion of fee income in industry.

KEY CHARACTERISTICS OF FIRM TYPES

CHARACTERISTICS	MINI	SMALL	MEDIUM	LARGE	THE BIG 3
• Approximate number of firms	1,100	1,200	300	30	3
• Revenue	$100,000	$100,000-$999,000	$1-10 million	$10+ million	$100+ million
• Number of Employees	0-4	2-20	15-150	150+	4,000+
• Degree of specialization regionalization	Highly specialized or localized	Highly specialized or localized	Local diversified or national specialized	National diversified or specialized	National diversified
• Involvement in export	Unlikely	Unlikely	Varies	Varies	Considerable

Source: Statistics Canada Survey, 1982.

While these four types still exist in the industry today, we believe that it is important to separate out the "big three" in the industry - Lavalin, SNC and Monenco - as they have clearly separated themselves from the rest both in terms of employment and fee income. As a result, we have chosen to redesignate the firms into five basic types defined on the basis of fee income and employment. The five firm types and their share of the industry are illustrated in Exhibit 1.4.

Redistribution Among Larger Firm Groups

Perhaps the most significant trend in the evolving industry structure is that the biggest firms have grown bigger. Through acquisition, regionalization and diversification, Lavalin, SNC and Monenco have employment and fee income over twice the size of their nearest competitors. They have clearly become a new separate industry group, and, if anything have emerged stronger, but leaner from the recession.

The performance of the other large firms in the industry was quite mixed through the recession. Some large firms were particularly hard hit and have shrunk in size. The growth of firms in this category during this period was heavily influenced by their respective sectoral and regional specialization.

More Smaller Firms Starting Up

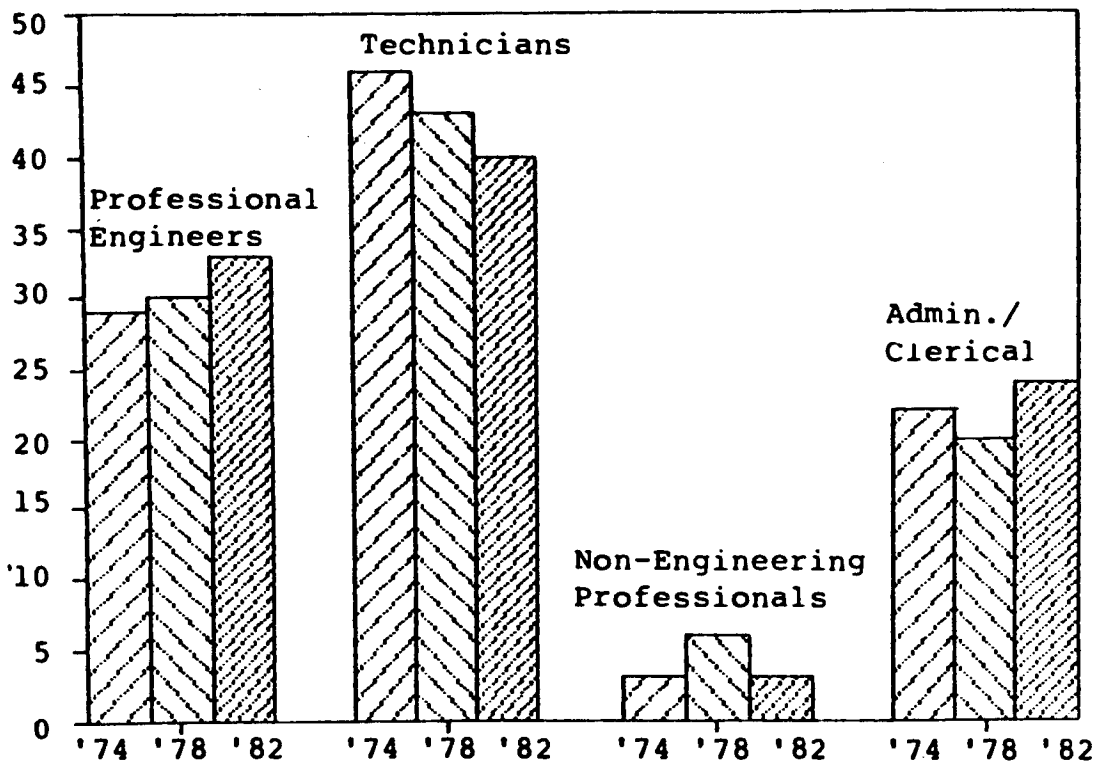
The proliferation of small firms observed across the country, in the 1982-84 period, is not so much a sign of growth as a sign of redistribution. Many of the individuals laid off from larger firms have gone out on their own. These firms tend to offer either highly specialized or highly localized low-cost services.

Another source of new small operations has been the tendency of larger firms to establish branch offices in various regions across the country. These small offices have been established in response to policies of provincial and municipal governments that favour local firms, and to be closer to other regional clientele.

EXHIBIT 1.5

STAFF MIX CHANGING

Professionals growing
at expense of technicians...



Source: Statistics Canada, Consulting Engineering Services 1974. Catalogue 63-528.

Statistics Canada, Engineering and Scientific Services, 1978. Catalogue 63-537.

Statistics Canada, Survey of the Offices of Architects and Consulting Engineers, 1982.

Many Medium-Sized and Regional Firms Having Difficulties

Depending on their regional or sectoral specialization, the medium-sized regional firms were amongst the hardest hit during the recession. Unlike the very large and very small firms, this group lacked the flexibility to respond to the changes brought about by the recession. The majority of these firms were in the municipal, buildings and transportation engineering fields.

Firm Employment Composition Changing

Within all firms, the professional/technical/administrative mix of personnel is changing. An examination of the breakdown of employment in 1974, 1978 and 1982 reveals a slight increase in the proportion of professionals (see Exhibit 1.5). Industry interviews indicated that increasingly technology and professionals are displacing technicians and in some cases, administrative staff. However, overall the administrative/clerical proportion of total employment has increased.

Professionals are "back on the boards" or "hands-on" the computer. According to members of the industry, this trend will probably continue for both productivity and cost reasons.

TECHNOLOGY HAVING AN IMPACT

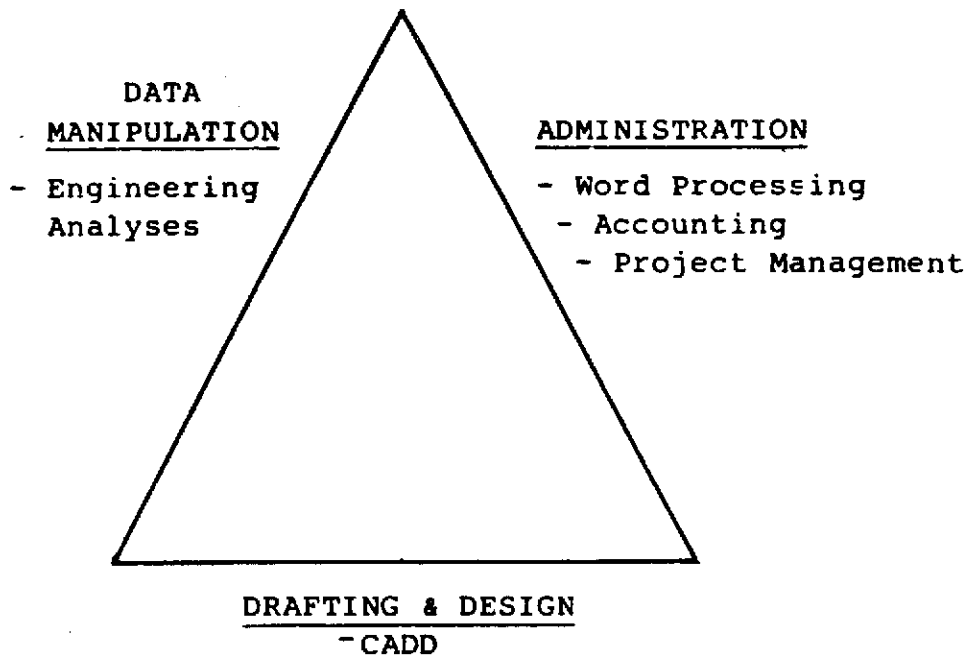
Another critical change which has influenced the development of consulting engineering in Canada in recent years and will continue to influence it, is the impact of technology. This is being felt in two ways:

- The influence of technology on engineering practice, i.e., how computers and other forms of high technology have affected the way consulting engineers practice.

- The influence of consulting engineers on technology, i.e., the way in which consulting engineers influence, through research and development the future of technology (both in research and application).

EXHIBIT 1.6

HOW COMPUTERS ARE USED IN ENGINEERING



Computers Exerting Major Influence

In talking to firms across the country it is evident that there are basically three ways that they use computers (see Exhibit 1.6):

- Administration
- Data manipulation
- Drafting and design.

The approach to computers and their application is by no means uniform in the consulting engineering industry. However, certain trends can be observed:

1. Widespread take-up of computers for administrative applications. From our interviews it appears that regardless of size, the vast majority of firms use word processing. In addition, an increasing proportion of firms use micro and mini computers for accounting and project management applications. Almost all firms interviewed indicated a significant potential for a relatively low-cost improvement in efficiency and productivity in the administrative area by using various types of computers and/or word processors.

2. Increasing emphasis on computerized data manipulation. A growing number of engineering professionals and technicians are "computer literate". It appears that in certain sectors computers have been used extensively for data manipulation. Firms reported significant increases in speed and flexibility over previous methods.

3. Cautious approach to CADD (Computer-Aided Drafting and Design). Many firms have spent considerable time in internal task forces investigating the potential for a full-blown CADD system. Many of those that have such a system experienced difficulties sustaining it during the downturn in business experienced from 1982 to 1984. In the last few years, fewer firms have opted for a major CADD system. CADD service bureaus and lower-priced, single, stand-alone work station systems offer alternatives to the consulting engineering industry. Increasingly, there seems to be a movement towards the use of low-cost micro terminals for special design and drafting applications.

Unrealized Potential in Research and Development

The influence of engineers on technological development has been relatively limited to date. The vast majority of research in engineering-related fields has been carried out by universities, government laboratories, non-profit research centres and private industry.

From our interviews, it is evident that few consulting engineers have the resources to perform research and development on their own account. Some firms do small-scale applied research in their specialized areas of expertise. A recent area of activity for many has been the development of software programs in their respective fields. These programs are seen as good marketing tools in a period of tough competition as well as new sources of revenue for some firms.

Industry members both individually and through the Association of Consulting Engineers of Canada have expressed concern about the lack of support for what is known as "need driven conceptualization":

> "In a very real sense, this is engineering research through which an idea, technique or design is tested against the perceived need by means of mock-ups, prototypes or other relatively inexpensive models of feasibility".*

Industry members feel that they have the technical, conceptual and business experience required to provide a major input to research and development. They also feel, however, that the required support for such activity has not been provided to date. Currently a major study is underway sponsored by the National Research Council and the ACEC on the role of consulting engineers in R & D. This study is expected to provide fresh insight and recommendations for new initiatives in this important field.

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* Association of Consulting Engineers of Canada (1983) Toward A Canadian Technology For The Information Era.

* * * *

Clearly, changes have occurred in the consulting engineering industry which must be recognized and dealt with effectively. But for industry members and for government a more in-depth knowledge of the domestic and export markets is required prior to the development of strategy. In the next two chapters we take a closer look at the performance and prospects within the individual markets, highlighting sectoral and regional strengths and weaknesses. We will have more to add on the subject of technology and R & D in Chapter 4.

EXPLANATORY NOTES

1. Industry fee income and total industry employment for 1982 and 1984 was determined as follows:

(i) Total Fee Income - 1982

GROUP A
- From 1982 Statistics Canada Survey
- 2,236 firms: $2,228,000,000

GROUP B
- From Revenue Canada information (requested by Statistics Canada)
- 221 firms : $106,700,000
- Assumptions for remaining non-respondents to survey.

An assumption had to be made to account for the remaining (i.e., after obtaining information from Revenue Canada) non-respondents. It was assumed that the firms categorized by Statistics Canada as "refusals" and "others" were, in fact, consulting engineering firms. In addition it was assumed arbitrarily that one quarter of the remaining non-respondents were consulting engineering firms.

GROUP C
40 refusals
57 others
94 (25 percent of remaining non-respondents)
191 Firms

An additional assumption had to be made regarding average fee income for the remaining non-respondents.

- Average fee income per firm for original firms surveyed = $996,422 (Group A)

- Average fee income per firm for firms obtained from Revenue Canada = $482,805 (Group B)

It was assumed that the lower average fee income per firm was likely representative of the remaining 191 firms. Therefore, the total fee income for Group C =

191 x $482,805 = $92,215,755

Therefore: Total Fee Income for Industry =

Group A	+	Group B	+	Group C
$2,228,000,000		$106,700,000		$92,215,755

= $2,426,915,755

Rounded off to the nearest $10 million

= $2,430,000,000 - 1982

(ii) Total Industry Employment

GROUP A

- From 1982 Statistics Canada Survey:

  2,236 firms: 39,352 paid employees

  Average fee income per employee

  = Total fee income for Group A / No. of employees in Group A

  = $56,617 per employee

GROUP B and C

- To determine the number of employees in groups B and C, the assumption regarding fee income per employee was applied to the total fee income of Groups B and C.

  Total Fee Income for for Group B and C = $198,915,755.

  Divided by average fee income per employee for Group A = $ 56,617

  = 3,513 employees

Therefore: Total Industry Employment =

Group A		Group B & C	
39,352	+	3,513	= 42,865 employees

Rounded off to the nearest hundred

= 42,900 employees 1982

(iii) Total Fee Income and Industry Employment, 1984

- From our interviews with firms across Canada, it is evident that 1982 was the peak in fee income and employment for most firms. Although it is difficult to be precise regarding the 1982 to 1984 picture, industry interviews indicate that on average, employment and fee income dropped by 15 percent across the industry during this period.

  In the absence of any other more reliable information, we have assumed that total industry fee income in 1984 is down 13 percent in current dollars (21 percent in real dollar terms).

  Therefore: Total Industry Fee Income, 1984 is:

  2,430,000,000 - 13% = 2,114,100,000

  Rounded off to the nearest $5 million

  = $2,115,000,000

  The picture for total industry employment is rather different given that while firms may have reduced their staff by an average of 15 percent, not all of these employees left the industry. Based on our interviews it is evident that many laid off employees either started up their own small firms during this period or offered their services on contract. We have assumed that of the 15 percent staff reductions, only five percent actually left the industry.

Therefore: Total Industry Employment, 1984 is:

42,900 - 5% = 40,755

Rounded off to the nearest hundred

= 40,800 employees 1984.

2. Figures for Estimated Industry Fees derived as follows.

Year	Obtained From:
1971	Statistics Canada, Service Trades, 1971, Catalogue 97-745
1974	Statistics Canada, Consulting Engineering Services 1974, Catalogue 63-528
1978	Figure derived from Statistics Canada, Engineering and Scientific Services, 1978. Additional fee income added on for non-respondents.
1982 and 1984:	See Explanatory Note #1 above.

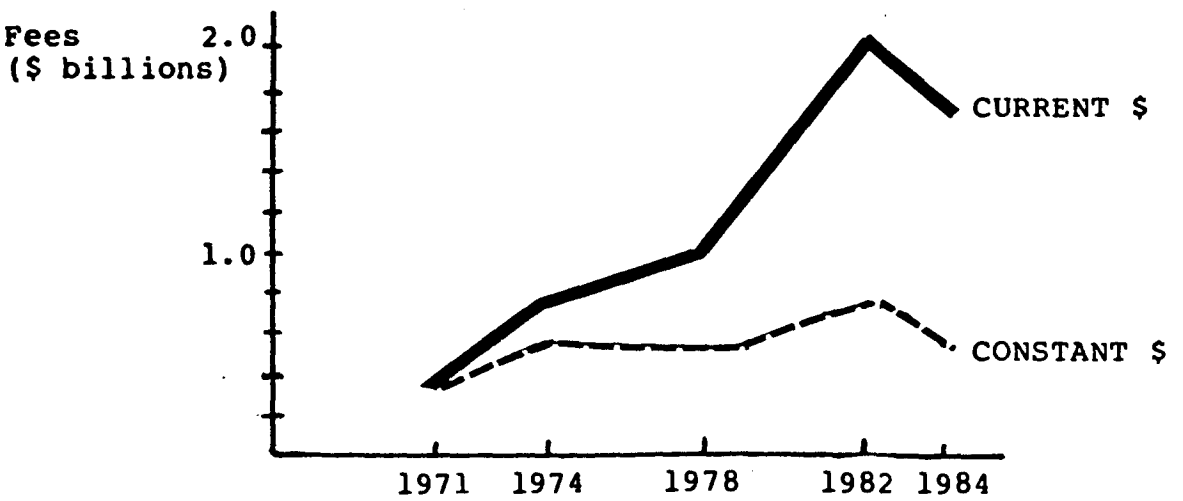
Constant dollar figures obtained by applying deflators derived from implicit price index (based on gross national expenditure). Source: Statistics Canada, National Income and Expenditure Accounts, 1968-1982. Catalogue 13-201.

EXHIBIT 2.1

DROP-OFF IN DOMESTIC MARKET GROWTH

	Estimated Domestic Fees		Compound Annual Average Growth Rate	
	Current $	Constant $ (1971)	Actual (i.e. based on Current $)	Real (i.e. based on Constant $)
1971	367 million	367		
			28%	17%
1974	770	583		
			7%	-2%
1978	1000	543		
			21%	9%
1982	2138	775		
			-8%	-13%
1984	1774	582		

Source: Figures obtained or derived from various Statistics Canada sources. See Explanatory Notes 1 and 3 at the end of this chapter.



2. THE DOMESTIC MARKET - PERFORMANCE AND PROSPECTS

The domestic market is the major source of sustenance for the vast majority of consulting engineering firms in Canada. Its cyclical swings affect their performance and prospects. The early 1980's brought both good times and bad times. A strong upsurge in 1980 and 1981 was counteracted by a severe decline from 1982 through 1984. These changes in overall industry growth were reflected in regional and sectoral shifts across the country. The changes also revealed critical barriers which must be overcome to achieve the growth potential in the Canadian domestic market.

GOOD TIMES AND BAD TIMES - THE EARLY 1980'S

The domestic market grew during the 1970's, and, while experiencing cyclical behaviour, more than doubled in real terms between 1971 and 1982 (Exhibit 2.1). Growth rates have always varied considerably for the industry as it follows alternate recessionary and growth periods in capital investment.

The domestic market entered the 1980's in a strong bounce-back period. However most firms began to experience difficulties in late 1981 and early 1982, and for the vast majority the period from 1982 to 1984 was extremely trying.

The slump observed in the domestic market is in part a continuation of slower growth trends observed in the mid-1970's. The long-term factors which resulted in slower growth were:

- Excess capacity in key economic sectors
- Declining population rates and rates of household formation
- Government restraint toward capital projects
- Severe decline in nuclear and some energy projects.

EXHIBIT 2.2

MARKET SHARE SHIFTED WESTWARD 1978 TO 1982

Head Office Locations	% of Firms			% of Fees		
	1974[1]	1978[2]	1982[3]	1974	1978	1982
Atlantic	7	7	6	3	3	2
Quebec	17	14	14	32	26	25
Ontario	35	36	34	30	42	35
Manitoba/ Saskatchewan	5	4	4	4	3	2
Alberta	20	23	24	16	13	19
British Columbia	17	16	18	15	13	17

Source: 1. Statistics Canada; Consulting Engineering Services, 1974 Catalogue 63-528.

2. Statistics Canada; Engineering and Scientific Services, 1978 Catalogue 63-537.

3. Statistics Canada; Survey of the Offices of Architects and Consulting Engineers, 1982.

These general trends were compounded by new factors in 1982-84. The recession and the associated lack of investor confidence led to numerous projects being shelved or postponed. There was a considerable withdrawal of investment in oil- and gas-related projects stemming from the effects of the National Energy Program as well as weak world oil prices. A number of firms also suffered from bad debts due to client insolvency.

Overall, the 1982-84 period was one of extreme difficulty for consulting engineers in Canada. As a consequence of the downturn, real billings have fallen in 1984 to mid-70's level.

REGIONAL STRENGTHS SHIFTING

The late 1970's and early 1980's saw a shift in market share to the west, followed shortly thereafter by renewed strength in Central Canada (Exhibit 2.2).

Market Share Shifted Westward

Western-based firms' share of total domestic fee income increased considerably from 1978 to 1982. Spurred by the investment in oil- and gas-related development and associated infrastructure, Alberta and British Columbia-based firms increased their share of total fee incomes by 6 percent and 4 percent respectively. However, the implementation of the National Energy Program and weak world oil prices in 1982-84 led to a major drop in fee income.

From our interviews, it is evident that Alberta firms have "bottomed out". For many, severe financial losses occurred in 1982-1983 and major staff cuts in 1983-1984. The outlook in the near-term is still very slow with the exception of a few sectors - public transit, water treatment and irrigation.

Saskatchewan and Manitoba-based firms fared the recession relatively better than other western firms. Provincial government contracting policies, particularly in Saskatchewan have helped sustain local firms. Depending on their areas of specialty, firms in these provinces underwent relatively modest staff cuts. The near-term outlook is clouded by poor performance in the

agricultural economy due to crop failure and therefore reductions in government revenue and spending. The mining and plant process sectors should benefit from heavy oil upgrader projects, as well as potash and uranium mining. In the longer term, there is considerable untapped potential in agriculture, irrigation and water supply projects.

For many British Columbia-based firms, their welfare is heavily influenced by the viability of the resource-based sectors such as pulp and paper and mining. The combinations of a downturn in capital investment in these sectors and a provincial program of severe spending cuts has hurt firms in the province. A few major Vancouver projects such as Expo 86, B.C. Place and the Vancouver ALRT (Area Light Rail Transit) have provided work for some firms, but the near-term outlook is relatively poor.

Since 1982, Central Canada Has Shown Renewed Strength

In the recession Ontario and Quebec-based firms "weathered the storm" better than western-based firms. From our interviews, it is evident that the severe retrenchment experienced in the west, particularly in Alberta, was not felt to the same extent in central Canada. While central Canadian firms did experience decline during this period, their national and more diversified base helped them through.

For most Ontario and Quebec firms, 1982 was the "peak" in revenue. Since 1982, the majority of firms have cut back staff to core levels. Reductions in private sector work during this period were offset to some extent by public investment. Most firms noted an increase of 10 to 15 percent in the public proportion of their work. Central Canadian firms look to the future with a very cautious optimism. For many the 1984 picture is one of a return to profitability, primarily due to lower costs and improved productivity.

Atlantic Canada "On Hold"

Overall, firms based in Atlantic Canada have for the most part held their own, although some have been extremely hard-hit by the recession. Early optimism for offshore oil and gas development as well as large public

EXHIBIT 2.3

SECTORS CONTINUE TO BE HIGHLY CYCLICAL

AVERAGE ANNUAL REAL RATE OF GROWTH	1971 to 1974[1]	1974 to 1978[1]	1978 to 1982[1]	1982 to 1984[2]	1984 to 1989[3]
Substantial Growth (Over 10%)	Power Dams & Irrigation	Power Plant Process	Mining Petroleum & Nat. Gas Transportation Air & Sea ports Dams & Irrigation		Plant Process
Good Growth (5 to 10%)	Municipal Agric./Fish/Forestry Air & Sea ports Petroleum & Nat. Gas Telecommunications		Plant Process Miscellaneous		Dams & Irrigation
Modest Growth (0 to 5%)	Buildings Plant Process Transportation	Telecommunications	Buildings Telecommunications	Air & Sea ports Transportation Dams & Irrigation Telecommunications Miscellaneous	Buildings Municipal Transportation Air & Sea ports Telecommunications Petroleum & Nat. Gas
Modest Decline (0 to -5%)	Mining	Agric./Fish/Forestry Air & Sea ports Municipal Petroleum & Nat. Gas	Agric./Fish/Forestry Municipal Power	Plant Process Municipal Agric./Fish/Forestry Mining	Power Agric./Fish/Forestry Mining
Significant Decline (-5 to -10%)		Transportation Dams & Irrigation Mining Miscellaneous		Power Petroleum & Nat. Gas Buildings	

Sources:
1. Based on figures from Statistics Canada Surveys, 1974, 1978 and 1982 converted to constant dollars.
2. Based on industry interviews and construction investment figures.
3. Based on: Construction Industry Outlook from Winter 1984 by the Canadian Construction Association - Construction Investment by Type of Structure converted to constant dollars; as well as general sectoral outlooks prepared by Conference Board, Economic Council of Canada, etc.

investment programs (e.g. Special Capital Recovery Projects) have created work and sustained many firms through the recession.

Many Atlantic Canadian firms had to implement severe staff cuts in the 1981-1984 period. Some firms were sustained by major capital investment projects such as: the Frigate Program in Saint John, New Brunswick; various Halifax-based marine works; and a number of oil and gas or energy-related projects in Newfoundland and Nova Scotia. The firms in Atlantic Canada are relatively optimistic but they fear that they may not reap the full benefits of development of Hibernia, the Sable-Mobile Venture project and other offshore energy-related projects. Increased emphasis on technology transfer and joint ventures will be an essential ingredient to their future success.

SECTORS VARY IN PERFORMANCE AND OUTLOOK

The twelve basic sectors of consulting engineering in Canada continue to show highly cyclical performance. Since 1971 no single sector has continously been either a very good performer or a very bad one (Exhibit 2.3). The cyclicality of sectors will probably continue, but a number of trends are clear. Because of the unreliability of quantitative sectoral forecasts in recent years, we provide instead a general qualitative outlook for each sector. We begin however with a discussion of the overall performance of the main sectors.

Overall, Traditional Sectors Diminishing in Importance

Traditional areas of strength - the Buildings and Municipal sectors - are diminishing in importance. As the Canadian economy matures, capital investment in basic infrastructure slows down. This situation is reflected in the market share of the two leading sectors in consulting engineering. Although the Buildings and Municipal sectors still rank first and second they are losing their share of the total market. In 1974 they accounted together for 42 percent of the domestic market but in 1982 for only 28 percent. The speculative booms

EXHIBIT 2.4

RANKING OF THE 12 SECTORS IN 1982

Rank	Sector	% of Domestic Market
1	Buildings	16
2	Municipal	12
3	Petroleum and Natural Gas	12
4	Plant Process	12
5	Miscellaneous	9
6	Power	9
7	Mining	9
8	Transportation	7
9	Dams, Irrigation and Flood Control	5
10	Air and Seaports	5
11	Agriculture/Fish/Forestry	4
12	Telecommunications	1

Source: Statistics Canada Survey, 1982.

in construction associated with both western energy development and east coast offshore development have resulted in some areas being overbuilt. As result, the short-term outlook for Buildings and Municipal remains poor.

As Canada's resource-based economic sectors - petroleum and natural gas, mining, power and agriculture/fisheries/forestry - swing up and down, so too do the consulting engineering sectors serving these resource bases. Given the susceptibility of resource sectors to large uncertainties, such as world commodity prices and changing market demands, these fluctuations are expected to continue.

Sectors Show Differing Prospects

Quantitative sectoral forecasts for the short and medium terms have proven to be particularly unreliable. We have therefore chosen to provide more general outlooks for the different sectors, highlighting the critical factors likely to affect the growth prospects of each. The relative growth of the individual sectors, is predicted in various forecasts prepared by the Canadian Construction Association, the Economic Council of Canada, the Conference Board of Canada, and Canadata.* Using information drawn from these forecasts and from our interviews, the twelve sectors of consulting engineering identified by Statistics Canada are examined below in order of their share of the total market in 1982 (See Exhibit 2.4).

1. Buildings: Slipping a Bit. Although still the number one sector, Buildings has declined in recent years. Heavily dependent on investor confidence, the Building Sector suffered considerably during the recession. Heavy declines in investment in residential, industrial and commercial buildings were experienced during 1982-83.

   In the coming years, the Building Sector should see modest growth. Lower investment in institutional and multiple residential buildings will be offset by stronger growth in industrial

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* See Explanatory Note #2 at the end of this chapter.

and commercial buildings. However, certain regions across the country are likely to experience reduced growth due to excess capacity. A number of major cities such as Calgary, Halifax and St. John's, are considered by many to be overbuilt. The outlook for these areas therefore is relatively poor.

BUILDINGS: SMALLER SHARE OF TOTAL

	1974	1978	1982
RANK	1	1	1
% OF TOTAL	23%	20%	16%
FEES (1971 $'000)*	31,428	100,501	103,880

Source: Statistics Canada Survey, 1974, 1978, 1982.

2. Municipal: Very Slow. The Municipal Sector, encompassing water supply, sewage and waste disposal, roads and streets, traffic engineering, and urban and regional planning, has slowed considerably in recent years. Although still the number two sector, Municipal accounts for a much smaller share of the total domestic market than it did in the past, and since 1982 has experienced continued decline. This drop has been attributed to the maturity of infrastructure development in Canada. In many areas, infrastructure upgrading and replacement has been postponed, while the limited extent of new urban and industrial growth has reduced the demand for further municipal services.

   The short-term outlook for the Municipal Sector is very slow growth. It is likely that deficit budgeting at all levels of government will postpone many projects. The future success of this sector will be highly dependent on the commitment to infrastructure replacement and the extent to which various levels of government contract out work.

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* See Explanatory Note #3 at the end of this chapter.

One area which does have a more positive outlook is waste disposal. This area has grown in recent years and is expected to continue to grow in the future.

MUNICIPAL: SLOWING DOWN

	1974	1978	1982
RANK	2	2	2
% OF TOTAL	19%	19%	12%
FEES (1971 $'000)[3]	109,471	94,765	77,398

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

3. Petroleum and Natural Gas Saw Growth then Decline. The Petroleum and Natural Gas Sector encompasses exploration, extraction and separation, pipelines, gas process plants and oil refineries. This sector enjoyed major growth between 1978-82, increasing its share of the domestic market from 8 percent to 12 percent. However during 1982-84 this sector went into a downturn as a result of the effects of the National Energy Program and weaker world oil prices.

   Future prospects for this sector are dependent on the future of the National Energy Program, international energy prices, and the final results of federal and provincial negotiations over energy development. If Canadian consulting engineering firms are to play a part in future petroleum and natural gas development, major project capability must be enhanced to overcome competition from United States' firms. Positive signs include the potential of offshore east coast energy developments and in heavy oil upgrading projects in Saskatchewan and Alberta. If major projects come on stream in the near future, and if Canadian consulting engineers play a significant role in them, the petroleum and natural gas sector could enjoy better growth in the late 1980's than it did in the early 1980's.

PETROLEUM AND NATURAL GAS: 74-82 STRONG PERIOD			
	1974	1978	1982
RANK	4	6	3
% OF TOTAL	8%	8%	12%
FEES (1971 $'000)[3]	48,419	38,846	76,036

Source: Statistics Canada Surveys, 1974, 1974 and 1982.

4. Plant Process: Relatively Strong with Good Prospects. The Plant Process Sector spans a considerable variety of manufacturing-related industries. It incorporates everything from food processing to heavy industrial manufacturing such as steel mills. This area experienced relatively good growth in the late 1970's and early 1980's. However, during 1982-84 the sector dropped off considerably due to low levels of capacity utilization and high inventories in most major industries.

   Of all the consulting engineering sectors, Plant Process has the best chance for substantial growth through the late 1980's. The actual rate of growth will be dependent on the outlook for manufacturing, but also, and perhaps more important, on the technological capabilities of consulting engineers to serve the changing demands in this area. Plant Process is a key area for applied research and development for consulting engineers. As industry technology in this area is developing rapidly (e.g. CADD/CAM, Robotics), consulting engineers will have to make a considerable effort to keep up with new technologies. Assuming that they do, this sector should enjoy substantial growth in the coming years.

PLANT PROCESS: STEADY GROWTH

	1974	1978	1982
RANK	7	4	4
% OF TOTAL	7%	12%	12%
FEES (1971 $'000)[3]	39,890	60,432	75,202

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

5. Miscellaneous: Steady. This category incorporates a wide range of fields such as air and noise pollution control, arbitration and litigation, computer science and data processing, environmental impact studies, interior design, naval architecture, remote sensing and photogrammetric soil mechanics. This sector as a whole has experienced continued steady growth in recent years primarily due to the diversity of its components. Key areas such as computers, environmental studies, and litigation have become increasingly important in recent years in consulting engineering.

   With environmental awareness and computerization expected to increase, this sector will continue to be a strong area of growth for consulting engineers. In addition, the continued growth of this area is a sign that the industry as a whole is broadening its scope of services. In fact, the Miscellaneous Sector should probably soon be subdivided into new separate sectors.

MISCELLANEOUS: FAIRLY STEADY

	1974	1978	1982
RANK	3	5	5
% OF TOTAL	9%	8%	9%
FEES (1971 $'000)[3]	53,939	41,050	56,005

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

6. Power: Major Drop-off. Following a period of extremely strong growth through the 1970's, the Power Sector has experienced a severe downturn. Ranked third in 1978, the sector dropped to sixth in 1982. The major utilities across the country now find themselves with demand much lower than forecasted and a large excess of generating capacity. Major reductions or moratoriums on investment spending by electric utilities have contributed to the severe decline in this sector.

   The outlook for Power is very poor because of the excess generating capacity among utilities. This factor combined with increasing negative public reactions to major power projects for social and environmental reasons is likely to postpone or shelve such projects for many years to come. The future in the Power Sector may be an increasing emphasis on small-scale and remote area power generation.

POWER: BEGINNING TO DROP

	1974	1978	1982
RANK	8	3	6
% OF TOTAL	6%	12%	9%
FEES (1971 $'000)[3]	36,067	62,540	55,649

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

7. Mining and Metallurgy: Cyclical. The Mining Sector, which has experienced many ups and downs in the last twenty years, experienced both again in 1978-82. The weakness of this sector can be attributed to an excess supply of some minerals, combined with weakened demand and lower prices on the world market. In spite of the modest recovery in output in 1983-84 for some metals, there has been little capital investment in the Mining Sector.

Mining will continue to be highly cyclical. With sluggish worldwide demand and prices, it is likely that no major growth will be realized in the near future. The mining industry will face continued price competition from countries with nationalized industries which are less concerned with profit than securing foreign exchange. Closer to home, mining investment will decline as demand for nickel, zinc and copper continues to subside. However plant upgrading to reduce costs of output could provide some recovery potential.

MINING: REMAINS CYCLICAL

	1974	1978	1982
RANK	6	9	7
% OF TOTAL	9%	5%	9%
FEES (1971 $'000)[3]	45,715	23,576	54,951

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

8. Transportation: Relatively Stable. The Transportation Sector incorporates bridges, tunnels, highways and expressways, railways, public transit and transportation studies. This sector has remained relatively stable in recent years, as reductions in highway and expressway building have been offset by increased investment in public transit.

The outlook for transportation is for modest growth to the end of 1980's. In the short term, there is likely to be continued investment in transit similar to those that have been undertaken in recent years - e.g. light rail transit in Vancouver, Calgary and Toronto. However, the long-term outlook in transportation will be heavily dependent on the commitment of federal, provincial and municipal governments to infrastructure upgrading and replacement. There is a growing concern among consulting engineers across the country that not enough attention is being paid to the maintenance of the current transportation infrastructure.

TRANSPORTATION: STEADY

	1974	1978	1982
RANK	5	7	8
% OF TOTAL	8%	6%	7%
FEES (1971 $)[3]	46,664	32,486	46,935

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

9. Dams, Irrigation and Flood Control: Improvement. This sector improved its performance in 1978-82, primarily because of investment in irrigation in the Prairie provinces, particularly in southern Alberta and Saskatchewan.

The outlook for dams, irrigation and flood control will be partially dependent on the farm economy and the level of investment by Prairie governments in irrigation. In the short term, weak demand will probably continue because of absence of megaprojects in hydro-electric power. The longer-term possibility of water sales to the United States may generate further demand for dams.

DAMS ETC: IMPROVED '78-'82

	1974	1978	1982
RANK	10	11	9
% OF TOTAL	4%	2%	5%
FEES (1971 $)[3]	21,061	9,488	30,219

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

10. Air and Seaports: Modest Growth. This sector, although small, has experienced relatively good growth in recent years. In addition to airports and harbours, it also includes docks and jetties, dredging, river and coastal works, terminals and warehouses, transportation studies, oceanography and hydrography. Recent growth is primarily due to federal spending on airport and harbour upgrading. However, growth has also been seen in the oceanographic and hydrographic areas due primarily to offshore east coast energy development.

    The prospects of offshore energy development on the east coast will likely stimulate further harbour, dock and jetty works, and increased work in oceanography and hydrography. The recent establishment of the Ocean Industry Development Office in Halifax may stimulate further development in the ocean-related sectors.

AIR AND SEAPORTS: MODEST GROWTH

	1974	1978	1982
RANK	11	10	10
% OF TOTAL	2%	2%	5%
FEES (1971 $'000)[3]	13,568	11,649	29,341

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

11. Agriculture, Fisheries, Forestry and Forest Products: Continued Weakness. This sector has shown continued overall decline because of weakness in the resource-based industries. Low operating levels and excess capacity in the pulp and paper industry have contributed to this decline.

The outlook for this sector is not entirely encouraging. Modest decline is foreseen through the remainder of the 1980's. The agricultural outlook will be dependent on climatic factors and world prices for various agricultural products. There are signs of optimism in the pulp and paper field in eastern Canada where many pulp and paper mills require modernization.

AGRICULTURE/FISHERIES/FORESTRY: CONTINUED WEAKNESS

	1974	1978	1982
RANK	9	8	11
% OF TOTAL	6%	6%	4%
FEES (1971 $'000)[3]	32,970	29,876	26,347

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

12. Telecommunications: Limited Growth. The Telecommunications Sector accounts for a very small proportion of the total domestic market. Recent years have seen limited growth in this area. Traditionally, most projects were "spill-overs" from projects performed internally by the major companies in the telecommunications field. During 1982-84, work was probably taken back in house to sustain staff levels.

The outlook for consulting engineers in the Telecommunications Sector will be heavily dependent on consulting engineers' technical capabilities compared to those of their clients. The components of the Telecommunications Sector - microwave, broadcasting, wireline transmission, telephone systems, supervisory control and data transmission - are all experiencing extremely rapid technological development. Consulting engineers will have to be up to date on the research and development in this field, if they are to have a part in it.

TELECOMMUNICATIONS: LIMITED GROWTH

	1974	1978	1982
RANK	12	12	12
% OF TOTAL	1%	1%	1%
FEES (1971 $'000)[3]	4,304	4,764	4,802

Source: Statistics Canada Surveys, 1974, 1978 and 1982.

THE YEARS TO COME
- SLOWER GROWTH

Overall, the outlook is for slower growth, but the future domestic growth picture for consulting engineering firms will be heavily influenced by three key factors: economic uncertainties, government policies, and the competitive capabilities of consulting engineers in the domestic market.

- Economic uncertainties. The experience of recent years underlines the futility of precise forecasting. Changes in U.S. and Canadian monetary policy will continue to influence rates of capital investment. For the resource-related sectors, fluctuations in world market prices for energy and key commodities will have a profound influence, particularly on the timing of our energy megaprojects. Finally, the general level of consumer and investor confidence will affect the domestic growth picture.

- Government policies. In the remainder of the 1980's we may see major changes in key government policy areas affecting consulting engineers:

  - Capital investment: Deficit budgeting will likely reduce overall capital expenditures, but some stimulative programs and projects may occur.

- Contracting out: The extent to which the "privatization movement" is applied to government contracting-out will influence the prospects of consulting engineers (this issue is discussed further in Chapter 4).

- Commitment to rehabilitation/repair: Given that much of Canada's basic infrastructure is in place, the outlook for the future will be influenced by public and private sector commitment to infrastructure replacement, modification and maintenance.

- Regional expansion: Government policies on regional preference, technology transfer, and joint venturing will influence the prospects of consulting engineers.

- Role in Research and Development: The role of consulting engineers in research and development will influence their prospects and competitiveness.

These and other government policy issues are discussed further in Chapter 4.

- Competitive capabilities. Consulting engineering firms face a future of increased competition. The extent to which "newcomers" penetrate existing consulting engineering markets will depend on the cost and quality of consulting engineering services relative to other competitors.

Bearing in mind these factors, we foresee a period of overall slower growth for the remainder of the 1980's. Most forecasts portray a continued recovery of the Canadian economy in the near future but a slow pace. Estimates of real growth in the 1985-1989 period range from 2 to 4 percent, as compared to average real growth rates in the 1970's and early 1980's in the range of 5 to 8 percent[2]. The combination of reduced government spending and cautious private sector investment will be the main causes of the slower growth.

Looking at the sectoral outlook for the future, we see both negatives and positives. On the negative side, the traditional sectors - Municipal and Buildings - will continue to decline as a proportion of total consulting engineering work. Power, also will likely continue to decline along with the resource-based sectors - Agriculture/Fisheries/Forestry and Mining.

On the positive side, Plant Process is likely to be a key sector in the coming years as Canada commits itself to advanced manufacturing and process technologies. Other smaller sectors such as Air and Seaports, and Telecommunications are also likely to do well in the coming years. Finally, as consulting engineers extend their services into new areas of expertise, the Miscellaneous category should grow.

* * * *

For the remainder of the 1980's, the overall picture for the domestic market will be one of modest growth. Prospects are relatively good if key obstacles are overcome. The "obstacles" will be addressed in futher detail in Chapter 4. In the next chapter however, we examine the export market highlighting the future challenges abroad.

EXPLANATORY NOTES

1. Figures for Estimated Domestic Fees derived as follows:

Year	Obtained from:
1971	Statistics Canada, Service Trades, 1971, Catalogue 97-745.
1974	Statistics Canada, Consulting Engineering Services, 1974, Catalogue 63-528.
1978	Figure derived from Statistics Canada, Engineering and Scientific Services, 1978. Additional fee income added on for non-respondents.
1982	Figure derived from Statistics Canada, Survey of the Offices of Architects and Consulting Engineers, 1982. Additional fee income added on for non-respondents.
1984	Figure based on overall performance from industry interviews.

2. A number of different forecasts were examined including:

   Canadata (1983): Construction in Canada: 1976-1986

   Canadian Construction Association (1984): Construction Outlook from Winter 1984.

   Department of Regional Industrial Expansion (1984): Report of the DRIE Capital Investment Intentions Survey Conducted in April 1984.

   Economic Council of Canada, Twentieth Annual Review (1983): On the Mend.

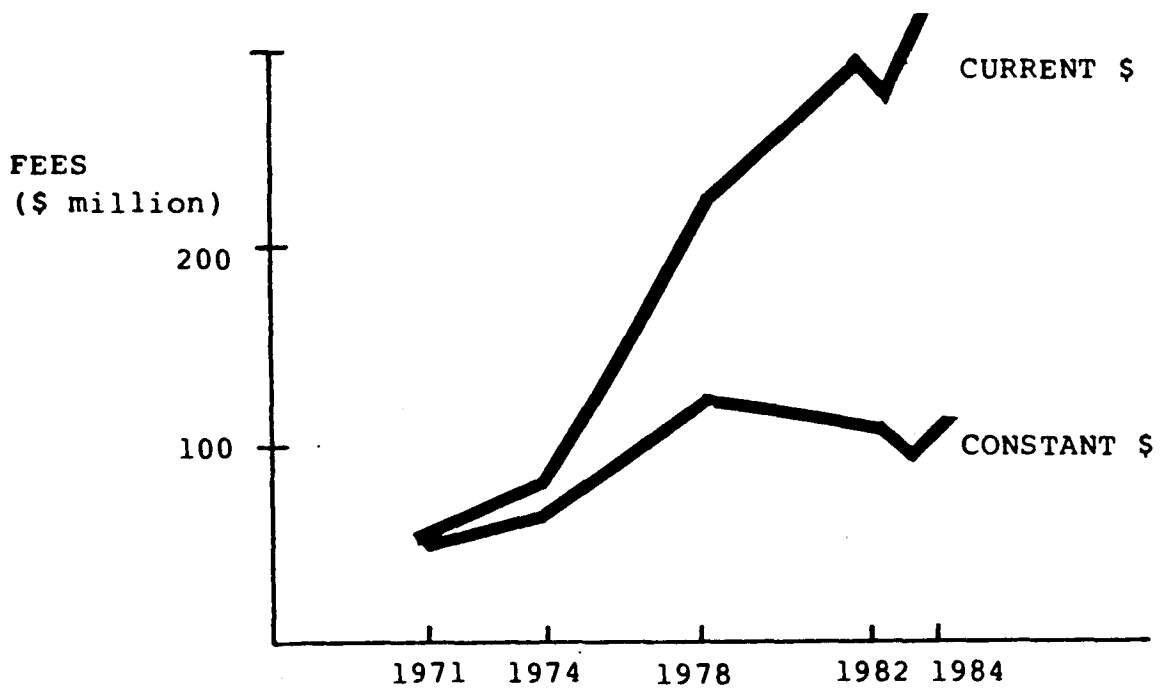
3. Constant dollar figures obtained by applying deflators derived from implicit price index based on gross national expenditure. Source: Statistics Canada, National Income and Expenditure Accounts, 1968-1982. Catalogue 13-201.

EXHIBIT 3.1

EXPORT FEE INCOME DOWN IN REAL TERMS

	Estimated International Fees		Compound Annual Average Growth Rate	
	Current $	Constant $ (1971)	Actual	Real
1971	50 million	50 million		
			+17%	+7%
1974	80	61		
			+29%	+18%
1978	220	120		
			+7%	-3%
1982	292	106		
1983	280	96	-4%	-9%
1984	340	111	+21%	+16%

Source: Figures derived from Statistics Canada sources, industry interviews and results of Department of Regional Industrial Expansion mini-survey - for further details see Explanatory Note #1 at the end of this chapter.



3. THE EXPORT MARKET-TOUGH CHALLENGES

The export market brings new challenges to Canadian consulting engineers in the 1980's. From a small base in the 1960's, export work in consulting engineering has shown strong growth. However, recent signs indicate that this overall trend has been shaken. Changing market demands and major new competitive forces are threatening the success of Canadian consulting engineering firms in the export market.

OVERALL, EXPORT MARKET FALTERING

From industry statistics, and through our interviews with firms across Canada, it is evident that Canadian competitiveness in the export area is slipping and that there has been retrenchment by some firms away from the export markets.

Fee Income Has Peaked

In current dollar terms, Canadian firms have grown in the export field over the past decade, with close to $340 million in export fees in 1984 (see Exhibit 3.1)*. Overall, this period has been one of strong marketing efforts by Canadian firms, with the result that many are well established in the export field with good track records to build upon in the years ahead. The export picture from 1982 through 1984 has been mixed. While "the big three" have continued to show strong gains in the export market, many of the medium to large and smaller firms have experienced reduced export fee income, particularly in 1983. While 1984 has been a strong year overall in export relative to 1983 and 1982, this success has been highly concentrated among a few firms - the big three and some smaller firms.

When the industry's performance as a whole is viewed in constant dollar terms, export income has been declining overall since the late 1970's. High inflation in this period coupled with a significant decline in

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* See Explanatory Note #1 at the end of this chapter.

EXHIBIT 3.2

PERFORMANCE OF TOP CANADIAN
FIRMS IN DEVELOPING COUNTRY MARKETS

	1982	1983
Number of Firms	12	13
Foreign Billings	$282.9 mil.	$269.0 mil ($ U.S.)
Share of Developing Country Markets	7.8%	7.0%

Source: Engineering News Record, Survey of The Top 200 International Design Firms, 1982 and 1983 (The survey ranks firms on the U.S. dollar value of foreign billings including fees for design and planning, program and construction management, design-construct and studies. Also included are fees from reimbursables, temporary staff transfers and construction inspections).

growth rates in export income are the main contributors to this decline. A further reason for the decline in export fee income may be that some fee income is not being repatriated but instead is remaining in foreign subsidiaries of Canadian firms.

The decline in growth rates has many causes. Changing oil prices and the general recession throughout the world have severely restricted the flow of funds for capital projects in the developing world, and in the United States, one of our major export targets. Thus Canadian firms have had to fight harder for a share of a constant, even decreasing worldwide market, rather than growing with an expanding market as in the past. However, there is some indication that the strong domestic market in the late 70's and early 80's focussed firms' attentions, and absorbed resources, at the expense of export market expansion. Also, as will be discussed later, the competitive situation worldwide has heated up considerably.

There are other signs that Canadian firms' competitiveness has slipped recently. While data sources on this subject are limited and unreliable, available data suggest that the share of the top Canadian firms in developing country markets, decreased from 7.8 percent to 7 percent from 1982 to 1983 (see Exhibit 3.2). During that same time period German and French firms increased their share in those markets by 0.5 and 0.7 percent respectively. These trends should be followed over the next couple of years to determine whether they are a reliable indicator of Canadian international competitiveness.

Few Firms Participating

Our interviews indicate that consulting engineering firms that export their services constitute a relatively "exclusive club" and one that is becoming more so. These firms tend to be either large or highly specialized. Canada's export activity is spearheaded by the same three firms who dominate the industry overall, Lavalin, SNC and Monenco. Between them, we estimate that they account for over half of total consulting engineering exports. As well, due to acquisitions and aggressive marketing these firms have been increasing their share of Canadian exports over the past five years.

EXHIBIT 3.3

CANADA FOURTH IN DEVELOPING COUNTRY MARKETS (1983)

	NUMBER OF FIRMS IN TOP 200	% OF FOREIGN BILLINGS
U.S.	66	31.3
U.K.	26	15.4
France	17	9.4
Canada	13	7.0
Scandinavia	15	6.9
West Germany	19	6.6

Source: Engineering News Record, Survey of The Top 200 International Design Firms in 1983.

Beyond the "big three" Canada has another eight to ten firms that are consistent exporters. As a group, all the other Canadian exporters have been falling behind the big three firms and have absorbed the bulk of the overall decline in Canadian export billing in real terms.

Some Canadian firms found export too time-consuming, costly and risky during the recession. As a result, they have lowered their export activity and may withdraw from exports entirely if the domestic market shows any promise in their areas. Our interviews indicated that many smaller and medium-sized firms have found export both costly and unprofitable. Yet others continue to feel that the export market holds potential to offset anticipated hard times domestically.

BUT SOME POSITIVE SIGNS

In spite of these negative signs, Canada still does very well in the export market for a country its size.

Canada Ranks Fourth

From a survey of the top 200 firms exporting consulting engineering services around the world, Canadian firms with 7.0 percent of the market in 1983, are fourth behind American, British, and French firms (Exhibit 3.3). While, the next closest competitors, Scandinavia and Germany, are not far behind, on any standard measure Canada is faring very well on the world market. Not included in these figures is the work of Canadian firms' in the U.S. which is generally believed to be greater than overseas competitors' volume there.

Of particular interest is the fact that Canadian firms have achieved this share with proportionally fewer companies than the other leading export countries. In part, this is due to the fact that the big three firms are amongst the top group of international competitors, and have generally been improving their market shares. However, it is also indicative of a situation in which Canada's performance is dependent on a small number of firms who have significant export volumes.

EXHIBIT 3.4

CANADIAN SHARE AT WORLD BANK INCREASING

	% OF DISBURSEMENTS TO CONSULTANTS FROM IBRD & IDA*					
COUNTRY	1979	1980	1981	1982	1983	1984
1. U.S.	18.4	19.2	17.6	21.8	20.3	20.6
2. U.K.	12.2	12.9	17.3	15.5	11.2	11.6
3. France	16.5	14.2	13.3	8.1	8.3	8.2
4. Canada	3.4	4.7	4.1	4.6	7.3	7.4
5. Germany	5.8	7.4	4.1	3.7	6.2	4.9
6. Other	20.2	17.9	16.5	18.9	16.4	17.4
Total % to Consultants in Industrial Countries	76.5	76.3	72.9	72.6	69.7	70.1

* IBRD - International Bank of Reconstruction Development
IDA - International Development Association

Source: World Bank - Projects Policy Department 1984: "Disbursement by Supplying Countries - Consultants".

Some Indicators of Relative Strength

An indicator of the relative strength of Canadian consulting engineering internationally is disbursements to consultants by international financial institutions. The Canadian percentage share has more than doubled, at the same time as the share of some of the major competitors has dramatically decreased (Exhibit 3.4). While the World Bank is only one of many international agencies, and the increased share for Canada can be attributed to success on a few large contracts and to the successes of "new" Canadian consulting entrants (eg. Crown corporations), nevertheless these statistics are encouraging. The status of the Bank and the competitiveness of the contracts adds to the belief that Canadian firms can be strong competitors.

Despite the relatively few firms with major export volumes, there are a large number of Canadian firms that do at least some export work. While no precise numbers are available, over 95 ACEC members have registered with the World Bank, and all but a few have international experience. Also, our interviews with firms across the country showed that there are many firms who have definite plans to increase export work.

FOCUS OF EXPORT ACTIVITY SHIFTING

To gain a picture of the Canadian role in the export market, it is useful to look at changes in key indicators. Regionally, Canadians have been strong in certain overseas markets. Sources of financing are changing while one of the indicators of export activity - sectoral breakdown - remains relatively unchanged.

Some Regions Growing in Importance, While Others Weaken

Data on regional market share can be skewed by one or two major projects within a given time. However, the overall strength of Canadian consulting engineering activity in various regions is changing (see Exhibit 3.5):

EXHIBIT 3.5

SOME REGIONS GROWING IN IMPORTANCE WHILE OTHERS WEAKEN

INTERNATIONAL FEES

	1974 CURRENT '000 $	1974 CONSTANT '000 $	1974 PERCENT	1978 CURRENT '000 $	1978 CONSTANT '000 $	1978 PERCENT	1982 CURRENT '000 $	1982 CONSTANT '000 $	1982 PERCENT
U.S.	26,171	19,827	33	24,338	13,227	14	50,629	18,344	20
EUROPE	6,472	4,903	8	16,121	8,761	9	17,606	6,379	7
LATIN AMERICA	13,688	10,370	17	28,525	15,503	16	25,635	9,288	10
CARIBBEAN	3,326	2,520	4	12,079	6,565	7	12,358	4,478	5
MIDDLE EAST	7,614	5,768	10	17,274	9,388	10	35,719	12,942	14
FAR EAST	8,677	6,573	11	33,565	18,242	19	30,125	10,915	12
AFRICA	12,894	9,768	16	41,770	22,701	24	55,050	19,946	22
AUSTRALASIA	1,503	1,139	2	3,037	1,651	2	17,037	6,173	7
UNSPECIFIED	50	38			0		4,465	1,618	3
	80,395	60,905	101	176,709	96,038	101	248,624	90,081	100

Sources: 1. Statistics Canada, Consulting Engineering Services, 1974. Catalogue 63-528.

2. Statistics Canada, Engineering and Scientific Services, 1978. Catalogue 63-537.

3. Statistics Canada, Survey of the Offices of Architects and Consulting Engineers, 1982.

- Africa. In terms of total international fee income for Canadian firms, Africa is the number one market. Recent Canadian performance in Africa has been particularly strong. Among top international firms, Canadians increased their share of the African market from 6.8 percent in 1982 to 9.2 percent in 1983*. The key engineering sectors in the African market are power, agriculture and plant process.

- United States. The U.S. plays a less dominant role in the export market than it did in the early 1970's, but it still is an extremely important market for Canadian firms. Key sectors in the U.S. market are mining, plant process and buildings.

- Middle East. In the late 1970's and early 1980's the Middle East grew in its importance for the Canadian consulting engineers. Ambitious urban development and industrialization programs resulted in increases in municipal and building projects in this area. However, the most recent data indicate that the Canadian share of this market relative to other top international firms decreased from 4.1 percent in 1982 to 3.7 percent in 1983.

- Far East. The Far East market is an area proclaimed by many as having considerable potential. In 1982, key sectors for the Canadian consulting engineers were power, as well as dams and irrigation. There are indications, however, that the Canadian share of the Asian market is declining (from 5.8 percent in 1982 to 5.5 percent in 1983). Other countries may be geographically and historically better positioned to take advantage of the potential in the Far East.

- Europe. The European market accounts for a relatively small but constant share of Canadian consulting engineering work abroad. The key sector in the European market is petroleum and natural gas.

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* This and subsequent market share statistics in this section are taken from Engineering News Record survey, 1983.

EXHIBIT 3.6

SHIFTS IN FUNDING SOURCES

	1978			1982		
	CURRENT '000 $	CONSTANT '000 $	PERCENT	CURRENT '000 $	CONSTANT '000 $	PERCENT
CIDA	34,196	18,585	19	34,022	12,327	14
EDC	45,289	24,614	26	23,819	8,630	10
WB, UNDP, IADB, CABEI, ADB, BAD	8,005	4,351	4	21,816	7,904	8
PCS	8,907	4,841	5	8,706	3,154	4
PFS	43,913	23,866	25	86,316	31,274	34
GFS	35,354	19,214	20	66,998	24,275	27
OTHER	1,042	566	1	2,482	899	3
UNSPECIFIED				4,465	1,618	
	176,706	96,037	100	248,624	90,81	100

Sources: Statistics Canada, Engineering and Scientific Services, 1978. Catalogue 63-537.

Statistics Canada, Survey of the Offices of Architects and Consulting Engineers, 1982.

* Abbreviations:

CIDA - Canadian International Development Agency
EDC - Export Development Corporation
WB - World Bank
UNDP - United Nations Development Program
IADB - Inter-American Development Bank
CABEI - Central American Bank for Economic Integration
ADB - Asian Development Bank
BAD - African Development Bank
PCS - Private - Canadian Source
PFS - Private - Foreign Source
GFS - Government - Foreign Source

- Latin America. While Canadian firms are strong there, Latin America has declined in importance relative to other market areas. Key sectors in this area remain power, dams and irrigation. The Canadian market share relative to other top international firms decreased from 10.5 percent in 1982 to 8.6 percent in 1983.

- Caribbean. The Caribbean remains a relatively small but stable area of activity for Canadian consulting engineers. In this region the key sector is municipal.

- Australasia. The late 1970's and early 1980's saw significant growth in Canadian activity and interest in this area. While a small market now for Canadians, many firms interviewed see it as a key source of growth in the future.

Shifts in Funding Sources Reflect Maturity in World Marketplace

Funding sources for Canadian projects overseas are changing significantly (see Exhibit 3.6). The increased importance of private and host government sources and the associated reduced dependence on CIDA, EDC and the international financial institutions may well reflect the increased sophistication of major Canadian firms overseas. Our interviews indicated that CIDA projects, for example, provided an important stepping stone into the world marketplace. However, many major Canadian firms now have strong independent liaisons in foreign countries and are no longer dependent on either aid or international financing from Canada to obtain export projects. The continued relative strength of the U.S. market is another reason why private funding sources predominate, as the vast majority (over 80%) of U.S. work is private.

Signs of this increased success with other funding sources can be seen in growth in certain ones (Exhibit 3.6). Canadian firms have been particularly successful acquiring projects funded by world funding agencies, foreign governments and private foreign sources. Diversification in funding sources is a good sign of maturity of the Canadian engineering presence in the overseas marketplace.

EXHIBIT 3.7

FOUR SECTORS PREDOMINATE IN EXPORT

MAJOR SECTORS	1974 RANK	1974 %	1978 RANK	1978 %	1982 RANK	1982 %
Plant Process	1	17	2	21	4	12
Agric./Fish/Forestry	2	17	3	9	2	18
Mining/Metallurgy	3	17	4	6	3	15
Power	4	15	1	35	1	19
TOTAL OF TOP 4		66%		71%		64%

MINOR SECTORS	1974 RANK	1974 %	1978 RANK	1978 %	1982 RANK	1982 %
Transportation	5	8	12	1	10	4
Miscellaneous	6	6	8	3	7	6
Municipal	7	5	6	4	5	8
Buildings	8	4	10	3	8	5
Air & Seaports	9	4	9	3	11	2
Petroleum & Nat. Gas	10	3	7	4	6	7
Telecommunications	11	3	11	3	12	1
Dams, Irrigation, etc.	12	1	5	6	9	5

Sources:
1. Statistics Canada, Consulting Engineering Services, 1974. Catalogue 63-528
2. Statistics Canada, Engineering and Scientific Services, 1978. Catalogue 63-537.
3. Statistics Canada, Survey of the Offices of Architects and Consulting Engineers, 1982.

Four Sectors Continue to Predominate

Since the early 1970's four sectors have continued to predominate in the export of consulting engineering services:

- Power
- Plant Process
- Agriculture/fisheries/forestry
- Mining/metallurgy

Although power continues to be the number one sector, its relative share of the total market has decreased. There are signs that Canadian export work abroad is becoming increasingly diversified. The four major sectors in 1982 accounted for a smaller share of the overall export market than they did in either 1978 or 1974 (see Exhibit 3.7).

There are indications in the world market that there may be a long-term shift in demand from traditional infrastructure projects to industrial sector projects. This shift reflects two major factors - the increased level of development of developing countries, and the growing capabilities of local firms and developing world firms to take on infrastructure work.

MAJOR NEW COMPETITIVE FORCES

Perhaps the most influential change which has occurred in the export market in recent years has been increased competitiveness. This competitiveness has come from all sides - from within Canada, from other industrialized countries, and from the developing countries.

Uncertain Influence of New Canadian Consulting Entrants

A new phenomenon in the Canadian export market is the entrance of new consulting bodies. The consulting arms of crown and private corporations have looked in recent years increasingly to export for work. Since the recession, many industries have faced flat or even declining growth in demand. This has resulted in an increase in competition for market share among firms or, in some cases, for employment of underused resources.

Industries have had to decide whether to let people go or to find new sources of revenue and ways to use their people. Few industries want to let their engineering capability go because most feel that demand will resume at some point in the future. The search for new sources of revenue has also resulted in an interest in involvement in overseas consulting engineering and related businesses.

Many consulting engineers believe they are experiencing competition from these groups in the international market. However, the services provided by groups are not necessarily competitive with those of consulting engineers. They may provide non-engineering services such as organization and management or training skills, and some specialized expertise in particular areas such as operations or maintenance. These groups also tend to be generally weaker in marketing, service delivery and consulting skills generally than the consulting engineering firms.

An indication of the extent to which there are new entrants in the consulting engineering field, is provided by examining the registration of firms with the World Bank. Registration covers all firms offering consulting services, not just engineering. Of the firms listed, only about 30 percent are ACEC member consulting engineering firms. About 10 percent are consulting arms of public sector agencies, universities, research institutes and major private industry. The remainder includes other industries and other types of consultants (architects, management consultants, etc).

Firms From Other Industrialized Nations are Tough Competition

Canada's main competition in the export market is found in firms from the U.S., U.K., France, Germany and Scandinavia. As in Canada, firms in these countries have been suffering from downturns in domestic business and are increasingly focusing on the export market. Many have been in this market for as long or longer than Canadian firms and have developed close ties with clients in important market areas. A number also have close working relationships with contractors and manufacturers more familiar with the export field than comparable Canadian organizations.

No comprehensive analysis has been done of the comparative support provided by various countries to their consulting engineering export sector. However, interviews and other data suggest that Canada may be at a disadvantage for one or more of the following reasons:

- Disjointed export image abroad
- Inadequate market intelligence
- Lower support for export finance

This is clearly an area of long-standing uncertainty, and also an area of increasing importance. The absence of a comprehensive analysis of the support and coordination tactics of competing countries is a serious lack in the export positioning of Canadian consulting engineering firms.

Firms From Lesser Developed Countries Providing Lower Cost Alternative

Firms from South Korea, Pakistan, the Philippines, Brazil and other countries at a similar stage of development can offer basic consulting engineering services at lower costs than firms from Canada and other developed countries. The savings are primarily because of lower labour costs (both salary and living expenses) and in some cases lower access costs due to geographic proximity. The arrival of these firms in the international market poses new competitive threats for firms from industrialized nations such as Canada particularly in the sectors of engineering requiring lower levels of technology. This includes certain types of work in buildings, municipal, transportation and dams and irrigation, as well as peripheral work in many of the more advanced fields.

Increasing Emphasis On "Local" Consulting Firms

The export market is increasingly affected by policies of both indigeneous countries and international financial institutions regarding the hiring of local firms. Such sponsors will often favour or even require that local firms be hired for projects. The World Bank has an explicit policy to "encourage and foster the development of domestic consulting firms".

EXHIBIT 3.8

TOTAL WORLD BANK DISBURSEMENTS

	1979	1980	1981	1982	1983
Industrial Countries	76%	76%	73%	72%	69%
Developing Countries	7	8	7	7	7
Local	14	15	20	19	23
Undetermined	3	1	1	1	1

Source: World Bank - Projects Policy Department
1984: "Disbursement by Supplying Countries - Consultants".

The side effects of this trend has been the increased emphasis given to training and technology transfer in the export field. World Bank disbursements from 1979 to 1983 show a decrease in the amount of money going to firms from industrial countries and an increase in the amount going to local firms (see Exhibit 3.8). It is clear policy in all agencies concerned with developing countries to see that the market share for local firms continues to grow in the future.

OUTLOOK: TOUGH CHALLENGES AHEAD

The future of Canadian consulting engineers in export work is difficult to predict. Whether Canadian firms can re-establish real growth in export income will be dependent on many factors including growth prospects for the overall market and Canadian firms' success competitively in that market.

While no overall forecasts are available, it is clear that the total export market should grow with continued funds being devoted to the under-developed world and internally generated investment in the more rapidly developing countries, particularly in the east. At present, however the excessive debt load of many countries, coupled with slow growth in the industralized world is constraining the world export market.

How Canadian firms will fare in the future depends on increasing their competitiveness. To become more competitive will require adjustments in the mix of services offered, continual technological development, and innovative financing.

Required Service Mix is Changing

As circumstances change, so do clients needs and the priorities of international funding agencies. Several important services are now receiving particular attention.

- Training and technology transfer. The objective of increasing the capabilities of local engineers in the developing countries has led to increasing

attention being paid in bidding and tender evaluation to specific programs designed to transfer knowledge. These are increasingly becoming a standard component of requests for proposals and evaluation points are awarded for the quality of this aspect of the proposals. Counterpart requirements, often grudgingly accepted by Canadians as a necessary part of contracts in the past, are giving way to more sophisticated training and technology transfer programs. Canadian firms have not yet developed the training services to provide a significant competitive edge in this important service area.

- Construction management through to turnkey. Always important components of the international market, services requiring construction, construction management and project management progressing towards full turnkey, commissioning and start-up are potential growth areas for Canadian firms. A few of the largest have progressed in the provision of these types of services. Numerous studies and reports have urged further development of these services with the Canadian construction and manufacturing industries who have not kept up with Canadian consulting engineers in export market penetration. Growing in the export market will depend, in part, on the success of efforts to increase Canadian competitiveness in these services.

- Operation and maintenance. Many developing countries are experiencing major difficulties in efficiently operating plants and other facilities built in the past. In some instances these facilities are in need of major repair and upgrading for which traditional consulting skills are needed. But more frequently what is required is management expertise. Contracts can involve a combination of the supply of short-term operating personnel, counterpart supervision and training, installation of new management systems and overseeing of repair and major maintenance work. Some Canadian firms have experience in this area, but new partnership and expertise will have to be acquired to compete successfully internationally.

Generally, therefore, projects are becoming more complex and the services required are changing. Growth in international billings for the industry will depend both on sharpening traditional skills and broadening services in these new areas.

Technology and Innovative Financing are Keys

One means by which firms from industrialized countries maintain a competitive lead over those from other countries is by continuing to advance technologically. As discussed in Chapter 1, Canadian firms have taken steps to incorporate advanced computer technology into their practice operations. These steps - although not completed by many firms due to constraints imposed by the recession - are important for reducing production costs, speeding delivery and improving quality of service.

It is equally important that Canadian firms increase their technological sophistication in connection with the facilities they are designing. If firms can stay ahead in technological application then they can provide more advanced design skills than competitors from lesser developed countries.

A continued critical factor in success in the export market is innovative financing. New forms of financing have evolved which require special skills and a knowledge of a wide range of products and markets. For example, a recent phenomenon is counter trade - in which an engineering fee for construction service is paid in the form of a commodity rather than the traditional exchange of money. Increasingly, export contracts are won and lost on the basis of the financing packages offered. While government involvement in these packages is often critical, it is clear that consulting engineers will need further development of skills and services offered in the financial area.

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The key to the future in the consulting engineering export market will be an ability to adapt to the new challenges arising. The next and final chapter addresses these challenges and discusses various ways they can be met.

EXPLANATORY NOTES

1. Figures for Estimated Export Fees derived as follows:

Year	Obtained from:
1971	Statistics Canada, Service Trades, 1971, Catalogue 97-745.
1974	Statistics Canada, Consulting Engineering Services, 1974, Catalogue 63-528
1978	Figure derived from Statistics Canada, Engineering and Scientific Services, 1978. Additional fee income added on for non-respondents.
1982	Figure derived from Statistics Canada, Survey of the Offices of Architects and Consulting Engineers, 1982. Additional fee income added on for non-respondents.
1984	Figure based on overall performance from industry interviews, and on figures obtained from Department of Regional Industrial Expansion Export Survey.

Readers may note that our estimate of total international fee income in 1982 ($292 million) is about 9 percent lower than the estimate for 1980, in our previous report: "Consulting Engineering in Canada - An Update" (published in March 1981). The 1980 estimate was based on considerable optimism expressed by industry members at the time, as well as our "reading" of the colective experience of firms interviewed for that report. In retrospect, we feel that the 1980 estimate was high, given the reported figures by firms in the 1982 survey. One final comment, export figures can be skewed by one or two very large projects within a given time period. A variation of $\pm$ 10 percent would be quite conceivable for all of the export figures.

4. LOOKING TO THE FUTURE

What will be the critical challenges for Canadian consulting engineers in the years to come? An overall context of slower growth, combined with cyclicality and uncertainty, will make planning difficult. Increased competitiveness both at home and abroad, along with the changes stemming from computerization and rapidly advancing technology, provide particular challenges for the industry.

The remainder of the 1980's should be a time when consulting engineers, industry and government come together to grasp the challenges at hand. Resolving longstanding issues in contracting out and procurement policies and practices would go a long way towards maximizing the domestic market opportunity. Setting industry targets and implementing the actions required to achieve them would also be a major step forward. Foremost among these targets should be: achieving the number three position in the world for export of consulting engineering services. To do this, and to remain competitive at home, Canadian consulting engineering firms need to develop further their capabilities in technology, training and financing.

OVERALL OUTLOOK FOR THE 80'S: LESS ENCOURAGING

A critical issue facing consulting engineers in Canada in the late 1980's, will be the volume of work. Our outlook suggests that "the pie is not getting much bigger". Consulting engineers will have to strive both to retain their overall market share and to move into new areas.

- A More Competitive Future. As outlined previously, we foresee modest growth for the industry at a rate generally lower than in the past decade - in line with the outlook for the general state of the economy. The entrance of new competitors will make competition increasingly tough. Consulting engineers will need to become more aggressive and innovative to cope with that competition.

- First Step: A Healthy Economy. The consulting engineering industry is predominantly a creature of capital investment. The health of the industry therefore will depend on renewed investor confidence and an associated increase in capital investment. From our interviews the industry is more concerned with national policies and programs affecting investment than with sector-specific assistance programs. Time and time again, industry members have stressed the need to create an environment supportive of private industry growth. Although there is no specific strategy for a healthy economy, in general the industry should support, in whatever way possible, national and provincial policies which encourage investment and remove disincentives to investment.

RECOGNIZING CONSEQUENCES OF NEW INDUSTRY STRUCTURE

The new structure of the consulting engineering industry is an important factor for government and industry members to consider in their planning.

Emergence of Dominant Three

The top three firms - Lavalin, SNC and Monenco - have clearly separated themselves from the rest. They have become increasingly regionalized and diversified and are among the world's leading exporters of consulting engineering services. In addition, they have diversified outside of consulting engineering services into other businesses.

The advantages of having three large dominant firms at the top of an industry structure are many:

- Improved international competitiveness
- Greater financial stability
- Better chances to acquire an increased share of megaproject work

- Greater potential funds available for research and development and general technological development

- An ability to pull other smaller firms with them on export projects thus reducing the risks and marketing costs while increasing the exposure of these smaller firms to new markets.

In spite of these advantages, a number of members of the industry have expressed concern. Potential disadvantages attributed to an industry dominated at the top by three national firms include threats to the markets of smaller regional firms, and the dissuasion of smaller firms from exploring the export market. These concerns make it imperative that the industry continue to work at accommodating the interests of both large national and smaller regional firms in any overall strategy for development of the consulting engineering business.

Medium and Large Firms Feeling the Squeeze

Firms in the middle have been subject to market encroachment from both the top and the bottom. Attempts by many medium and large firms to expand and diversify have been both risky and costly. Many have found that it is exceedingly difficult to adjust during the recession to lower work volumes due to higher overheads and a lower flexibility in terms of staffing. Some have retrenched to concentrate on fields in which they are particularly strong while others have backed away from the export market.

These firms represent a strong resource in the consulting engineering industry. In this group are firms with specialized national expertise not widely available and others who service a wide range of clients in a region of the country. Also included are some important exporters. Altogether, the large and medium-sized firms are a core resource of the industry which has been hard hit, but which is critical to its future strength.

Proliferation of Small Firms

The increase in one-man or small sectorally or regionally specialized firms is a relatively new phenomenon in the consulting engineering industry. These firms have moved into cost-conscious markets with low barriers to entry. The key issue for the future will be: can the market support them and will they grow?

The indications are that the answer will be "yes". Increasing competition within the industry plus the continuing maturing of regional economies will mean that markets will continue to exist for the small firm, and out of these roots will come the larger firms of the future.

Differing Needs

Changes in the industry structure are important for both associations and government. It is essential that both of these groups recognize that the size, character and interests of the firms within the industry have diversified.

For associations, both national and provincial, the fact that the industry is becoming more polarized in size and geographical distribution has consequences for their activities. It will become increasingly necessary to recognize the differing needs of different groups of firms in such things as committee structures, industry policies and programs.

Similarly, for government, it is essential to recognize that the concerns and needs of the major firms in the industry differ considerably from those of the various types of smaller firms. The design of programs should reflect the varying abilities of the participants in the industry. For example, if smaller and medium-sized firms are to play a part in the export market, they will require considerably more advice and support than the major firms in the industry.

Finally, with some recovery in the economy, there will likely be continuing merger and acquisition activity. Given the current situation of the industry and the need to deal with continuing cyclicality in the

future, this activity is probably desirable to build stronger, more resilient companies. Government policies (particularly in the taxation field) should not be a disincentive to mergers, and association programs should explore appropriate techniques and management approaches.

MAXIMIZING THE DOMESTIC OPPORTUNITY

The domestic market has both new and old challenges. In spite of continuous dialogue between industry and government and actions by both parties, some old problems remain. Procurement practices and contracting out, along with regional expansion policies, remain concerns within the industry. However, since our last report new problems have evolved, particularly in the form of new types of competitors.

Improving Procurement Policies and Practices

The burden of procurement practices and the dangers of selection by price remain significant concerns among consulting engineers. In spite of considerable dialogue between industry and government, the types of problems cited by consulting engineers have not changed since our first report was published in 1978.

1. Burdens of procurement practices. Through our interviews of consulting engineering firms across the country, a number of recurrent problems were identified:

   - Too many firms invited to bid on government contracts
   - Elaborate proposals required
   - Inadequate/inappropriate terms of reference
   - Delays in selection procedures
   - Shelving of projects for which costly proposals were prepared.

2. Basis of selection: price or ability? A number of consulting engineers stressed the dangers of competitive bidding for projects. Increasingly they have found that cost or price becomes the determining factor in the selection of a firm. It has been suggested that competitive bidding for projects will lead increasingly to one or more of the following situations:

   - Minimal engineering, minimal innovation
   - Too narrow interpretation of scope of the assignment, resulting in less than appropriate solutions, lack of analysis of side effects
   - Use of less experienced professionals with consequent increased risks and potentially poorer quality of work
   - An inadequate investigation of potentially better or cheaper alternatives.

Industry concern is sharp enough to warrant special effort to resolve concerns regarding procurement policies and practices. This will involve continued action by the consulting engineering industry in meeting with government - federal, provincial and municipal - and with the private sector, particularly with the industry and trade associations. In summary, the consulting engineering industry should continue and further develop its dialogue on procurement policies and practices with both public and private sector clients.

Encouraging Contracting Out

A recurrent concern in the industry is the extent to which government and client industries contract out work to consulting engineers. The desirability of contracting out by government and private industry has been the subject of considerable public debate for over 20 years. From our interviews it is evident that possible constraints on contracting out became an even greater concern to consulting engineers during the recession. At a time when consulting engineers were short of work, government agencies and private industries were pulling

work back in-house to sustain their staff levels. Many firms stated that various departments within federal, provincial and municipal governments were now doing a larger percentage of their total work in-house, particularly on smaller projects.

There is no precise documentation of the proportion of engineering work carried out in-house in the public or private sector, but it naturally remains a major concern among consulting engineers. The report by the Consultative Committee on the Canadian Consulting Engineering Industry stated the problem succinctly:

> "A strong and urgent case exists for the establishment and implementation of aggressive contracting out - policies and practices by government and client industries with respect to in-house engineering. Such policies and practices will contribute to the future rapid growth of development of engineering expertise in the private sector, increase R & D expenditures, and enhance export capability, thereby improving the prospect for increased follow-on sales of manufactured goods and other services."*

To address this issue directly will not be an easy task given the natural preference of a manager in any organization to have full control over work for which he or she is responsible. If contracting out is to increase, a clear rationale along with guidelines and criteria - defining when an organization should be contracting out more work - need to be developed. To meet this challenge, we recommend the following actions.

- Develop the economic rationale and guidelines. There is debate among economists on the overall economic merits of contracting out versus in-house work. The consulting engineering industry cannot just emphasize the "free enterprise is better" ethic in its arguments for greater contracting out. It must have a clear economic rationale. Studies should be encouraged to identify the broad economic benefits of contracting out, as well as to develop practical

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* Report of the Consultative Committee on the Canadian Consulting Engineering Industry (1982) The Canadian Consulting Engineering Industry: Realizing the Potential

criteria and guidelines for determining how much of its work a particular organization should contract out. The approach should be flexible enough to be used for assessing both private and public sector organizations. These studies could well be carried out at one or more universities.

- Assess the real extent of excess in-house work. Using the results of the above work, the Association of Consulting Engineers of Canada along with the provincial associations should come together with government to fully assess the realities of in-house work which could be contracted out. An assessment should be made that answers the following questions:

  - How much work done in-house by private industry would be more efficiently handled by contracting out?

  - How much work is being done in-house by government which could be more efficiently done by the private sector?

  - Which departments or agencies could be contracting out more?

  - What regions and industry sectors would be most benefited by this contracting out?

  This assessment could be done on federal departments and agencies and at the provincial level including both government agencies and private companies.

- Plan organization-specific strategies. Having done the overall assessments, certain organizations should be singled out for a specific review in cooperation with their senior management. These examinations could be done by joint association-government committees, with the backing of central government agencies concerned with overall economic productivity. The criteria developed in the earlier studies would be used to assess the extent and desirability of the contracting-out opportunity.

Meeting New "Competitors"

An emerging issue in the consulting engineering industry is the entrance of new types of competitors into the domestic market. There is a strong belief that government agencies and private industry are making inroads into certain market areas previously regarded as the exclusive territory of consulting engineers. In many cases, these are the same groups who have reduced the amount of work contracted out to consulting engineers.

The problems which engineers are experiencing are not unique - in a period of tight domestic competition, many organizations are exploring new business opportunities which may not be directly related to their major area of work. Although we have not conducted a detailed study of the extent of this phenomenon, we did encounter numerous complaints across the country. In particular, consulting engineers cited examples of competition with the following organizations: provincial and federal research centres, technology centres, power utilities, and various other federal or provincial agencies.

The time has come to assess the extent of competition from the "unwanted newcomers". The first steps which must be taken in this process are as follows:

- Collect evidence of government agencies actually competing with consulting engineers

- Dialogue with organizations concerned. Having developed the information, the consulting engineering industry associations should sit down and talk with these organizations. The purpose of this dialogue would be to understand why this competition is occurring, and to ensure that if these groups are going to compete they do so on a fair-cost basis and their form of consulting not be government-subsidized.

- Look for opportunities to cooperate. While some organizations may be competing with consulting engineers, it is highly likely that others will be providing somewhat different services than those normally provided by the consultants. If this is the case, or if the organizations possess skills complementary to those of the consultants, then new opportunities might be identified.

Continuing Efforts To Reduce Imports

In certain sectors, Canadian consulting engineers still lack the necessary technology, skills, experience or size to carry out some major projects. Although there are no precise figures regarding imports of consulting engineering services from the United States and other countries, there is a fear in certain regions of the country that there is not enough Canadian content on major projects. This is an issue that has existed since our first study of the industry but one which has subsided recently with the fall-off in major project activity. Higher Canadian content is seen as desirable for a number of reasons:

- To have greater domestic control over the development of large resource projects by having Canadian firms in charge
- To provide more employment for Canadian engineers
- To ensure that Canadian firms increase their expertise, thereby broadening their potential export markets and generally increasing their competitiveness internationally.

The extent of participation by Canadian firms in the East Coast offshore energy development was singled out for emphasis in our interviews.

For Canadian consulting engineers to gain the required skills and size to participate in major projects, pressure by governments should be maintained to ensure that Canadian firms are selected to play key roles on major Canadian projects whenever they have the necessary capabilities. Where they do not, then joint ventures with foreign firms should be structured so that an increased share of the work goes to Canadian firms and there is provision for technology transfer to Canadian firms built into the contract.

Promoting Regional Expansion

Canadian and provincial policies, whether explicit or understood, are generally aimed at strengthening, deepening and diversifying regional service bases. The rationale of having skills available near the needs is questioned by few. However, regional preference policies

may be considered dangerous if they are applied arbitrarily. In order to diversify and strengthen the capabilities of consulting engineers across Canada, certain steps should be taken, but government legislation should be avoided.

- Regional preference. On projects for which local or regional firms have the necessary skills and capability, preference should be given to them. Policies, and means of applying them, need to be agreed upon by the associations, starting at the national level. ACEC should continue its efforts in this regard.

- Technology transfer. In those cases where there is a lack of appropriate skills among local firms, joint venturing and technology transfer should be encouraged with the regional or national firms brought in to take on the work. For major projects likely to be repeated in the region, joint venturing with a training component should be encouraged. Where joint venturing is undertaken, local firms should get more than just the "peripherals". In all cases, the main contractor should be encouraged to incorporate into the term of reference an allowance for technology transfer to local firms.

MEETING THE EXPORT CHALLENGE

Canadian consulting engineers need to face up to the challenges in the export market and recognize that its demands are changing. With competition becoming increasingly tough, Canadian firms may in fact be slipping in competitiveness relative to other countries. The ability to compete will depend increasingly on a number of key factors. Increasing expertise in certain demand areas, understanding the competition and developing innovative ways of working with the competition will be some of the many challenges ahead.

Setting A Target - Number Three in the World

As noted in Chapter Three, Canadian consulting engineering firms placed fourth in developing country markets in 1983 behind the American, British and French firms. A target for the remainder of the 1980's should

to be achieve third position by capturing a greater market share. To do this, the Canadian consulting engineering industry will have to take action immediately in certain areas.

Increase Expertise in Areas of High Future Demand

To compete effectively in the late 1980's, three important areas of service will have to be developed further:

1. Training. Explicit policies of both international financial institutions and lesser developed countries have made training and technology transfer an increasingly important component in contracts. Canadian consulting engineers should take advantage of Canada's excellent reputation in training. The combination of a good educational infrastructure at home, the absence of colonial ties, a cooperative rather than a paternalistic image and the capability of teaching in at least two languages provides a strong base for excellence in education and training. To capitalize on this resource, the following actions should be undertaken:

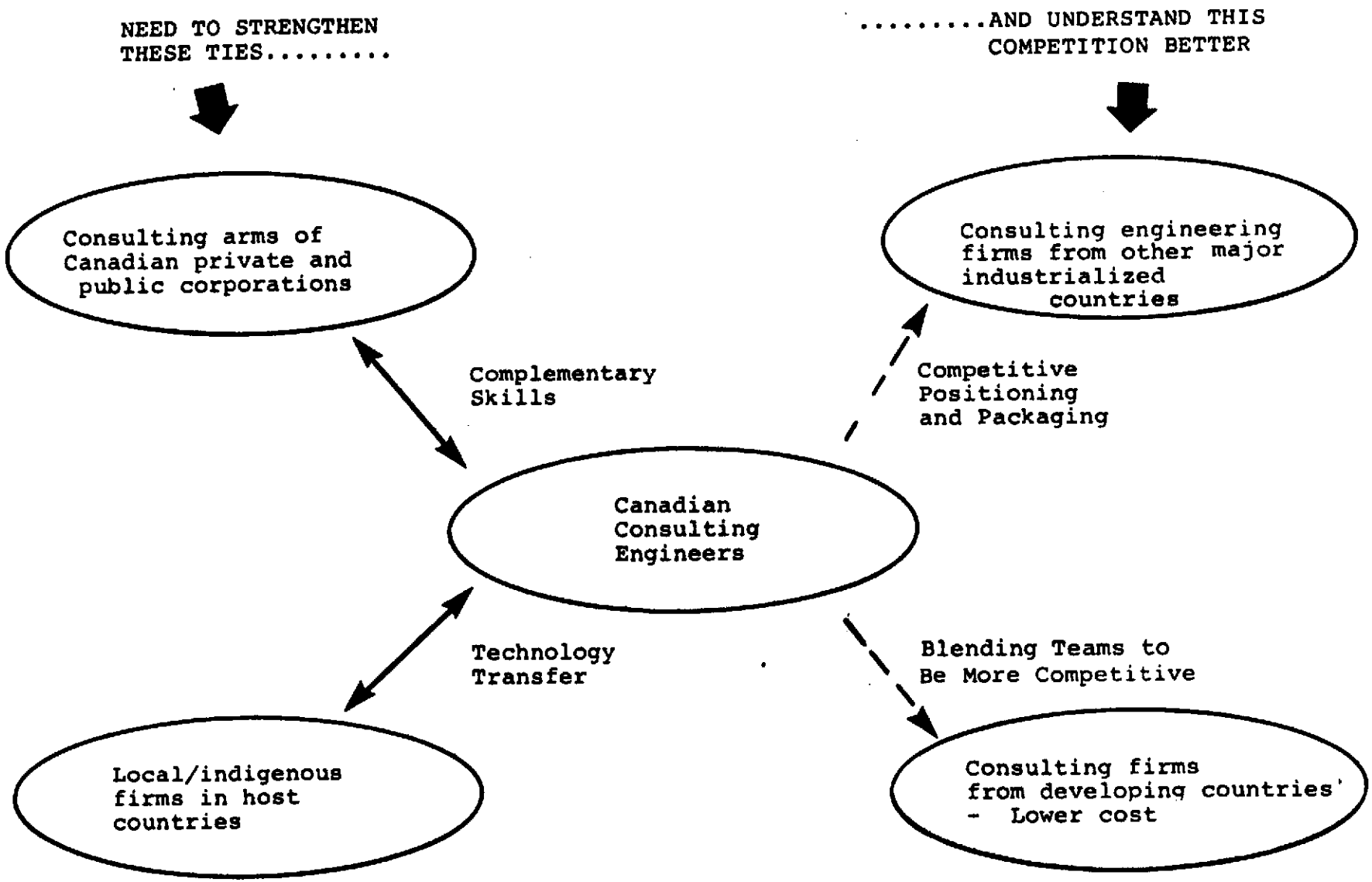
   - More dialogue should be initiated between consulting engineers, educational organizations and private corporate training groups. This might take the form of conferences or regular meetings

   - Better training products. Efforts should be directed towards an examination of the design, delivery, evaluation and improvement of existing training and technology transfer programs in the export of consulting engineering services

   - More joint venturing. Canadian consulting engineers should be encouraged to form joint ventures with non-consulting educational organizations.

EXHIBIT 4.1

DEALING WITH THE COMPETITION IN EXPORT



2. Appropriate technology. To compete effectively in the world market, Canadian consulting engineers need to be technologically up to date. Not only must they retain their preeminence in certain areas such as mining and metallurgy, transportation, forest products and electric power generation, but they must also recognize the changing demands from the lesser developed countries. For such countries the appropriate technology is becoming more "micro-oriented" than "mega-oriented", more adapted to their level of development and their ability to maintain it. To meet this demand, certain actions will be required.

   - R & D funding. The federal government should make available funds for export-oriented research and development into appropriate technologies likely to be in demand in lesser developed countries.

3. International financing. Increasingly, a key factor in winning projects is having the right financing package. As Engineering News Record has pointed out, "financial engineering is not a brand new thing under the sun .... What's new is compulsion - help find the financing or lose the bid". In addition, the use of counter-trade has become an increasingly important consideration. In total, engineering firms that wish to be successful in export need to be adept with numerous financing sources including international financial institutions, commercial banks, investment bankers, counter-trade, federal export programs, and sometimes the individual company's own resources.

Dealing with the Competition

Clearly, Canadian consulting engineering firms cannot "go it alone" in the export market. They must face up to the fact that competition is coming at them from many sides (see Exhibit 4.1):

- Consulting arms of major Canadian private and public corporations

EXHIBIT 4.2

RECOGNIZING COMPLEMENTARY STRENGTHS

	CONSULTING ENGINEERS	CONSULTING "ARMS" OF PUBLIC AND PRIVATE CORPORATIONS
• Engineering Service Strengths	- Feasibility studies - Planning and design - Detailed design - Construction supervision - Project management	- Operations - Maintenance planning - Specialized technical knowledge
• Other "Skills"	- Experience overseas - Export marketing - Understanding the competition	- R & D capability - Experience in training - Procurement
• Critical Resources	- Flexibility	- Access to financing - Access to major hi-tech facilities, large computing capacity - Quasi-government

- Local/indigenous firms in the host country
- Firms from major industrialized countries
- Lower-cost firms from developing countries.

The strategies which should be considered to deal with these groups range from working with them to understanding them better so that Canadian consulting engineers can improve their competitive edge:

1. Recognizing complementary strengths. The increasingly higher profile of new Canadian consulting entrants in the export market has worried many in the Canadian consulting engineering community. The consulting "arms" of major public and private organizations such as Hydro-Quebec International, Canadian Pacific Consulting Services Ltd., Ontario Hydro and Bell Canada International have moved into the export field. The response from the consulting engineering community has been at times fear and outrage. However, a potentially better approach is to recognize the complementary strengths of each group and work together (see Exhibit 4.2).

   Consulting engineers can bring many skills to the new consulting entrants - perhaps most importantly a "savoir faire" in working and marketing overseas. On the other hand, many of the major corporations bring with them a greater depth and range of experience in operations and maintenance planning, as well as greater access to financing and other resources. The two groups should sit down together to discuss these mutual strengths, and to develop effective modes of doing business together. The approach to these organizations should be integrated. As we have already observed these groups may be competitors, clients or partners in both the domestic and export markets. The Canadian consulting engineering industry should develop an integrated strategy in approaching these firms regarding contracting out and competition at home as well as developing a partnership for work abroad.

2. Strengthening ties with indigenous firms. As noted previously, teaming up with indigenous firms in developing country markets is increasingly important in the eyes of the international financial institutions and host countries.

Canadian firms need to strengthen ties with indigenous firms through joint ventures and consortia, and they must further develop their ability to work effectively with these groups through good training techniques and technology transfer.

3. Understanding the competition. In order to maintain a competitive edge in the world market, Canadian consulting engineers need to know what they are up against. The lack of a comparative analysis of the support provided by competing countries in export marketing, financing, insurance, taxation, and high-level government assistance puts Canadian consulting engineers at a disadvantage. A study on the relative competitiveness of Canadian export support* suggested that Canada requires an in-depth evaluation of export marketing and promotion programs, and a national coordinated strategy for exporters.

   The federal government should reassess Canada's export programs and strategy focussing on key issues:

   - A national strategy for export, i.e. minimizing duplication of effort among government agencies (federal and provincial) involved in marketing and promotion

   - Competitive financing and insurance

   - Influence of taxation on incentive to export

   - The possibility of a national approach to bidding - eliminating competition among Canadian firms.

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* Horgan, D.H. (1983), A Study on the Relative Competitiveness of Canadian Consulting Engineers in the Export of Services to Developing Countries - a dissertation presented to the Canadian School of Management.

Getting More Firms Into Export

One final area of concern regarding the export market is that relatively few firms actually participate in it, i.e. "all of our eggs are in relatively few baskets". An increasing area of importance will be encouraging the smaller specialized firms to get into export. Programs such as PEMD - the Program for Export Market Development - and CIDA projects are important stepping stones in the industry.

The federal government should continue to provide programs and project funding which facilitate the entrance of Canadian consulting engineering firms into the export field. These additional export sales will be needed if we are to achieve the goal of becoming the number three exporting country in consulting engineering services.

COPING WITH CYCLICALITY AND UNCERTAINTY

For consulting engineers, the phenomena of cyclicality and uncertainty are facts of life. What is new is the expectation that the current "low" in the cycle will be protracted, i.e. that slower growth will continue for the remainder of the 1980's. For individual firms, this means competing in a tougher market and finding ways to cope with the inevitable gaps and surges in work. It also means that to be competitive a firm must be more productive, have lower costs and be in the right market at the right time.

Reducing Cost Exposure

To deal effectively with cyclicality, individual firms must reduce their cost exposure. During 1981-84, a number of firms found themselves incapable of adjusting quickly enough to reductions in work volume and revenue. Increasingly, firms are exploring means to increase their flexibility by building in safety valves to protect themselves against cyclical demands, including:

- Hiring people on contract to increase flexibility in staffing and reduce the possibility of unlawful dismissal suits.

EXHIBIT 4.3

FOUR WAYS TO INCREASE PRODUCTIVITY

1. PEOPLE ⇩ MACHINES

2. MACHINES ⇩ MORE EFFICIENT MACHINES

e.g. CADD

3. PEOPLE ⇩ MORE EFFICIENT NEW PEOPLE

4. PEOPLE ⇩ MORE EFFICIENT SAME PEOPLE

- Compensating employees through a low base salary plus a profit-sharing scheme (thereby reducing payroll costs and exposure during rough times and creating incentives for employee productivity).

- Reducing overhead through sharing or renting of various facilities, e.g. CADD.

Improving Productivity

Productivity in the service sector is lagging behind that in the industrial sector. From 1950 to 1980, the average annual rate of growth in output per person was 1 percent in the service sector, compared with 3.1 percent in industry.* Productivity in the future for the service sector will depend very much on improvements in personal and machine productivity.

To compete effectively in the marketplace, particularly internationally, consulting engineers will have to become increasingly productive. There are four basic ways to increase productivity in the future (Exhibit 4.3). The first two methods are: to substitute machines for people; and to replace older machines with newer and more efficient ones. Translated into the consulting engineering environment, this generally means coming to terms with computers, although in some sectors others forms of technology are also having pronounced impacts on productivity. The third and fourth methods - replacing current staff with more efficient staff or improving the efficiency of existing staff - encompass the greatest challenge. Various methods of improving staff productivity exist.

1. Coming to Terms With Computers. A major challenge for all firms in the industry is developing a strategy regarding computerization:

   - What kind of computers do we need?

   - For what applications?

   - And what are the productivity/manpower implications?

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* Chand, U.K. Ranga "Why The Domestic Increase In Service Sector Employment?" Canadian Business Review V.10, N.3, Autumn 1983, 25-28.

Computerized administration is seen as critical for productivity, regardless of the size of the firm. While most firms have already incorporated word processors into their operations, a smaller proportion of firms have computerized their accounting, project management, and other management information systems.

Increasingly, firms are looking to mini and micro computers for data manipulation applications. A vast array of software has been developed for various engineering applications. To remain productive and competitive, firms will have to be aware of these programs and make use of them.

One of the most talked about elements of computerization is CADD - computer-aided drafting and design. Although for most Canadian firms the experience with CADD to date has not been uniformly successful, there has been a definite recognition of its potential. A survey sponsored by the U.S. Professional Services Management Journal revealed that firms with computerized design and drafting capabilities are more profitable than firms without this capability. Canadian firms must come to terms with CADD, both to increase productivity and to maintain competitiveness in the international market.

2. Improving People Productivity. Increasing output per man-hour quantitatively and improving it qualitatively represent a major challenge for consulting engineers. It involves maximizing not only the output per individual but also the output per project.

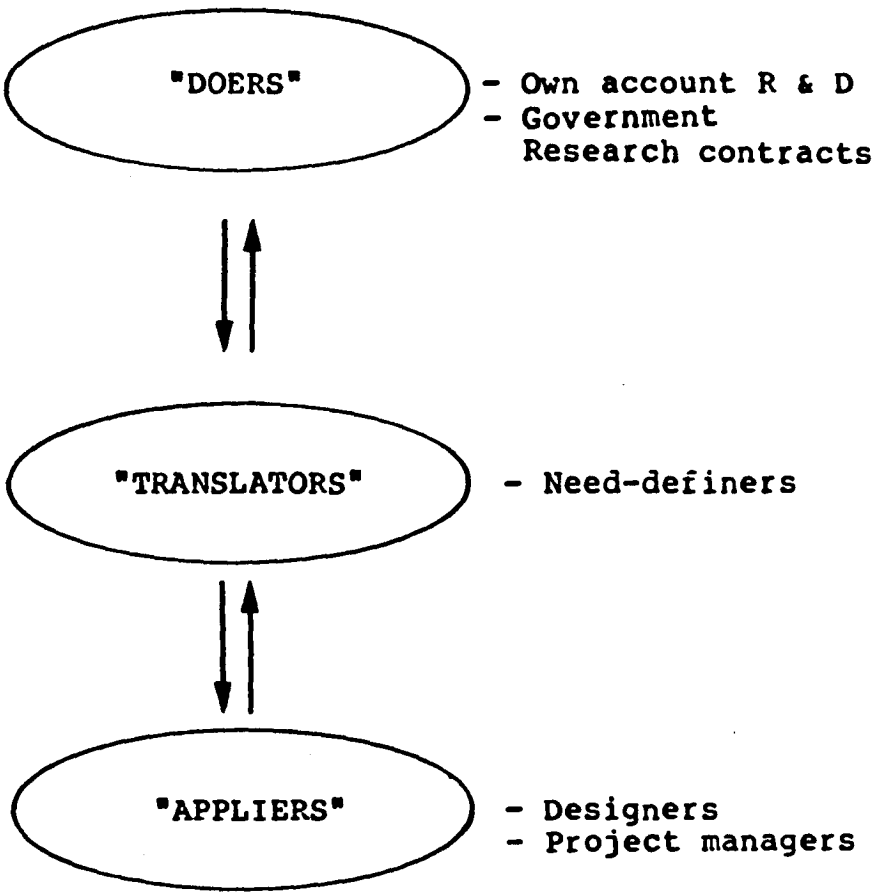
   Consulting engineers need to pay increasing attention to what makes people productive. A recognition of the major factors affecting employees' job performances and productivity is the first step. Key factors include:

   - Technology - integration with machinery

   - Physical environment - noise, lighting, ventilation, temperature, etc.

EXHIBIT 4.4

A RANGE OF ROLES FOR CONSULTING ENGINEERS IN R & D



- Ability - skills, knowledge

- Human social conditions - leadership, personnel policies, organization structure, etc.

- Breaking-down and structuring of the work items.

Each of these elements requires ongoing attention by individual firms if productivity is to be maximized.

A critical element of productivity in consulting engineering is the output per business unit or per project. Increasingly, consulting engineers must re-examine the skills/technology mix on an individual project. It is questionable whether the recent tendency towards a higher-skill mix within a firm is productive. Firms must be continuously re-examining the higher-skill versus lower-skill mix, and delegating the less skill-intensive work where possible.

Participating In Technological Development

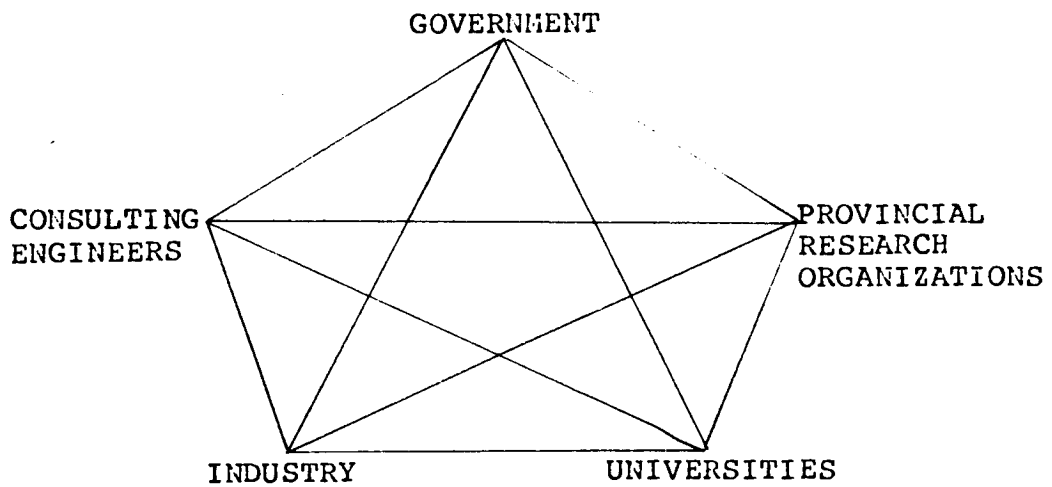
The appropriate role of consulting engineers in technological research and development has attracted much attention in recent years, but has yet to be clarified. From our interviews it is evident that few consulting engineers actually do true research and development on their own, but many have the desire and ability.

A range of roles exists for consulting engineers in the research and development process (Exhibit 4.4). Finding the appropriate niches for consulting engineers will be a major challenge in the 1980's. Clearly consulting engineers have a lot to offer, especially in the role of translator, ensuring that emerging needs in the design and construction process are addressed by those in research and development.

The National Research Council is addressing the role of consulting engineers in research and development through two basic mechanisms:

EXHIBIT 4.5

NEED IMPROVED DIALOGUE BETWEEN
KEY GROUPS IN RESEARCH AND DEVELOPMENT



- The establishment of an Associate Committee on Consulting Engineering and Technology Transfer (ACCETT)

- The initiation by that Committee of a major study on the appropriate role of consulting engineers in research and development.

These two efforts should go a long way towards the formulation of a research and development strategy.

The consulting engineering industry must clearly come to terms with this issue soon. In addition to the NRC efforts in this regard, consulting engineers should engage in improved formal and informal dialogue between the key groups in R & D, as illustrated in Exhibit 4.5.

TAKING ACTION

Clearly, there are some areas of concern that require immediate action by industry associations, government and individual firms. The priorities which should be attached to the various recommendations are illustrated in Exhibit 4.6. To maximize the potential in the domestic market, governments and industry associations, must work together to resolve a number of key issues including:

- Improving procurement practices

- Contracting out

- Dealing with new competitors

- Reducing import penetration

- Promoting regional expansion

Meeting the export challenge and becoming number 3 in the world will require:

- Increasing expertise in training, technology and financing

- Working with and understanding the competition

- Getting more firms into export

EXHIBIT 4.6

PRIORITIES OF RECOMMENDATIONS

HIGH PRIORITIES

- Improving procurement policies and practices
- Encouraging contracting out
- Increasing expertise in training
- Improving relationships with "partners" in export
- Understanding world competition
- Participating in technological development, R & D, etc.

MEDIUM PRIORITIES

- Recognizing large firms vs. small firms in programs
- Dealing with new competitors
- Promoting regional expansion
- Developing appropriate technology for export
- Coming to terms with computers

LOW PRIORITIES

- Reviewing merger and acquisition approaches
- Reducing import penetration
- Increasing expertise in international financing
- Getting more firms into export
- Improving "people" productivity

Individual firms will need to come to terms with the environment of the 80's - tough competition at home and abroad, as well as cyclicality and uncertainty. The challenges are many:

- Becoming more productive
- Coming to terms with computers
- Participating in technological development

To deal effectively with these challenges, and to maintain or improve market share, individual firms will need to spend more time on strategic planning. Careful competitive positioning will be a key ingredient to sucess. For those less familiar with the process of strategic planning we have included a possible approach in Appendix A. It is designed to help firms ask themselves some significant questions about the future.

* * * *

In conclusion, the future will be one of fast-paced change for the consulting engineering industry. The industry will be venturing into new territories - whether they be new technology, new sectors, new services or new regions. As in the past, the consulting engineering industry will no doubt maximize the opportunities these new territories bring.

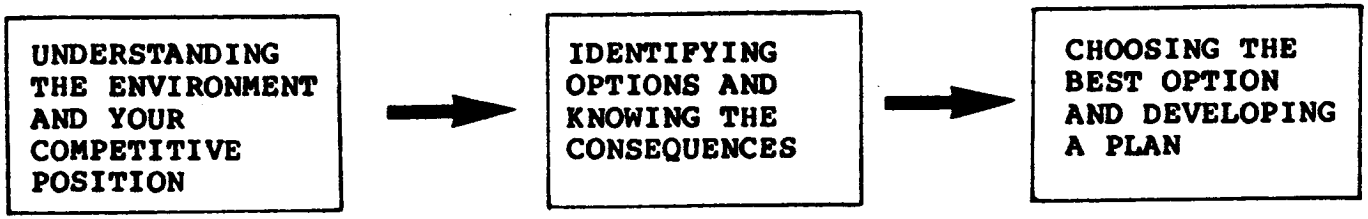
APPENDICES

A. STRATEGIC PLANNING FOR THE FUTURE

B. SECTORS OF CONSULTING ENGINEERING - DETAILED BREAKDOWN

EXHIBIT A.1

STRATEGIC PLANNING IN THE CONSULTING ENGINEERING INDUSTRY



- Environment
- The three C's
  - Company
  - Customers
  - Competition

- What are the advantages/ disadvantages of each option?

- What option "fits" best?
- Defining resource requirements
- Developing an action plan

APPENDIX A

Strategic Planning For The Future

Our interviews revealed a broad spectrum of approaches to the process of strategic planning. Some firms devote many man-hours to it, while others regard it as mysterious and unnecessary. Nonetheless, any firm will sooner or later ask itself some significant questions:

- Should we diversify?
- Should we specialize?
- Should we export?
- How many and what kind of staff do we need?

Strategic planning is what provides answers to these questions (see Exhibit A.1). Some firms might find the following approach helpful.*

Understanding Your Competitive Position

The initial step is understanding the major forces which influence a firm's options, i.e. the firm's "environment" and the competitive position (see Exhibit A.2).

Understanding the environment means defining the changes in major economic and social forces, the technological developments, and the political and legislative changes which will have an impact on the firm.

The tough competition facing the industry in the 1980's will make it increasingly important to understand an individual firm's competitive position in the industry. This means understanding three basic elements - the three C's:

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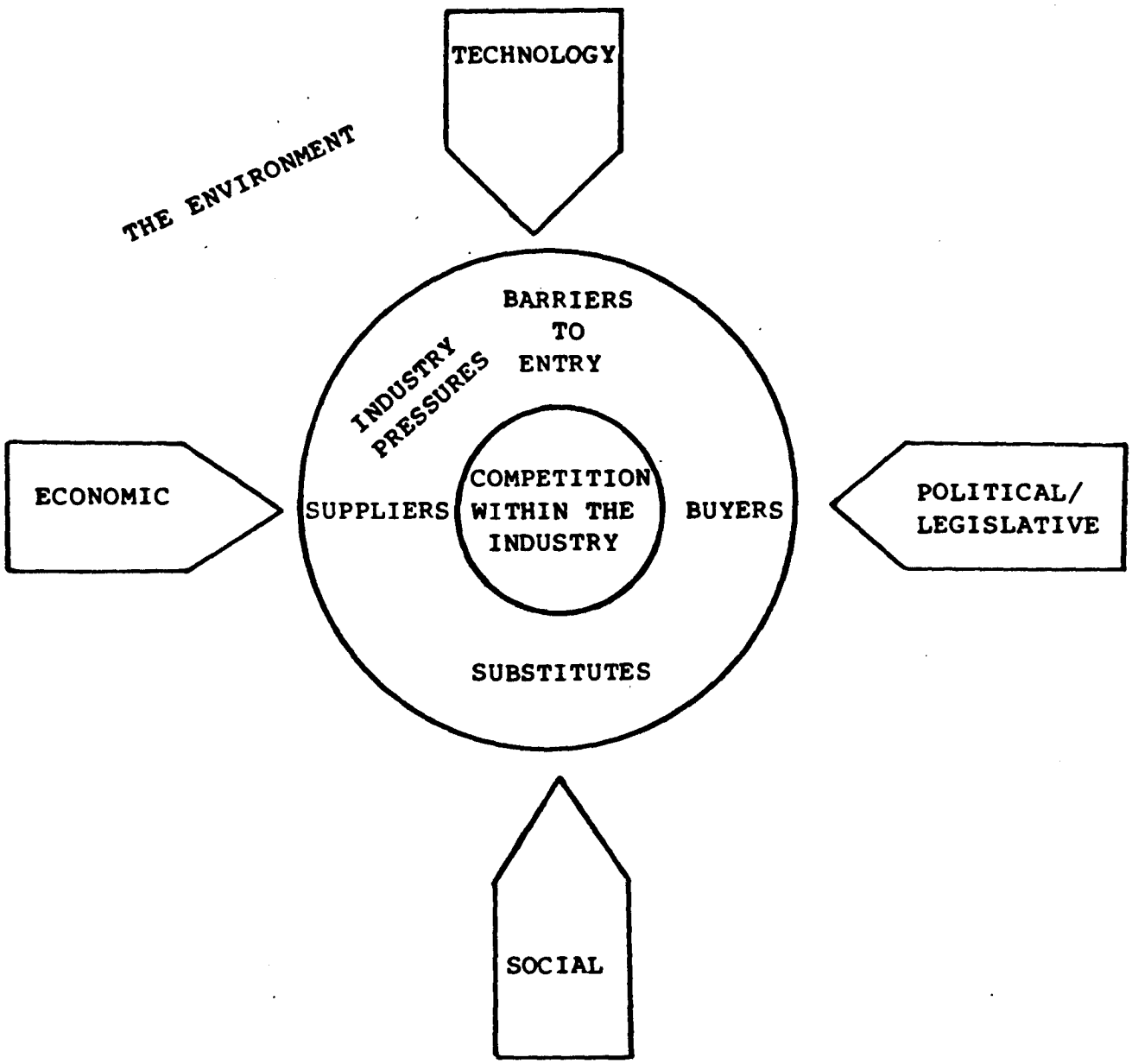
* Porter, Michael E. (1980), Competitive Strategy - Techniques for Analyzing Industries and Competitors. The Free Press, New York.

EXHIBIT A.2

UNDERSTANDING THE ENVIRONMENT



- The Company

  - What resources do we have?
  - What unique skills/advantages - what problems, deficiencies do we need to overcome or circumvent?

- The Customers

  - Who are/will be the customers?
  - What are their needs?
  - What do we need to do to sell to them successfully?

- The Competition

  - Who are they?
  - What are their similarities/dissimilarities to us?
  - Where are they weak or strong?

With an understanding of these basic elements, the firm can move on to identify the options available to it and to assess the consequences of those options.

Identifying the Options

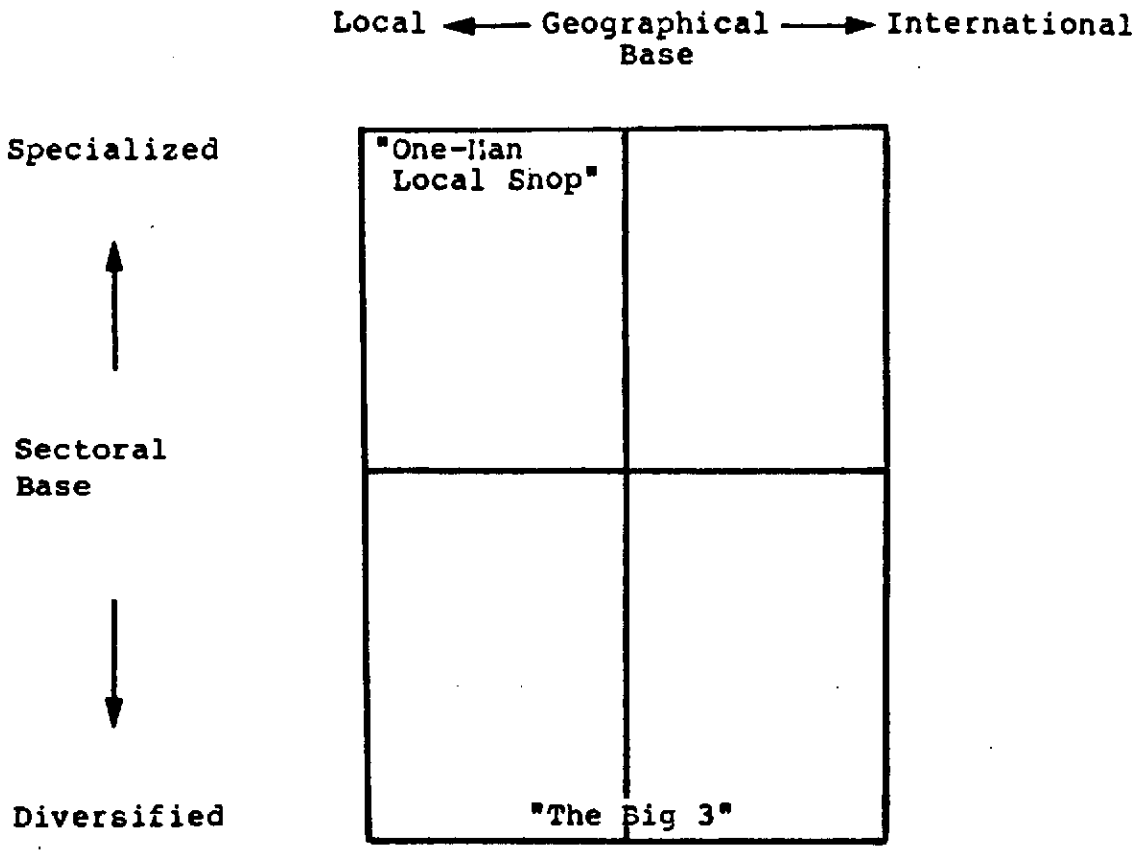
For the vast majority of firms, a decision must be made regarding two major variables:

- Sectoral base. Targetting growth sectors and avoiding stagnant sectors requires a close look at the market. Firms may choose to become increasingly diversified by pushing into new sectors and offering a range of services to their clients. Alternatively, they may choose to deepen a specialty and become recognized experts within a particular sector.

- Geographical base. Determining the appropriate geographical base of operations is a tough strategical question. Firms may decide to focus their efforts by tightening their grip on the local/regional market. Alternatively they may wish to spread their efforts across Canada or move into the international market.

EXHIBIT A.3

IDENTIFYING THE OPTIONS - SECTORAL AND GEOGRAPHICAL



In making plans, it helps if firms analyze their current position sectorally and geographically, and consider the direction in which they wish to develop. Exhibit A.3 identifies in a cell diagram the range of options available. In recent years a number of firms such as "the big three" - Lavalin, SNC and Monenco - have deliberately positioned themselves to encompass a diversified operation on a wide geographical scale. Other firms, such as the one-man "local shop" have made a deliberate decision to be local and specialized - they have neither the desire nor the resources to extend themselves further. But for most firms, strategic choices have to be made on a regular basis. Exhibit A.4 identifies two options and their likely risks and advantages. For small firms in particular, a decision will often have to be made between becoming a diversified local firm and becoming a specialized national or international firm.

An option often overlooked, especially by small firms, is the joint venture. This option has particular advantages for the smaller firm which is unlikely to succeed on its own in competition for major projects or international work. The advantages to the small firm of joint venturing with a major firm on a local project are transfer of technology and risk minimization. For the small specialized firm there are also major advantages in joint venturing with large firms on international work, such as easy entrance into the international market with minimal marketing costs, lessened risk and training in how to do export work.

Choosing the Best Option and Developing a Plan

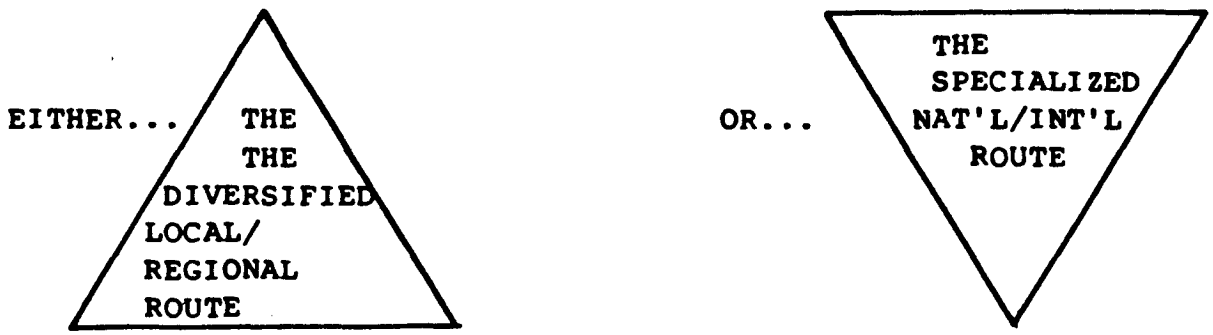
Regardless of size, consulting engineering firms need strategic planning to determine their resource requirements in terms of manpower and technology and to understand where their marketing efforts should be directed.

A chosen strategy should answer, at a minimum, the following questions:

EXHIBIT A.4

RECOGNIZING THE CONSEQUENCES OF DIFFERENT OPTIONS

NARROW ← SECTORAL BASE → WIDE



WIDE ← GEOGRAPHICAL BASE → NARROW

STRATEGY

- Consolidate regional base
- Anticipate demand of local market

RISKS

- Subject to swings of local economy
- Insufficient scale to get some local work

ADVANTAGES

- May be safer

STRATEGY

- Expand beyond current markets - export
- Intensify specialty though R & D

RISKS

- Subject to changes in demand for sector-specific services
- High costs of R & D marketing
- Insufficient scale to handle some work

ADVANTAGES

- Greater potential for profit

- Who will we sell to?
- How will we compete?
- What will make us successful?
- What resources will we need?
- How will we acquire them?

Having answered these questions, firms can position themselves better to cope with the competitive market in the years to come.

APPENDIX B

SECTORS OF CONSULTING ENGINEERING - DETAILED BREAKDOWN

1. MUNICIPAL

Water Supply
Sewage Disposal
Waste Disposal
Roads & Streets
Traffic Engineering
Urban & Regional Planning
Other

2. BUILDINGS

Acoustics
Communications
Electrical
Elevators, Escalators & Moving Sidewalks
Heating, Ventilating & Air Conditioning
Illumination
Mechanical
Piping Systems
Refrigeration
Structural
Other

3. PETROLEUM & NATURAL GAS

Exploration
Extraction & Separation
Pipelines
Processing Plants
Refineries & Upgraders
Mains & Lines
Other

4. POWER

Systems Planning & Operation
Hydro Power
Thermal Power
Nuclear Power
Transmission & Distribution
Other

5. MINING AND METALLURGY

Exploration
Mine Planning & Production
Mineral Beneficiation
Smelting
Refining
Other

6. PLANT PROCESS DESIGN

Aluminium Fabricating
Aluminum Smelting
Automotive Plants
Breweries
Cement Plants
Chemical Plants
Distilleries
Feed & Flour Mills
Fertilizer Plants
Food Processing
Founderies
Glass & Ceramics
Industrial Environmental Control Facilities
Industrial Power Houses
Metal Working
Misc. Manufacturing Plants
Petro-chemical Plants
Steel Mills
Textile Mills
Wood Working
Other

7. TRANSPORTATION

Bridges
Tunnels
Highways & Expressways
Railways
Public Transit
Transportation Studies
Other

8. FORESTRY, AGRICULTURE AND FISHERIES

Agricultural Engineering
Fisheries
Forestry
Logging
Sawmills
Veneer & Plywood
Particle & Waferboard Mills
Hard & Soft Board Mills
Pulp & Paper Mills
Other

9. DAMS AND IRRIGATION

Dams
Irrigation
Flood Control
Other

10. AIR AND SEAPORTS

Airports
Harbours, Docks & Jetties
Dredging, River & Coastal Works
Terminals & Warehouses
Oceanography & Hydrography
Other

11. TELECOMMUNICATIONS

Microwave
Broadcasting
Wire Line Transmission
Telephone Systems
Supervisory Control & Data Transmission
Other

12. MISCELLANEOUS

Air & Noise Pollution Control
Arbitration & Litigation
Computer Science & Data Processing
Environmental Impact Studies
Interior Design
Naval Architecture
Remote Sensing & Photogrammetry
Soil Mechanics
Other

Source: Statistics Canada 1982 Consulting Engineers Sector Classification List