

Engineering and Technology Labour Market Study



Canada's Consulting Engineering Sector in the International Economy

Engineers Canada
and
Canadian Council of Technicians and Technologists

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About Engineers Canada

Established in 1936, Engineers Canada is the national organization of the 12 provincial and territorial associations and ordres that regulate the practice of engineering in Canada and license the country's more than 160,000 professional engineers. Engineers Canada serves the associations and ordres, which are its constituent and sole members, by delivering national programs that ensure the highest standards of engineering education, professional qualifications and professional practice.

About the Canadian Council of Technicians and Technologists

The Canadian Council of Technicians and Technologists (CCTT) establishes and maintains national competency standards for certifying members with a 'quality seal of approval' in 14 applied science and engineering technology disciplines: bioscience, industrial, building, instrumentation, chemical, mechanical, civil, mining, electrical, petroleum, electronics, geomatics, forestry, and information technology. CCTT's provincial associations are responsible for issuing these highly regarded credentials, which are recognized by provincial statute in many Canadian provinces.





Engineering and Technology Labour Market Study:

Canada’s Consulting Engineering Sector in the International Economy

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Trends:

- Canada ranks among the world's leading exporters of engineering services. In recent years, Canada has been the third largest exporter of engineering services, after the United States and the United Kingdom.
- From 2002 to 2007, Canada's share of the international market (as measured by the business of the world's 225 largest engineering firms) averaged 3.4%. This is a significant increase over the latter half of the 1990s when Canada's share was 2.6%.
- One in every five Canadian professionals working in the consulting engineering sector was supported, at least in part, by international work.
- Recent commitments by governments in the OECD and China to invest heavily in infrastructure will ensure that the international market remains a significant source of demand.
- The profile of the international market differs from the domestic market. The fields which predominate in the international engineering services market are:
 - infrastructure design and execution,
 - mining and metallurgy development, and
 - energy-related projects.
- Canadian foreign direct investment in energy and mining is a significant factor in the international engineering market and generates a substantial portion of the demand for Canadian engineering service exports.
- Non-traditional sourcing models – e.g., public-private partnerships, design-build, design-build-operate, etc., – are significantly more evident in the international market than the domestic market. Non-traditional sourcing models are actively promoted by the World Bank and the various regional development banks.

Factors Affecting Competitiveness:

- Small size is not a bar to working internationally. However, the advantages of scale directly and significantly contribute to being competitive in international work. The advantages of scale are more evident in international work than in domestic work. The current wave of consolidation will strengthen the competitive capacity of Canada's consulting engineering firms in the international field.
- The capacity to innovate is a critical competitive advantage. Engineering firms that are innovators are significantly more likely to be exporters and engineering firms that are exporters are much more likely to be innovators.
- Canadian engineers are not cost competitive in doing standardized engineering work, or 'commodity' engineering. In fact, it is increasingly common for firms with international offices to move Canadian engineering work to countries where it can be carried out on a lower cost basis.
- To be competitive internationally, Canadian engineering professionals must offer skills that are in short supply and which therefore command a significant premium. These skills fall into four categories:

1. high level project management skills,
2. specialized technical skills, usually in design areas,
3. advanced levels of practical experience, and
4. familiarity with and access to proprietary technologies.

These four types of skills are the fundamental human capital foundation of competitiveness in the international engineering market.

- Increases in the Canadian dollar did not significantly affect the export of engineering services. The weak correlation between the exchange rate and export performance underscores the important links between exports and innovation, human capital, proprietary technologies, and reputation. These factors 'trump' the exchange rate as determinants of export performance.
- None of the executives whom we interviewed attached a high degree of importance to mobility barriers.
- CIDA's reduction in support for the Industrial Cooperation Program has had a particularly adverse consequence for smaller companies for whom the feasibility studies that were partially financed by that program were a key means of entry into certain types of international consulting work. Some firms have cut back significantly on their international work, as a result of CIDA's reduction in the Industrial Cooperation Program budget.
- Many governments use their aid agencies and state enterprises to provide substantial support to their consulting engineering sector in the international market. These governments view consulting engineering both as a source of high value-added service exports and also as a vehicle for drawing into the international market other domestic suppliers of goods and services. Canadian policy cannot afford to be oblivious to these efforts on the part of other governments to create competitive advantage for their engineering consultancies.
- In recent years, policy support for Canada's involvement in the international consulting engineering market has been *ad hoc*. As the international market place becomes more competitive, it will also become more politicized. A more strategic assessment of the potential role of public policy is required.
- The report makes five recommendations, including the creation of a stakeholder forum, looking at the contribution that centres of excellence can make to strengthening competitiveness, documenting the role of the consulting engineering sector in opening export markets for other sectors, and continuing efforts to harmonize international licensing and certification standards.



Canada ranks among the world's leading exporters of engineering services. Based on data collected by *Engineering News Record*, Foreign Affairs and International Trade Canada, estimates that Canada is the third largest exporter of engineering services, after the United States and the United Kingdom. Canadian firms provide engineering services in more than 125 international markets. In recent years, 20% or more of the consulting engineering sector's revenues have been generated by work outside Canada. Although imports of engineering services have also been increasing, Canada is a significant *net* exporter of engineering services and has a strong interest in promoting open and accessible market conditions.

This study focuses on trends in Canada's exports of engineering services and the factors that underpin and contribute to the international competitiveness of Canada's consulting engineering sector. *Canada's Consulting Engineering Sector in the International Economy* is part of a larger research program - the *Engineering and Technology Labour Market Study*. The *Engineering and Technology Labour Market Study* was commissioned by Engineers Canada and the Canadian Council of Technicians and Technologists, with financial support from Human Resources and Skills Development Canada. Additional information on the *Engineering and Technology Labour Market Study* is available on the study's website: www.engineerscanada.ca/etlms/index.cfm

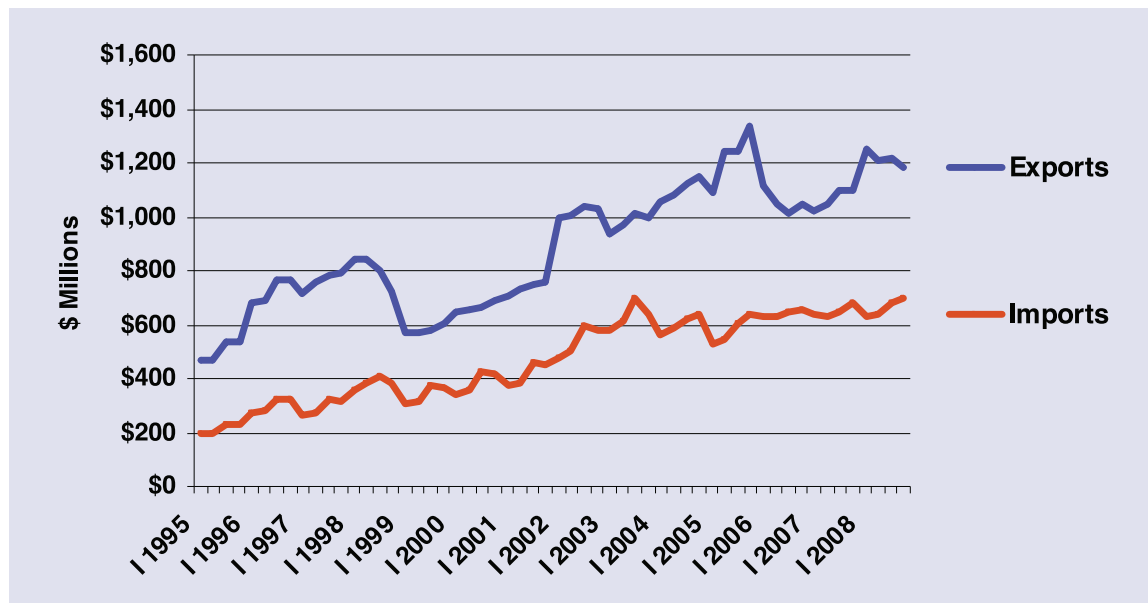
The findings presented in this study are based on a review of statistical sources, published materials and interviews with leaders in Canada's consulting engineering sector. A list of persons interviewed can be found at Appendix A.

Export and Import Trends:

Figure No. 1 shows recent trends in the export and import of 'architectural and engineering services'. Architectural and engineering services are combined, in part because it is increasingly common in some design firms to offer both of these services, but also because regulatory boundaries between engineering and architectural practice are not identical across countries.¹ As can be seen from Figure No. 1, prior to the downturn in 2008-09, export revenues grew at an annual average rate of approximately 5.65% per year.

Figure No. 1

Quarterly Exports and Imports of Architectural and Engineering Services, 1995-2008
 Statistics Canada: CANSIM



Export Revenues in Relation to Total Revenues:

Figure No. 2 compares receipts from exported services of 'engineering and architectural services' with operating revenues of the consulting engineering sector. Because the first data series includes architectural services, the ratio overstates the contribution of export revenues to total operating revenues. Also, it should be noted that not all export earnings are earned by the consulting sector. Some manufacturers and utilities also earn revenues from exporting engineering services. Nevertheless, the ratio gives a broad indicator of the approximate importance of export earnings to the consulting sector. *It can be conservatively estimated that, in recent years, exported services accounted for 20-25% of the operating revenues of the consulting engineering sector.* In 2006, the lower boundary of this estimate would have applied; in the period 2002-2005, the higher boundary would have applied.

1. Although Statistics Canada (and most other statistical agencies) combine engineering and architectural services when measuring international transactions, it is likely that the Canadian estimates are dominated by engineering services. The 2006 Census reported that there were 12,235 architects employed in the consulting sector (NAICS 541: Scientific and Professional Services), but 70,255 engineers. Engineers therefore accounted for 85% of the combined total of the two professions in the consulting sector.

Figure No. 2

Exports of Architectural and Engineering Services
compared to Operating Revenues of Engineering Services Firms, 1997-2007
Statistics Canada: CANSIM

	Operating Revenues of 'Engineering Services' Firms (NAICS: 54133) \$Millions	Export Earnings 'Engineering and Architectural Services' \$Millions	Ratio of Export Earnings to Operating Revenues
1997	\$8,247.2	\$3,045	36.9%
1998	\$8,492.7	\$3,202	37.7%
1999	\$8,977.3	\$2,326	25.9%
2000	\$9,314.5	\$2,653	28.5%
2001	\$10,446.0	\$2,940	28.1%
2002	\$10,866.3	\$4,075	37.5%
2003	\$11,044.5	\$3,916	35.5%
2004	\$12,147.8	\$4,410	36.3%
2005	\$13,793.5	\$4,917	35.6%
2006	\$15,371.7	\$4,221	27.5%

Canadian Affiliates of International Engineering Consultancies:

When international engineering consultancies establish a presence in Canada, they usually do so by acquiring a local practice. The motivation for establishing a presence in Canada is to exploit opportunities in the Canadian market. International firms, for the most part, do not establish a Canadian presence to access to Canadian engineering resources for deployment on international projects. Indeed, a number of the engineering executives whom we interviewed were emphatic that the Canadian office of an international engineering consultancy will only bid on Canadian work. However, if the Canadian affiliate of an international consultancy develops a particular and recognized expertise, the parent company may deploy Canadian engineering resources on some aspects of international work. It is difficult, however, to gauge the magnitude of Canadian engineering resources that are deployed on international assignments through these channels. Transactions that are internal to an international engineering consultancy may not be captured by trade data. This measurement issue applies both to exports and imports. International engineering consultancies can also facilitate the off-shoring of their Canadian affiliate's low-value engineering work to lower cost locations. Our interviews provided us with no basis to formulate an estimate of how significant these internal flows of engineering resources could be. We can only conclude *the presence in Canada of an increasing number of international engineering consultancies means that data on both the import and export of engineering services are likely to be somewhat underestimated.*

Changing Geographic and Technical Dimensions of the International Engineering Market:

Unlike many other sectors of the Canadian economy, engineering services do not depend on the United States as a primary source of export revenues. The Association of Consulting Engineers of Canada estimates that, in recent years, only 30% of Canada's engineering services exports are to the United States. Markets in Asia and Africa attract roughly 50% of Canadian exports, while Europe and South America make up the remaining sources. *The technical nature and geographic location of the demand for engineering services is broadly determined by capital spending, both actual and prospective.* In some instances, such as mining developments, capital spending is predominantly undertaken by the private sector. In the case of infrastructure and environmental assessments or remediation, the public sector is predominant. Energy investments may be either private or public sector. Changes in the composition and location of capital spending are constantly re-shaping the international market for engineering services.

Figure No. 3 shows changes in the geographic origin of the revenues of the 225 largest engineering firms, as estimated by *Engineering News Record*. As can be seen in Figure No. 3, over the ten year period 1997 to 2007, there was a significant increase in shares of Europe and the Middle East as sources of export earnings. This reflects the importance of pipeline and energy investments in the overall composition of capital spending. It would be an error, however, to expect that the geographic distribution evident in 2007 will be stable. *Recent commitments by governments in the OECD and China to invest heavily in infrastructure development will alter both the technical nature of the engineering services market and the geographic distribution of demand.*

Figure No. 3

Geographic Distribution of Export Revenues of
225 Largest International Engineering Firms, 1997 and 2007

Engineering News Record

	1997	2007
Canada	2.0%	2.7%
U.S.	12.3%	11.9%
Latin America	7.5%	6.2%
Caribbean Islands	1.3%	0.6%
Europe	26.8%	31.1%
Middle East	9.5%	20.3%
Asia/Australia	31.5%	17.9%
North Africa	3.6%	4.2%
South/Central Africa	4.9%	5.0%
Other	0.6%	0.1%



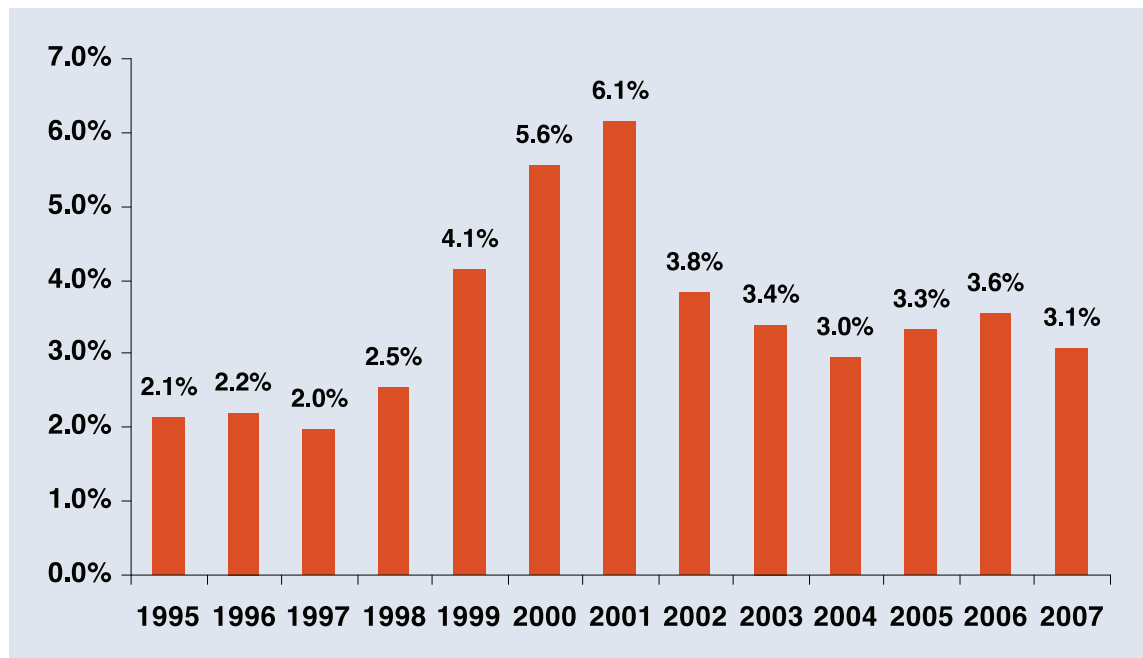
Canada's Share of the International Engineering Market:

Figure No. 4 summarizes the share of Canadian engineering firms in the *Engineering News Record's* estimate of the total non-domestic revenues of the world's largest 225 engineering firms.

Figure No. 4

Share of Canadian Engineering Firms in the Non-Domestic Revenues of the 225 Largest International Engineering Firms, 1995-2007

Engineering News Record

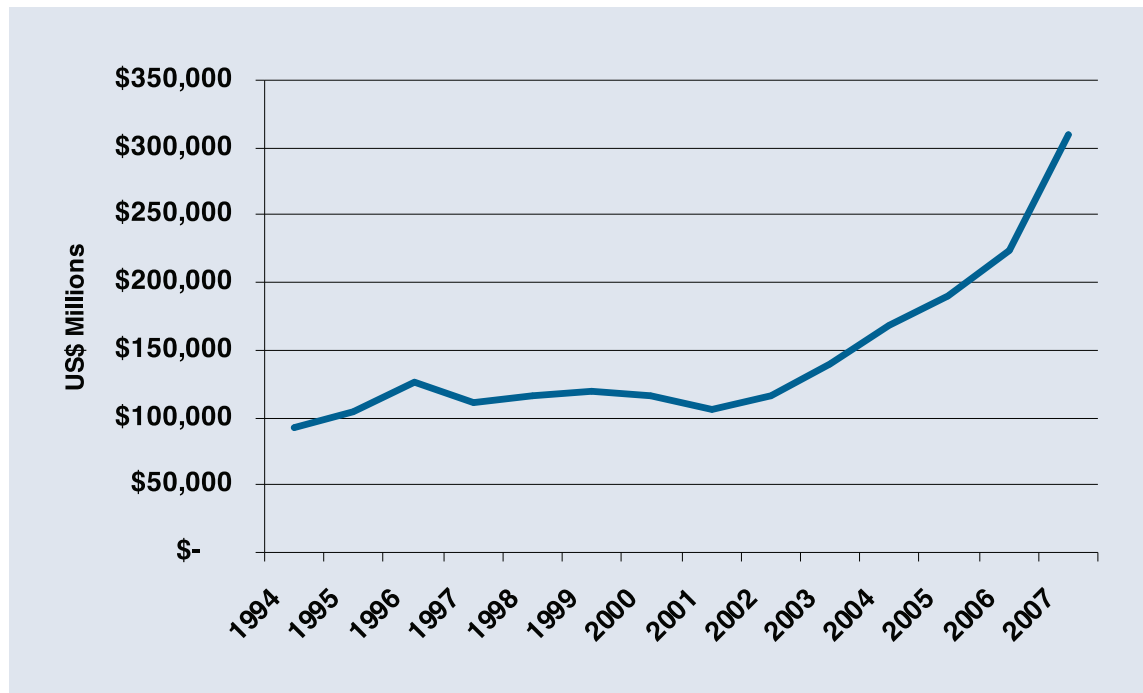


As can be seen from Figure No. 4, the Canadian share peaked at 6.1% in 2001. The decline after 2001 was attributable to two factors. First, domestic demand engaged a greater share of the resources of Canadian consulting engineering firms. Our interviews with engineering executives confirm that especially after 2001, capital spending in western Canada, and in the mining sector across Canada, absorbed engineering resources that might otherwise have been deployed internationally. Second, as Figure No. 5 shows, after 2003, there was a dramatic increase in the size of the international engineering market. While Canadian firms increased their international revenues, they were not able to keep pace with explosive growth in the international market after 2002. From 2002 to 2007, the *Engineering New Record* estimates that the non-domestic revenues of the 225 largest engineering firms more than doubled.

Figure No. 5

Total Non-Domestic Revenues of
the 225 Largest International Engineering Firms, 1995-2007

Engineering News Record



Proportion of Engineering and Technology Professionals Deployed on International Work:

It is important to distinguish between the export revenues and Canadian-based engineering resources that are engaged in export-oriented work. In the first place, there may be regulatory reasons for engaging local (i.e., non-Canadian) staff on an engineering project. In some countries, engineering work must be 'stamped' by a locally licensed engineer. Often there are residence requirements for holding an engineering licence. Even in the absence of regulatory requirements, Canadian firms may still engage local professional staff because of their knowledge of local conditions. A second factor of importance is the relative cost of Canadian vs. non-Canadian professional salaries. When projects are undertaken in countries with comparable or higher professional salaries, Canadian firms may carry out the preponderance of the engineering work with their Canadian staff, either by doing the work in Canada or by assigning Canadian staff to the site of the project. On the other hand, when projects are undertaken in countries where professional salaries are significantly lower than Canadian salaries, Canadian firms will often employ local engineering professionals, to the degree that this is practical. It is common for large engineering consultancies to maintain offices in the markets they serve. Typically those offices are staffed at least in part, with local engineers and technologists. For all of these reasons, the share of Canadian engineering resources deployed on international work is likely to be lower than the share of export revenues in total revenues.

Depending on market conditions in Canada and abroad, international work accounts for 20-25% of the revenues of the Canadian engineering consulting sector. The lower estimate would have applied in recent years, the higher estimate before 2006. Based on our interviews with engineering executives, we estimate that the proportion of Canadian engineering resources engaged in non-domestic assignments will be somewhat lower – approximately 15-20%. Again, the lower estimate would have applied in recent years, while the higher estimate would have applied prior to 2006.

In many firms, engineering and technology professionals are engaged both on international and domestic projects. Thus the proportion of engineering and technology professionals who are supported, at least in part, by international engineering work will be higher than 15-20%. *In practical terms, we conservatively estimate that, in recent years, the employment of one in every five Canadian professionals in the consulting engineering sector was supported, at least in part, by international work.* A higher estimate (one in four) would also be plausible.

These estimates are broadly consistent with results from the *Survey of Engineers and Engineering Technicians and Technologists* which found that over the period 2004-2008, just over one-quarter of engineers employed in the consulting sector had worked outside of Canada.

Public Sector vs. Private Sector Assignments:

In the international sector, public sector work is primarily focused on infrastructure (including water and waste management, transportation, airports, harbours, highways, etc.) and, to some degree on energy, which is often partly developed through state enterprises. Public sector clients include both national and sub-national governments, international aid agencies (both the Canadian International Development Agency, and the aid agencies of other governments where they tender competitively), the World Bank Group², and the regional development banks³.

There are some international consulting practices that are primarily focused on work funded by aid agencies, the World Bank Group, and the regional development banks. The involvement of aid agencies or international development as clients or co-clients largely removes the risk of non-payment for services. This risk is real when dealing with governments or state enterprises in some countries. Private sector work, of course, is always subject to some measure of financial risk. Our interviews with senior engineering executives suggest that the mark-ups on public sector assignments tend to be lower than for private sector work of comparable size and complexity. Whether this reflects the reduced risk of non-payment or different competitive conditions is not clear.

For some firms, the lower mark-ups on international public sector work means that this work often plays a 'buffer' function. Some firms pursue international public sector work when domestic work is insufficient to fully utilize their professional resources. This results in cycles in which the firms' involvement in the international market waxes and wanes in response to demand conditions in the Canadian market. Some of the executives whom we interviewed indicated that the strength of

² The World Bank Group comprises:

- International Bank for Reconstruction and Development (IBRD)
- International Development Association (IDA)
- International Finance Corporation (IFC)
- Multilateral Investment Guarantee Agency (MIGA)
- International Centre for Settlement of Investment Disputes (ICSID)

³ The principal regional development banks are:

- Inter-American Development Bank (IADB)
- Caribbean Development Bank (CDB)
- African Development Bank (ADB)
- Asian Development Bank (ADB)
- European Bank for Reconstruction and Development (EBRD)
- Central American Bank for Economic Integration (CABEI)
- East African Development Bank (EADB)
- West African Development Bank (WADB-BOAD)
- Corporacion Adina de Fomento (CAF)

the Canadian market for consulting engineering in the past few years had led them to focus their resources on domestic work. This may have contributed to the moderate decline in exports after 2006.

The requirements of public sector clients for engineering services are diverse. However, infrastructure spending dominates those requirements. *Specialized expertise in the design, project management, and operation of these types of infrastructure projects therefore constitutes one of the key types of engineering demand in the international market.*

Role of Foreign Direct Investment:

Foreign direct investment patterns are an important influence on international private sector work in the consulting engineering sector. Businesses that undertake foreign investment projects typically do so with a long-standing history working with engineering firms in their home country. Thus, when U.S. firms invest abroad, they have a bias to use the U.S. engineering firms with whom they already have a history. The same applies to European and Japanese firms. Companies in India, China, Korean and Taiwan are now aggressively involved in foreign direct investment. A consequence of this will be to bring more engineering firms from these countries into the international market for engineering services.

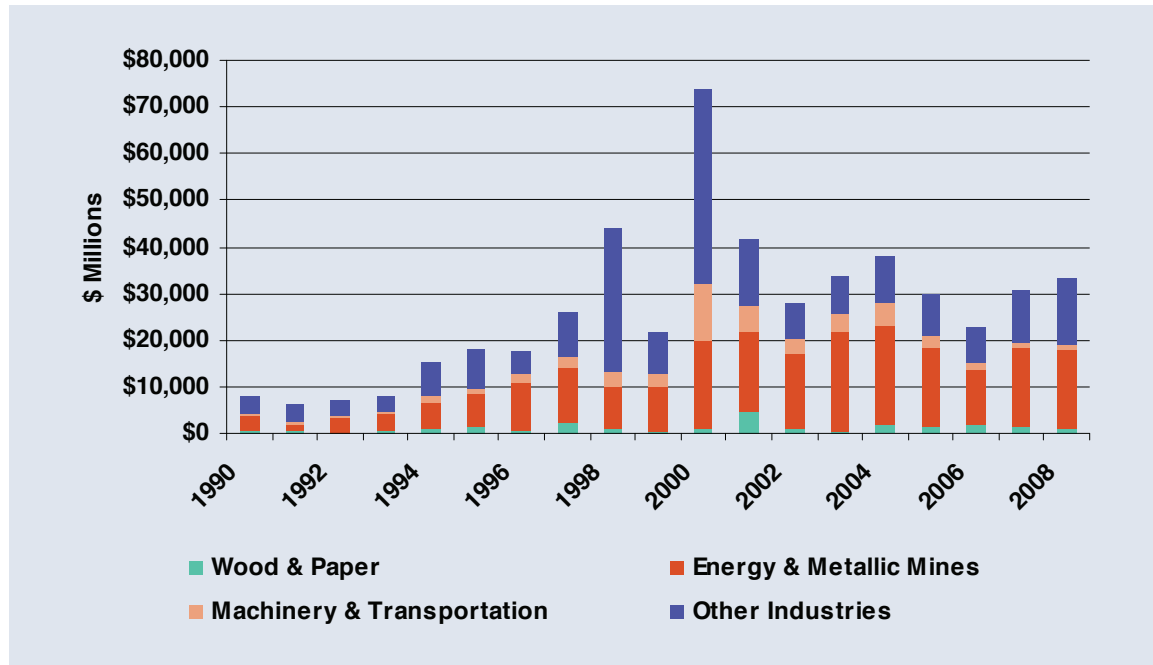
Figure No. 6 shows recent trends in foreign direct investment by Canadian firms in economic sectors that potentially entail a demand for engineering services.⁴ Two trends are important in these data. The first is that there was a significant increase in foreign direct investment by Canadian companies. This trend is likely to be reversed by the current economic downturn. However, it is likely that the trend to increased foreign direct investment by Canadian companies will resume, following recovery from the current recession. The second trend that is evident is that *foreign direct investment in energy and mining projects always looms large and, in some years, dominates Canadian foreign direct investment abroad.*



⁴ For purposes of this analysis, 'foreign direct investment' is the sum of gross outflows plus re-invested earnings. The data series excludes foreign direct investment in finance, insurance, retailing and other services. The industry categories are (1) wood and paper, (2) energy and metallic mines, and (3) machinery and transportation, and (4) other industries.

Figure No. 6

Foreign Direct Investment Abroad by Canadian Companies in Selected Industries, 1990-2008
(Foreign Direct Investment: Sum of Gross Long-Term Outflows and Re-invested Earnings)
Statistics Canada: CANSIM 376-0014



In light of the importance of foreign direct investment patterns for the private sector side of international engineering work, it is not surprising that energy, mining and metallurgy are key areas in which Canadian consulting firms export their expertise.

It would be an exaggeration and an error to suggest that foreign direct investment patterns limit or define international engineering work in the private sector. However, *providing services to Canadian firms that invest abroad is an important vehicle for entering the international market and establishing a professional reputation that can subsequently be leveraged with non-Canadian clients.*

Technical Fields:

The technical fields that predominate in international work are:

Public Sector:

- water and waste management,
- transportation systems,
- airports,
- harbours and related marine projects,
- major bridges,
- major highways, and
- power generation and distribution.

Private Sector and Mixed Public-Private:

- mining and metallurgy
- petroleum
- natural gas

These technical fields are also, of course, important in domestic consulting. *However, the technical scope of international consulting is somewhat narrower than domestic consulting.* Environmental impact analysis, industrial engineering, and chemical engineering (except for petroleum engineering) are generally less prominent in international work than in domestic consulting. Computer engineering requirements are also more likely to be sourced domestically than internationally.

Non-Traditional Sourcing:

The conventional model for constructing infrastructure entails separate roles for the client (usually a government, a state enterprise or other type of public sector body), the financier (governments, development banks, private banks), engineering design, project execution, and project oversight. Since the 1980s, but especially in the last 10-15 years there has been a pronounced movement away from the convention model in both public and private projects. Design-build projects require collaboration between engineering design and project execution, such that clients are provided with a turn-key solution. Typically in a design-build project, all of the design and construction risks remain with the design-build consortium. Design-build-maintain and design-build-operate projects require ongoing involvement on the part of the design-build consortium, meaning that the consortium also assumes risks related to the long-term maintenance and long-term performance of the asset. Both these types of projects and public-private partnerships often require the consortium to provide or arrange for at least some of the long-term financing of a project. Some of these projects may involve an equity stake for the consortium. *While non-traditional sourcing models have become more prominent in the domestic market, these newer sourcing models are significantly more evident in the international market where they are actively promoted by the World Bank and the various regional development banks.* It is likely that the wave of infrastructure investment that will occur over the next decade will significantly increase the role of non-traditional sourcing models.

One of the consequences of non-traditional sourcing models is to 'raise the bar' for international engineering consultancies. Firms must be able to provide not only traditional engineering design services, but also project management, project maintenance, and project operation services. As well, firms may be called upon to arrange or facilitate private sector financing for some, or all, of the long-term costs of a project. Financing will be exceedingly difficult if credit conditions do not improve. The comparative soundness of Canadian banks may be a long-term competitive asset for Canadian firms that are pursuing P-3 and similar opportunities.⁵ *Overall, the greater use of non-traditional sourcing models increases the competitive advantages that arise from scale, from strategic links to the financial sector, and from access to the risk mitigation facilities offered by governments.*

5. 'P-3' is a commonly used acronym for 'public-private partnerships'. There is no single P-3 model. However, most models involve a public service or infrastructure asset being funded and/or operated through a partnership of government and one or more private sector companies. In some types of P-3 ventures, the government uses tax revenue to provide capital for investment, with operations run jointly with the private sector or under contract. In other types of P-3 ventures, capital investment is made by the private sector on the strength of a contract with government to provide agreed services. Recent P-3 examples include: the 407 Toll Highway north of Toronto, Confederation Bridge linking PEI to the mainland, the western portion of Highway 30 in Quebec, and the Canada Line rapid transit service in Greater Vancouver. Additional information on the P-3 model is available through the Canadian Council for Public Private Partnerships: www.pppcouncil.ca

Scale:

In the market for professional services, scale factors (*i.e.*, size) operate differently than in many other industries. In the manufacture and distribution of many types of goods, there are economies of scale that reduce costs per unit of output. These same economies of scale also operate in the supply of some types of services, notably in the financial sector where it is cost efficient to amortize sizeable investments in IT over a large base of operations.

In the supply of professional services, there are also advantages to scale. This is evident in the higher revenue per employee that is the norm in large professional service firms, compared to smaller firms. Economies of scale are also behind the wave of mergers and acquisitions that has been evident in Canada, the U.S., and Europe.⁶ It should be noted that in professional services, economies of scale are not associated with lower fee scales, nor with lower operating costs. Indeed, the opposite can be the case: larger firms may have higher operating costs than smaller firms and also may charge higher hourly rates than smaller firms. In the professional services market, the attractions of scale are not primarily based on cost advantages. Rather, the competitive advantages that are based on scale include:

1. the ability to obtain greater leverage from professional reputation,
2. a greater ability to provide clients with a broader range of professional services, thereby 'locking in' clients,
3. a greater ability to develop and apply proprietary technologies,
4. a greater ability to develop a diverse portfolio of advanced specializations,
5. a greater ability to reduce overall revenue risk by operating in more diverse fields and more diverse markets,
6. a greater ability to undertake large assignments that allow for higher operating margins,
7. in an international context, the ability to relocate work to lower cost locations,
8. a significantly greater ability to undertake and, where necessary, to finance complex projects involving design-build or design-build-operate requirements.

These potential advantages that are associated with increased scale are important. The pursuit of these advantages largely explains the current wave of consolidation that is occurring in the consulting engineering sector. An indication of this consolidation can be found in data from Statistics Canada's *Annual Survey of Service Industries*. Between 2005 and 2006 (most recent data), the number of establishments in the consulting engineering sector fell by 8.5%, while total revenues for the sector increased by 11.4%.⁷

⁶ One study, for example, found that the largest 100 engineering consultancies in Europe increased their professional staff by 120% and their gross revenues by 170% between 1990 and 1998. G. Kreitl, et al., "Corporate growth of engineering consulting firms: a European review", *Construction Management and Economics*, Vol. 20, No. 5, (July 2002), pp. 437-448

⁷ Statistics Canada, CANSIM 360-0005

Small size is not a bar to working internationally. Small and mid-sized firms can undoubtedly develop the specialized expertise that is one of the underpinnings of competitiveness in the international field.⁸ *However, the advantages of scale also directly and significantly contribute to being competitive in international work. Indeed, the advantages of scale may be more evident in international work than in domestic work.* It is not surprising, therefore, that the lion's share of international work is undertaken by large firms. *The current wave of consolidation will strengthen the competitive capacity of Canada's consulting engineering in the international field.*

Propensity to Innovate:

In a study for Statistics Canada, R. Chiru found that, among engineering firms, innovators were significantly more likely to be exporters than non-innovators, even when other factors, such as ownership, firm size, niche market orientation, etc. were held constant.⁹ An 'innovator' was defined as a firm that had introduced a significantly improved process or product into the market within the last three years (2001 to 2003).

In another study for Statistics Canada, D. Hamdani found that the preponderance (63.2%) of innovations by engineering services firms pertained to 'quality improvements or cost reductions'.¹⁰ More significantly, Hamdani also found that 73% of engineering service exporters were innovators, compared to 32.3% of non-exporters.¹¹

The conclusion, therefore, is that the correlation between innovation and export orientation is significant in both directions: innovators are significantly more likely to be exporters and exporters are much more likely to be innovators.

Based on the data from Statistics Canada's 2003 *Survey of Innovation*, Lonmo estimated that 47.4% of engineering services firms were innovators during the period 2001-2003.¹² While innovation is clearly one of the underpinnings of export orientation, a possible inference from this finding is that a *significant proportion of innovative consulting engineering firms are not participating in international markets, even though they would likely be competitive, based on their capacity to innovate.*

Given the growing importance of professional services exports in the overall make-up of Canada's international trade, it is important to better understand the factors that constrain some innovative firms from entering the international market.

8 It is interesting to note, however, that although small and mid-sized consultancies are both less likely to be exporters than large firms, mid-sized firms are more likely to have an exclusive domestic focus than small firms. Radu Chiru, *Innovativeness and Export Orientation among Establishments in Knowledge-Intensive Business Services (KIBS)*, 2003, Statistics Canada, Working Paper - Science, Innovation and Electronic Information Division, Cat. No. 88F0006XIE – No. 001

9 Radu Chiru, *Innovativeness and Export Orientation among Establishments in Knowledge-Intensive Business Services (KIBS)*, 2003, Statistics Canada, Working Paper - Science, Innovation and Electronic Information Division, Cat. No. 88F0006XIE – No. 001

10 Daood Hamdani, *Capacity to Innovate, Innovation and Impact: The Canadian Engineering Services Industry*, Statistics Canada, Research Paper - Science, Innovation and Electronic Information Division, Cat. No. 88F0017MIE – No. 011 (March 2001), Table A, p 11

11 Daood Hamdani, *Capacity to Innovate, Innovation and Impact: The Canadian Engineering Services Industry*, Statistics Canada, Research Paper - Science, Innovation and Electronic Information Division, Cat. No. 88F0017MIE – No. 011 (March 2001)

12 Charlene Lonmo, *Innovation in Selected Professional, Scientific and Technical Services: Results from the Survey of Innovation 2003*, Statistics Canada, Working Paper - Science, Innovation and Electronic Information Division, Cat. No. 88F0006XIE – No. 013

Human Capital:

Our interviews with engineering executives underlined that *Canadian engineers are not cost competitive in doing standardized engineering work, or 'commodity' engineering, as it is sometimes termed.* Indeed, some firms with international offices move Canadian engineering work to their affiliated offices in countries where it can be carried out on a lower cost basis. *To be competitive internationally, Canadian engineering professionals must offer skills that are in short supply and which therefore command a significant premium.* These skills fall into four categories:

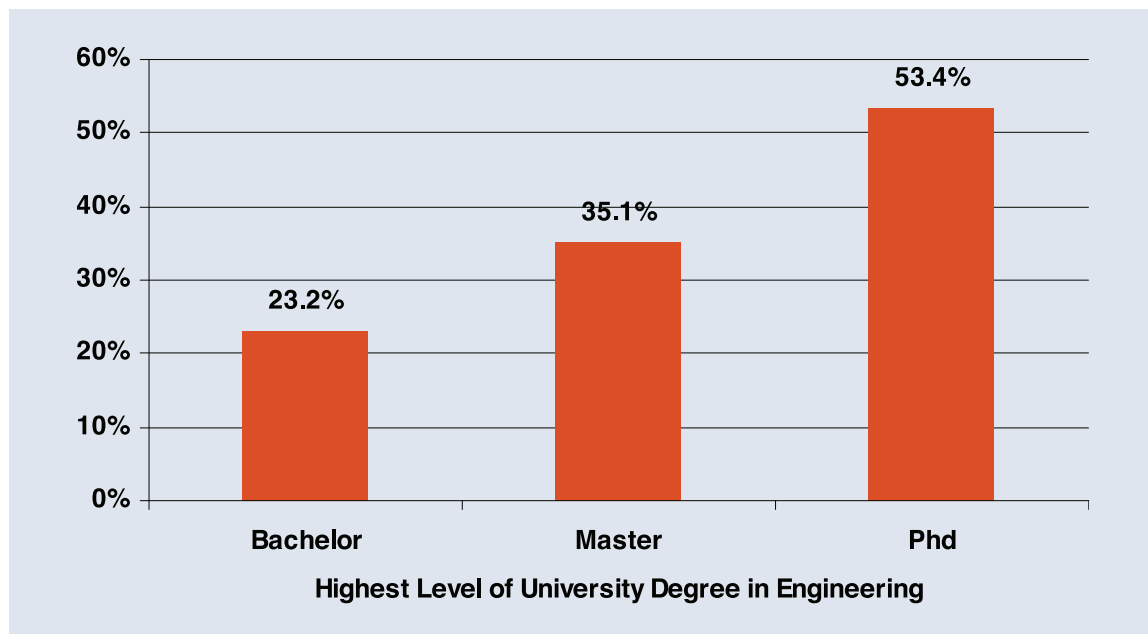
1. high level project management skills,
2. specialized technical skills, usually in design areas,
3. advanced levels of practical experience, and
4. familiarity with and access to proprietary technologies that are developed as part of a strategic commitment to innovation.

These four types of skills are critical to both sustaining and growing the export earnings of Canadian firms. They are also critical to supporting the long-term employment of approximately one in every five engineering and technology professionals in the consulting engineering sector.

The *Survey of Engineers and Engineering Technicians and Technologists, 2008* found that 26.3% of engineers employed in the consulting sector worked outside of Canada between 2004 and 2008. However, as Figure No. 8 shows, that the propensity to work outside Canada in the consulting sector increases significantly with graduate qualifications. This pattern confirms the greater importance attached to advanced or specialized skills in the international market and is consistent with interview evidence that advanced or specialized skills can often command a higher premium in the international market.

Figure No. 7

Percent of Engineers Employed in Consulting Engineering who Worked Outside Canada, 2004-2008
Survey of Engineers and Engineering Technicians and Technologists, 2008



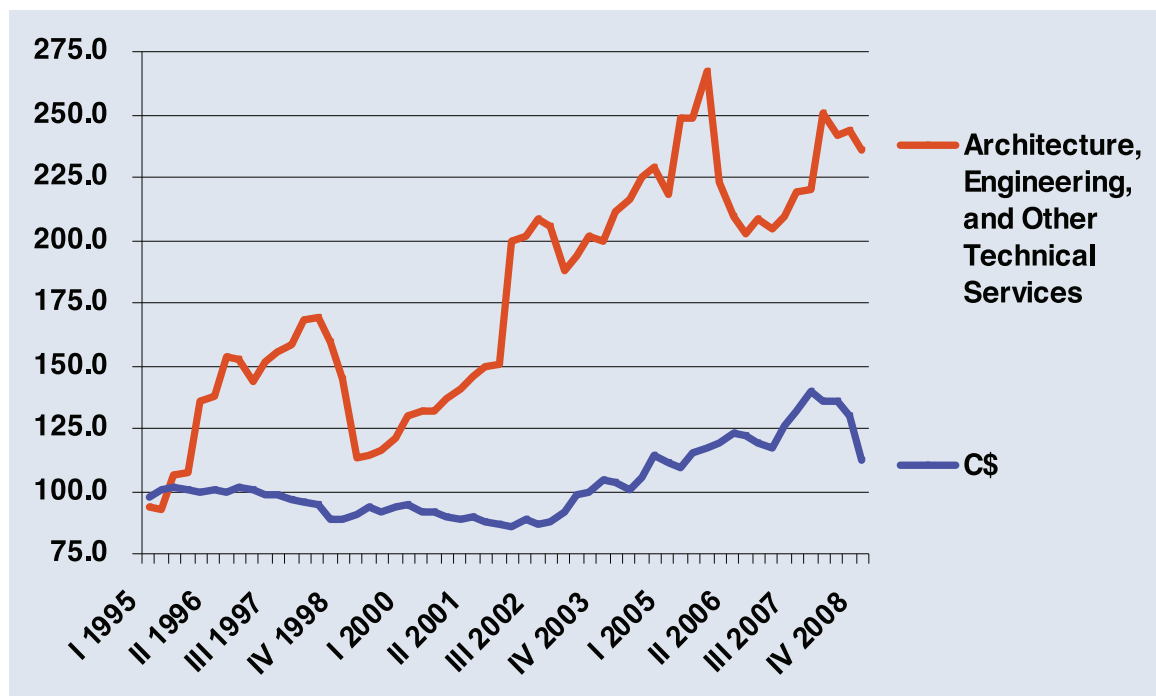
Advanced or specialized skills, which command a premium, can be contrasted with standard or 'commodity' engineering skills. Virtually all countries have universities or polytechnics that train engineers. 'Commodity' engineering skills are those competencies which are associated with most undergraduate engineering programs, regardless of whether the programs are fully commensurate with Canadian standards (i.e., 'Washington Accord' standards). In most countries, requirements for 'commodity' engineering skills can be met by drawing on local resources. Consequently, 'commodity' engineering skills do not command a premium. Canadian engineering consultancies cannot be cost competitive selling 'commodity' engineering skills in the international market. Canadian engineering is only competitive when it sells into markets that are characterized by shortages, namely markets that require some or all of the four premium skills cited above.

Canadian Dollar:

Figure No. 8 compares export revenues for 'architecture, engineering and other technical services' with changes in the Canada / U.S. exchange rate. Both data series are indexed to a common base, 1995=100.

Figure No. 8

Comparison of Quarterly Export Revenues from Architecture, Engineering and Other Technical Services and the Canadian /U.S. Exchange Rate, 1995-2008 Index for both Data Series: 1995 Average = 100



What is apparent from Figure No. 8 is that *increases in the Canadian dollar did not appear to significantly affect the export of engineering (and related) services*. In 2006, exports declined, perhaps in part attributable to the appreciation of the Canadian dollar. However, in 2007, exports increased again, even though the Canadian dollar continued to appreciate throughout 2007. The correlation between export performance and the Canadian dollar is surprisingly weak.¹³ This weak correlation is confirmed by our executive interviews. While some engineering executives reported that the higher Canadian dollar put them at a competitive disadvantage, this was not the view of the majority of executives. *The majority stressed that they were selling their professional services into*

¹³ The correlation between the Canadian dollar and imports of engineering (and related) services is similarly weak.

markets characterized by a scarcity of specialized skills. For the most part, the costs of the higher Canadian dollar were passed on to clients in the form of higher rates.

The weak correlation between the exchange rate and export performance of engineering consultancies underscores the important links between exports and the role of innovation, human capital, proprietary technologies, and reputation. These factors 'trump' the exchange rate as determinants of export performance.

International Orientation:

The Canadian consulting engineering sector did not suddenly become a player in the international market for engineering services. Our interviews with engineering executives suggest that, unlike engineering consulting in many other countries, a substantial segment of the Canadian sector has always had an international orientation. Today's export orientation and the current international reputation of Canadian consultancies are the result of business decisions made at least one generation ago, and probably earlier.

Changes in immigration policy which emphasize human capital have augmented the professional resources available to the Canadian consulting engineering sector. Our engineering executive interviews suggested that immigration supplies the Canadian consulting engineering sector with cultural and language abilities to work in international markets that consultancies in most other OECD countries cannot equal. Consistent with these observations on the positive role of immigration, the *Survey of Engineers and Engineering Technicians and Technologists, 2008* showed that foreign trained engineers in Canada have a significantly greater propensity to undertake international work than Canadian-trained engineers. Thus, 21.2% of domestic engineering graduates in the consulting sector worked abroad between 2004 and 2008, compared to 49.1% of engineers who obtained their undergraduate degree outside Canada. The inference to be drawn from these data is that the long-standing international orientation of Canada's consulting engineering sector has been strengthened and reinforced by immigration policy.

Mobility:

In the engineering and technology field, there are three dimensions to mobility. The first pertains to mutual recognition of educational qualifications. This is primarily relevant to professionals who are permanently re-locating and wish to obtain a license or certification in the country to which they are immigrating. The second dimension of mobility is the degree to which a professional who is qualified in one country can enter another country for the purpose of doing professional work on an assignment basis. The third dimension is the degree to which a business that is headquartered in one country can undertake work in another country.

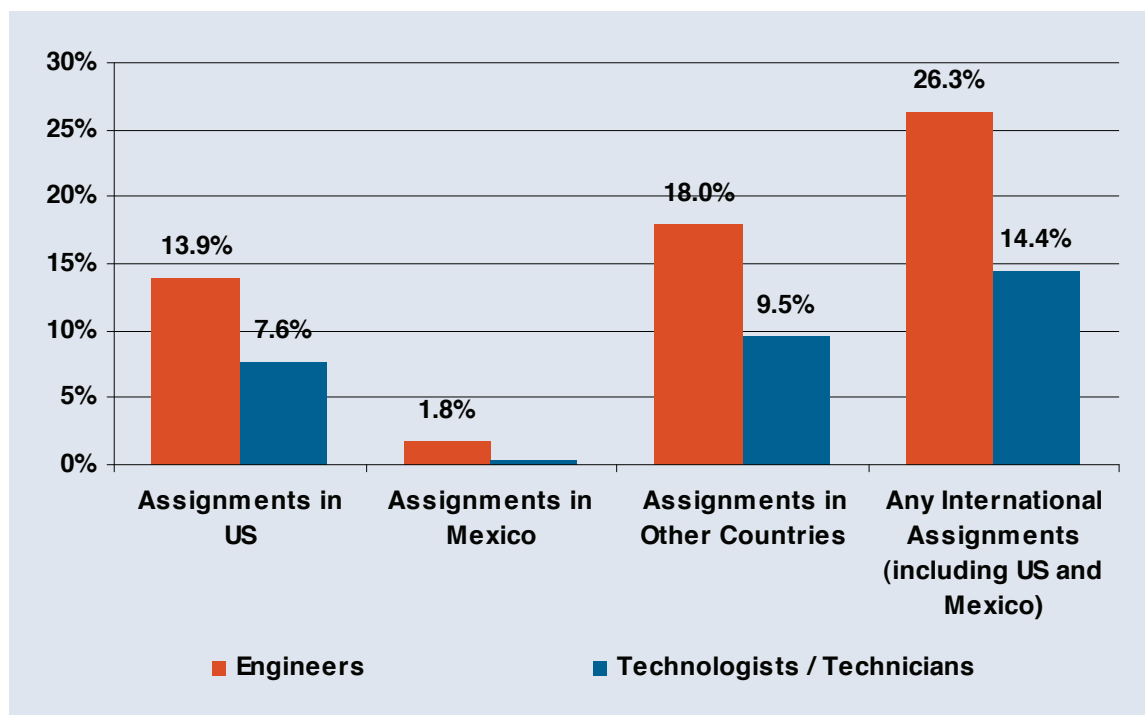
In the engineering profession, the Washington Accord is the principal vehicle for achieving mutual recognition of educational qualifications. In the technology professions, the Sydney Accord and the Dublin Accord perform a similar role. The Engineering Mobility Forum and the Engineering Technologists Mobility Forum are responsible for advancing the scope and coverage of the respective Accords. For the consulting sector in Canada, these mobility agreements are important because they facilitate the integration of internationally educated professionals who contribute to the sector's competitiveness.

Theoretically, restrictions on engineering firms or on professionals engaged on an international assignment could be serious impediments. In practice, however, such restrictions are not a significant

constraint. *None of the executives whom we interviewed attached a high degree of importance to such mobility barriers.* Indeed, some executives commented that it is sometimes easier to work internationally than within Canada. Large firms were especially emphatic that they were usually able to work around any regulatory restrictions on practice by using local engineering professionals or partnering with a local engineering firm. Smaller firms may not have the same flexibility. For smaller firms, local restrictions on professional practice could pose a greater impediment. As the provision of engineering services becomes more globalized, there could be an increase in regulatory impediments to foreign sourcing. At this time, however, regulatory impediments to professional mobility are not a significant constraint on exporting engineering services. This is supported by data from the *Survey of Engineers and Engineering Technicians and Technologists* which shows that 26.3% of engineers and 14.4% of technology professionals reported that they had been involved in international assignments over the past five years.

Figure No. 9

Proportion of Engineers and Technicians/Technologists who Worked outside Canada, 2004-2008
Survey of Engineers and Engineering Technicians and Technologists, 2008



The relative openness of the international engineering services market is confirmed by a recent study undertaken by the Australian Productivity Commission.¹⁴ The study examined four professions, including engineering. The study distinguished between barriers to establishment, *i.e.*, regulations that prevent foreign suppliers from establishing a physical presence in a local market, and barriers to ongoing operations, which refers to regulations that restrict the provisions of services after a physical presence is established. The study examined regulatory systems in 34 countries, reflecting a mix of OECD and non-OECD countries. Overall, the study found low levels of restrictiveness in 29 of the 34 countries studied (including Canada) and moderate levels in only five countries. Of the four professions examined – engineering, architecture, accounting and law – the fewest overall impediments to international sourcing were found in engineering. This analysis is consistent with both our survey data and the views expressed in interviews with Canadian engineering executives.

¹⁴ Duc Nguyen-Hong, *Restrictions on Trade in Professional Services*, Australia Productivity Commission, Staff Research Paper (August, 2000).

Canadian International Development Agency (CIDA):

Historically, contracts with the Canadian International Development Agency (CIDA) were important to a number of international practices. Among the more important of CIDA's programs, from the perspective of the consulting engineering sector, is the Industrial Cooperation Program which was established in 1978. The Industrial Co-operation Program provides support for up to 75% of the cost of undertaking feasibility studies related to infrastructure and industrial development. The Industrial Co-operation Program is the only CIDA program which is specifically designed to act as a bridge between Canadian firms and business opportunities in developing countries.

The feasibility studies supported by the Industrial Cooperation Program were important because they conferred significant competitive leverage on Canadian engineering firms. Engineering firms that undertook these feasibility studies were favourably positioned to subsequently compete for the much more substantial assignments arising from implementation of the projects.

In recent years, CIDA has re-focused its priorities to emphasize non-infrastructure development initiatives, including debt reduction. CIDA, it should be noted, has not been alone in this re-focusing of priorities. USAID, for example, has also shifted its emphasis away from infrastructure. In 2007, the budget for Industrial Cooperation Program was reduced from \$54 million to \$26 million. Several of the engineering executives whom we interviewed believed that CIDA's re-focusing of its priorities away from infrastructure and the reduction in the Industrial Cooperation Program budget had diminished opportunities for Canadian engineering firms. Some engineering executives noted that the aid agencies of other countries continue to support infrastructure development. While Canadian firms are sometimes able to access support from these agencies, not surprisingly many of these agencies favour companies from their own countries.

The magnitude of the budget reduction in the Industrial Cooperation Program may seem modest when compared to the overall volume of engineering service exports - a \$28 million reduction in program spending compared to \$4.9 billion in total engineering service exports. However, the Industrial Cooperation Program has an importance that is significantly greater than the numbers might suggest. The feasibility studies supported by the Industrial Cooperation Program contributed to successful bids on much larger assignments related to project implementation. *CIDA's reduction in support for the Industrial Cooperation Program has had particularly adverse consequences for smaller companies for whom these feasibility studies were a key means of entry into certain types of international consulting work. Some of the engineering executives whom we interviewed reported that their international work had been cut back significantly, as a result of CIDA's reduction in the Industrial Cooperation Program budget.*

It is not within the scope of this study to examine the merits of infrastructure or non-infrastructure development priorities. Nor is it within the scope of this study to join the debate whether international aid should be used as a lever to advance Canadian commercial interests. However, as will be discussed in the next section, *many governments use their aid agencies and state enterprises to provide more substantial support to their consulting engineering sector in the international market. These governments view their countries' respective consulting engineering sectors not only as vehicles for high value-added service exports, but as important levers to draw in other domestic exporters as suppliers of goods and services. Canadian policy cannot afford to be oblivious to these strategies to create competitive advantage.*

The 'Politics' of the International Engineering Consulting Market:

In the late 1960s and early 1970s, a number of countries, including Norway, Sweden, Denmark, Finland, the Netherlands, Germany, France, Belgium, Italy, Japan, Spain, Austria, Taiwan, New Zealand, Australia, and Canada developed strategies or programs to encourage the use of their engineering consultants overseas. One manifestation of this was the creation of technical consultants pools which marketed professional services under a single organizational banner. Example of this included: Nedeco (the Netherlands), Sweco (Sweden), Norconsult (Norway), Finnconsult (Finland), and JOC (Japan).

State enterprises were also encouraged to provide international engineering services. Thus, France supported BCEOM, Systra, ADP and EDF. Sweden supported SweRoad, SwedeRail and Swedavia. Japan supported JARTS. Taiwan sponsored Sinotech, while Germany supported Deconsult. In Canada, the major hydro utilities were encouraged to move into the international market. U.S. firms have always benefited from defence related spending, both in the US, but also outside the US.

Canadian export promotion strategy now includes the 'Team Canada' missions, whereby the prime minister and senior cabinet ministers lead a large commercial delegation with a view to 'opening doors' for the exports of professional services, technology, and products. The engineering profession has been involved in a number of these missions.


The consulting engineering sector is an exporter of high value-added services. The export earnings of this sector support and encourage the growth of the knowledge intensive employment that we are counting on to contribute to our future prosperity. As this brief canvass of the 'politics' of international engineering consulting shows, it would be naïve to expect that market factors alone will determine how the international market for high value engineering services is apportioned. Governments have always been involved in this market and will continue to be involved. In recent years, policy support for Canada's involvement in the international consulting engineering market has been *ad hoc*. *As the market place becomes more competitive, it may also become more politicized. A more strategic assessment of the potential role of public policy may be required.*

Export Development Canada (EDC):

The Export Development Canada (EDC) provides a range of financial support to Canadian companies engaged in the international market. Among EDC's most important services are: insuring receivables, insuring assets against political risk, providing various types of export financing, and providing bonding where this is required by an overseas client. While some engineering executives reported that their firms do not use EDC services, *several executives from large firms underscored the importance of EDC support. Indeed, some firms indicated that there are markets they would not be in, without EDC insurance against political risk or risk of non-payment.* As discussed earlier, the wave of infrastructure investment that will dominate the international engineering market in the next decade is likely to be associated with increased use of non-traditional sourcing models, *i.e.*, public-private partnership, design-build, and design-build-operate/maintain. These types of sourcing will increase the risk exposure and financing needs of Canadian engineering firms. In turn, *this will increase the need for risk mitigation facilities, such as those provided by EDC, and for credit facilities that are commensurate with the requirements of non-traditional sourcing models.*

Recommendations



1. Given the importance of the international market for engineering services, Engineers Canada and the Canadian Council of Technicians and Technologists should *explore the potential for creating a forum which will bring together the industry and professional organizations with a stake in the international engineering services market*. This stakeholder forum would regularly review the competitive challenges facing Canada's engineering consultancies in the international market and consider the contribution that policy and other initiatives could make to strengthening Canada's competitive performance in this field. The forum should also conduct research that compares the Canadian policy environment to that of other countries that also compete aggressively in the international engineering services market.
 2. Engineers Canada and the Canadian Council of Technicians and Technologists should *explore the contribution that centres of excellence in the post-secondary system could make to strengthening the supply of specialized and other skills that are so critical to competitive success in the international engineering services market*.
 3. Engineers Canada and the Canadian Council of Technicians and Technologists or the stakeholder forum proposed above, should *document the strategic role of international engineering consultancies in opening export markets for other sectors of the Canadian economy*, including the financial sector, industry, and resource developers.
 4. Engineers Canada and the Canadian Council of Technicians and Technologists should continue their efforts to *harmonize international licensing and certification standards in a way that reduces the remaining mobility impediments to Canadian engineering and technology professionals without jeopardizing or weakening the high standards of engineering and technology professions in Canada*. Equally important, given the significant role of internationally educated professionals in Canada's international engineering consultancies, Engineers Canada and the Canadian Council of Technicians and Technologists should continue their efforts to *harmonize international qualification standards* so as to facilitate the integration of internationally educated professionals into the Canadian labour market. This is particularly important for those internationally educated professionals who have advanced degrees in engineering and science.
 5. In light of the number of engineers, technicians and technologists whose employment is supported, in whole or in part, by international engineering service exports, Engineers Canada and the Canadian Council of Technicians and Technologists should *explicitly factor conditions in the international engineering service market into medium and long-term forecasts of human resource requirements and labour market conditions*.
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Employee Survey:

The *Survey of Engineers and Engineering Technicians and Technologists* was conducted throughout 2008. A total of 15,585 persons participated in the survey. Of these, 3,112 reported that they were currently employed in the consulting engineering sector. These comprised 1,931 engineers, 922 technologists or technicians, and 259 persons with other qualifications. The regional, gender and age distribution of respondents approximated the 2006 *Census* distribution.

More detailed information on the survey sample is available in the report, *Survey of Engineers and Engineering Technicians and Technologists*, which is available on the Engineering and Technology Labour Market Study website: <http://www.engineerscanada.ca/etlms/index.cfm>

Executive Interviews:

Figure No. 10 summarizes the regional and industry distribution of the executive interviews. Persons interviewed were generally chief engineers, chief technology officers, CEO's or directors of human resources. The interviews were conducted in the winter of 2009.

Figure No. 10
Regional Distribution of Executive Interviews

	Consulting
Atlantic	4
Quebec	1
Ontario	9
Manitoba – Saskatchewan	1
Alberta	1
British Columbia	5
Total	21

The interview protocol is reproduced below.



Interview Outline

Business Significance of International Assignments

1. Approximately what revenues did your firm¹⁵ generate from international work (i.e., work outside Canada) in the past year? What has been the high/low/average range of your revenues from international work over the past decade?
2. In the past year, roughly what proportion of your firm's revenues were generated by international work? Has this proportion changed in recent years?
3. Roughly what proportion of your firm's engineering and technology staff were involved in international assignments over the past year? Has this proportion changed in recent years?
4. Are there any trends respecting the profitability of international assignments, in relation to domestic work?

Trends

5. Have you observed any trends of importance over the past several years in terms of:
 - a. Canadian competitiveness,
 - b. changes in markets (either geographically or by types of expertise),
 - c. the overall competitive environment internationally for engineering services?
6. Have you seen any trends respecting the import of engineering services, i.e., the use of foreign engineering firms by Canadian customers for engineering services? Offshoring?
7. What trends do you anticipate over the next five to ten years?

Canadian Dollar

8. How important have been recent changes in the Canadian dollar on the competitive position of your firm when bidding on or undertaking international assignments?
9. Did the volume of your international work go down when the Canadian dollar appreciated? Did it increase during the 1990s when the dollar depreciated?

Markets

10. In what types of engineering are Canadian firms considered highly competitive, based on expertise? (Both in terms of disciplines and vertical markets.)
11. Conversely, are there types of engineering in which Canadian firms (with some exceptions, of course) are generally not competitive?
12. Geographically, which markets tend to be most important for Canadian engineering firms?
13. What proportion of assignments would be private sector vs. public sector (including state-owned corporations)?
14. How important is work that emanates from or is financed (in whole or in part) by CIDA? By

¹⁵ In the case of the Canadian branch of an international firm, "firm" in these questions means the Canadian branch.

other development agencies, e.g., US AID, etc.? By the World Bank and its affiliated regional development banks?

15. How significant are trends in design-build, design-build-operate, P3, etc.? How are these trends affecting international consulting engineering?

Competitiveness Factors

16. What factors contribute most significantly to the international competitiveness of Canadian engineering firms?

17. What factors hamper the international competitiveness of Canadian engineering firms?

18. Are there particular skills that are especially important in international engineering consulting?

19. Are there any skill shortages that restrict your firm's ability to pursue international assignments?

20. Does your firm usually act as the lead consultant in an international assignment or as a sub-contractor?

21. Is your firm affiliated or regularly partnered with any other international engineering firms?

22. How important are financing or guarantees from the Export Development Bank?

Impediments

23. How important are impediments to mobility of professional engineers and technologists:

a. Within the NAFTA region

a. Within the EU

a. Elsewhere

24. Are there particular policy issues that are important to the consulting engineering sector in terms of agreements regulating the international trade in professional services?



Appendix B: List of Persons Interviewed

John Blair
McElhanney Consulting Services Inc.

Robert Blackburn
SNC-Lavalin International Inc.

Gordon Ho
Trow Associates Inc.

Michael Okun
Northwest Hydraulic Consultants Inc.

Andrew Steeves
ADI Group Inc.

Marc Parent
Tecsult Inc.

Suresh Bhatta
MMM Group

Richard Donald, Jacques Whitford, Michael
Jolliffe
AMEC America

Gary MacKeen
KMB International

Dwight Hawkins
Opus International Consultants

Charles Birt
Sandwell Engineering Inc.

Roger Mellor
HMA Consulting

Ian Williams
McCormick Rankin Corporation

Tom Galley
I.M.P. Group International Inc.

Alan Perks
RV Anderson Associates Limited

John Farrow
LEA Consulting Ltd/

John McVey
Bantrel Co.

Mohammed Bhabha
Wardrop Engineering

Glen Martin
Consulting Engineers of BC

George Davies
Hatch Engineering

Appendix C: Steering Committee Members



Kim Allen
Professional Engineers Ontario

Jean Luc Archambault
Order des Technologues Professionels
du Quebec

Michelle Branigan
Electricity Sector Council

David Chalcroft
Association of Professional Engineers,
Geologists and Geophysicists of Alberta

Samantha Colasante
Engineers Canada

Manjeet Dhiman
ACCES Employment Services

Brian George
Northwest Territories and Nunavut Association
of Professional Engineers, Geoscientists

Stephen Gould
Canadian Council of Technicians and
Technologists

Kevin Hodgins
Northwest Territories and Nunavut Association
of Professional Engineers, Geoscientists

Cheryl Jensen
Mohawk College

Ellie Khaksar
Diversity Integration and Retention
Services Inc.

Lise Lauzon
Réseau des ingénieurs du Québec

Edward Leslie
New Brunswick Society of Certified
Engineering Technicians and Technologists

Andrew McLeod
Engineers and Geoscientists
New Brunswick

Perry Nelson
The Association of Science and Engineering
Technology Professionals of Alberta

Robert Okabe
City of Winnipeg

D'Arcy Phillips
Manitoba Aerospace

Pat Quinn
Professional Engineers Ontario

Colette Rivet
BioTalent Canada

Tom Roemer
Camosun College

Kyle Ruttan
Canadian Federation of Engineering
Students

Deborah Shaman
Human Resources and Skills
Development Canada

Len Shrimpton
Association of Professional Engineers,
Geologists and Geophysicists of Alberta

Andrew Steeves
ADI Ltd.

Al Stewart
Royal Military College of Canada

Richard Tachuk
Electric Strategies Inc.

Jean-Pierre Trudeau
Ordre des ingénieurs du Québec

Gina van den Burg
Ontario Society of Professional Engineers

Deborah Wolfe
Engineers Canada

Bruce Wornell
Engineers Nova Scotia

Yaroslav Zajac
Canadian Council of Technicians and
Technologists

