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SECTOR COMPETITIVENESS FRAMEWORKS

CONSTRUCTION PART 1 – OVERVIEW AND PROSPECTS

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Industry Sector Service Industries and Capital Projects Secteur de l'industrie Secteur des services tarandes projets



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CONSTRUCTION PART 1 – OVERVIEW AND PROSPECTS

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PREPARED BY: SERVICE INDUSTRIES AND CAPITAL PROJECTS BRANCH This *Overview and Prospects* is the first of two companion documents on Canadian construction in the **Sector Competitiveness Frameworks** series, which is being produced by Industry Canada in collaboration with Canada's key stakeholders in the industry. *Part 2* — *Framework for Action* will be prepared in coming months, based on discussions with major industry stakeholders, following study and review of the *Overview and Prospects*.

The **Sector Competitiveness Frameworks** series focusses on opportunities, both domestic and international, as well as on challenges facing each sector. The objective is to seek ways in which government and private industry together can strengthen Canada's competitiveness and, in doing so, generate jobs and growth.

Part 1 — Overview and Prospects is being made available for distribution in printed as well as electronic forms. In all, some 30 industrial sectors are being analyzed.

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FOREWORD

The new Canadian marketplace is expanding from national to global horizons and its economic base is shifting increasingly from resources to knowledge. These trends are causing Canadian industries to readjust their business approaches, and government must respond with new tools to help them adapt and innovate. Industry Canada is moving forward with strategic information products and services in support of this industry reorientation. The goal is to aid the private sector in what it is best qualified to do — create jobs and growth.

Sector Competitiveness Frameworks are a series of studies published by Industry Canada to provide more focussed, timely and relevant expertise about businesses and industries. They identify sectors or subsectors having potential for increased exports and other opportunities leading to jobs and growth. They cover 30 of Canada's key manufacturing and service sectors.

While they deal with "nuts and bolts" issues affecting individual sectors, the Sector Competitiveness Frameworks also provide comprehensive analyses of policy issues cutting across all sectors. These issues include investment and financing, trade and export strategies, technological innovation and adaption, human resources, the environment and sustainable development. A thorough understanding of how to capitalize on these issues is essential for a dynamic, job-creating economy.

Both government and the private sector must develop and perfect the ability to address competitive challenges and respond to opportunities. The Sector Competitiveness Frameworks illustrate how government and industry can commit to mutually beneficial goals and actions.

The Sector Competitiveness Frameworks are being published sequentially in two parts. An initial *Overview and Prospects* document profiles each sector in turn, examining trends and prospects. The follow-up *Framework for Action* draws upon consultations and input arising from industry–government collaboration, and identifies immediate to medium-term steps that both can take to improve sectoral competitiveness.

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1 HIGHLIGHTS

onstruction is an essential component of every economy. It is responsible for building the facilities and supportive infrastructure necessary for a nation to produce wealth and provide shelter for and deliver services to its citizens.

The construction process involves seven main phases:

- developing the concept
- securing financing
- developing the design
- obtaining regulatory approval
- building the project
- maintaining the asset once the project is complete
- demolishing the asset at the end of its life.

This is a multifaceted process involving a broad number of players and industries. Real estate developers, property owners, construction material, equipment and machinery manufacturers, financial institutions, government regulators and planners, architects, engineers and construction contractors all play key roles in determining the cost, quality and length of time necessary to complete a project.

This Sector Competitiveness Framework of the construction industry focusses primarily on those phases of the construction process that are carried out by the contracting industry. It is produced in concert with two other documents in the Sector Competitiveness Frameworks series covering industries involved in the construction process, namely, architecture and consulting engineering.

Construction is an ancient sector, with roots extending far into the past. Much of the way in which projects are constructed is determined by local tradition and geographic factors such as material availability and environmental challenges (e.g. cold, dampness, termites).

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North America has fewer long-established traditions than other, more established cultures. The construction processes employed reflect the continent's predominantly European roots; nonetheless, a more flexible, laissez-faire system has emerged here than exists in other regions. Important differences also exist in attitudes to cost and quality. European and Japanese markets tend to require construction to be of very high quality and durability. In North America, greater emphasis is placed on the cost efficiency and speed of construction. In addition, shortages of skilled construction workers, which have been a problem in much of North America, have helped fuel the development of innovations in construction machinery, equipment and techniques. As a consequence, the productivity and costs of North American construction have been very competitive with those of other developed nations.

In recent years, the competitive advantage favouring North American construction projects has diminished. Changes in Europe and Japan (the broadening of the European Union, deregulation, the lowering of both tariff and non-tariff barriers) have removed some of the impediments adding to the cost of construction in these nations. As a consequence, the gap in construction costs between North America and its other major trading partners has narrowed significantly.

The Canadian construction contracting industry is composed primarily of a large number of small and highly specialized companies. In 1995, the latest year for which statistics are available, the industry comprised 20 000 general contractors and 107 500 trade contractors. In that year, the total Canadian construction market stood at approximately \$100 billion. Roughly two thirds (\$66 billion) of this activity was carried out by the contracting industry. The balance was undertaken by the in-house resources of establishments not primarily engaged in construction (e.g. utilities, governments, private companies). All together, the industry employed 724 000 workers in 1995 (5.4 percent of total Canadian employment).

The market for construction is characterized by three key factors that have had a profound impact on the industry's structure and performance:

- it is highly cyclical
- it is geographically diverse
- it requires a strong local presence.

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The result is an industry that is highly fragmented, specialized and composed primarily of small companies.

In order to limit their financial exposure to market downturns, firms in the industry operate with overheads that are very low relative to the size of the projects that they undertake. Financing and surety instruments have been developed to facilitate this.

The construction market comprises three major subsectors. Each accounts for approxiately one third of the total market. All three are quite distinct. They respond to different market forces, use different construction techniques and materials, and employ different labour forces.

The residential construction market includes all dwellings from single-family homes to large apartment buildings.

The institutional, commercial and industrial construction market encompasses all buildings that are not residential; for example, medical and educational facilities, offices, stores, hotels, plants, warehouses.

The engineering construction market covers all non-building construction projects; for example, roads, sewers and water, bridges, dams, railways, ports, airports, pipelines, and oil and gas facilities.

Historically, the development of the Canadian construction industry has been closely linked to:

- major infrastructure undertakings, which spurred the development of engineering construction
- periods of sustained economic expansion, which spurred investment in institutional, commercial and industrial construction
- increases in the size and wealth of Canada's population, which resulted in significant growth in residential construction.



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In the process, Canada has developed a strong, efficient, well-established construction industry with a solid reputation for reliability and innovative design. Niche strengths include cold weather construction, the design and construction of hydro-electric power projects, and the repair and renovation of salt-damaged structures.

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111 Major Trends

In recent years (beginning with the 1990 recession), the industry has endured the most prolonged period of stagnation it has had to contend with since the Great Depression of the 1930s.

This has been due to a combination of cyclical, demographic and structural factors. The market for institutional, commercial and industrial real estate has been depressed by government spending cuts, excess building capacity constructed during the 1980s and slow growth in Canada's domestic economy. The market for engineering construction has also been hurt by government spending cuts. The residential construction market has been hit by declines in disposable income and a reduction in the rate of household formation. In addition, all markets have been hurt by increases in real interest rates.

The construction industry is also being challenged by important changes to other elements of its business environment. Depressed domestic markets are causing the industry to look increasingly to foreign markets for growth. It is beginning to identify and confront barriers that limit its access to these markets.

Important changes are occurring in the way in which investments in construction are being carried out. The number of construction projects being developed as design-build projects and as public-private partnerships is increasing significantly. The industry and owners are working to develop best practices in these areas. New environmental regulations are opening up new market opportunities for the industry. However, they are also increasing the due diligence responsibilities required of construction firms and could result in delays and increased construction costs. The industry is being challenged to respond to cost, quality and environmental issues through greater innovation. The construction industry has a strong tradition in human resources development and will have to work to ensure that this continues.

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1.2 Key Issues

Innovation

Innovation in construction is embodied in five main elements:

- the construction materials and systems used
- the project's design
- the construction processes employed
- the organizational methods used
- the machinery and equipment used by the design and contracting industries.

Many stakeholders (particularly suppliers to the industry) are dissatisfied with the pace at which new innovations are being adopted. There are a number of reasons for this, the most important ones being:

- high risks
- fragmentation
- separation of benefits and risks
- · limited knowledge
- regulations.

Trade

Canadian companies are beginning to do more work in neighbouring provinces and in adjacent parts of the United States. Companies are also beginning to explore opportunities outside North America. However, the industry is facing a number of problems that limit its ability to take full advantage of the opportunities presented in the international marketplace.

A superior knowledge of local conditions (regulations, markets, labour force, terrain, climate) generally gives local construction firms a distinct competitive advantage. Despite this, or perhaps because of this, non-tariff barriers have historically played an important role inhibiting trade. When outside firms are attracted to an area by a particularly large



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project, buoyant market conditions or because they possess specialized skills, strong feelings are generated that this work should go to local firms. If public or institutional funding is associated with the project, immense pressure will often be brought to bear to ensure that the project is structured and designed so that local involvement will be maximized.

Progress has been made in the Agreement on Internal Trade, the North American Free Trade Agreement and the General Agreement on Trade in Services. Nonetheless, market entry is still often impeded by local regulations, technical requirements, product standards and discriminatory approval processes.

Investment

Almost half of the moneys invested by business in Canada are devoted to the construction of new construction projects (i.e. buildings and engineered works) or the maintenance and repair of existing ones. Hence, the cost effectiveness, quality and speed in which this activity is carried out are important determinants of the productivity of these investments.

Although the Canadian construction industry is very competitive, its highly fragmented nature has often been viewed as being responsible for a number of problems. Chief among these are:

- inefficiencies arising from the division of design and construction responsibilities
- a failure to focus on life cycle costs rather than on lowest initial cost.

Two alternative procurement systems are being championed as offering solutions to these problems: design-build and public-private partnerships. Neither is a particularly new development, and each has its weaknesses. However, frustrations with the existing situation and an evolution in thinking about the role of government have given both greater prominence.

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Human Resources

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The construction industry employed approximately 747 800 workers in 1997, representing 5.4 percent of total Canadian employment. Employment in the industry is concentrated in the construction trades (59 percent), followed by management occupations (17 percent) and the clerical occupations (9 percent).

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Training for most of the construction trade occupations is accomplished through an apprenticeship system. By establishing a co-operative system, which has avoided the chronic under-training found in other industries, the construction unions and their employers have played a central role in creating an effective trades training system for the construction industry.

New federal funding formulas and the effect of fiscal cutbacks at the provincial level may require the apprenticeship system, a provincial responsibility, to adapt to operating with fewer financial resources from public sources. If system efficiencies do not increase to compensate, the shortfall may be borne by users of the training system. The challenge to the apprenticeship system is to adjust to the new funding environment through greater interprovincial cooperation and greater operating efficiencies. New training techniques, some utilizing new technology, may be of benefit in lowering the cost of training.

Sustainable Development

The construction industry plays a critical role in most issues concerning the environment, including:

- energy conservation
- waste management
- water quality
- indoor environments
- environmental regulations.

The construction industry is responding to these developments. However, it is also often argued that the industry could play a greater role in dealing with sustainable development issues. To achieve optimum results, an approach is required that integrates environmental issues into the development, design and construction processes. This can be achieved only through the cooperation of all stakeholders (owners, building material manufacturers, architects, engineers, contractors, regulators). Due to the fragmented nature of the industry, this is difficult to achieve. A number of industry sponsored initiatives are now under way in an attempt to build the consensus necessary for progress. Government as an important stakeholder, both as an owner and as a regulator, could play an important role in assisting and facilitating these efforts.

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13 The Bottom Line

The Canadian market for new construction is expected to experience only limited growth in the long term. Some within industry have expressed concerns that the construction market may be entering a post-industrial phase, where much of the infrastructure and buildings required by the Canadian economy for growth have already been built. As a result, repair, renovation and retrofit work is expected to grow in relative importance. The number of design-build projects and public-private partnerships is also expected to grow in relative importance. A sluggish Canadian market will probably encourage more construction contracting firms to seek out foreign market opportunities but, because of the difficulties that are likely to be experienced, the majority will continue to focus solely on the domestic market. Slow but steady progress is likely to be experienced in the area of innovation, while more substantial progress is anticipated for public-private partnerships.

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2 KEY POINTS ABOUT THIS INDUSTRY

2.1 Global Context

A Key Sector

Construction is an essential component of every economy. It is responsible for building the facilities and supportive infrastructure necessary for a nation to produce wealth and provide shelter for and deliver services to its citizens. Construction accounts for a large portion of economic activity in every country (15 percent of gross domestic product in Canada) and the bulk of new investment (48 percent in Canada). The efficiency with which this activity is carried out is a major determinant of the competitiveness of a country's industries and the quality of life of its people.

This is a huge sector. Total world activity in 1992 (the latest year for which this figure is available) was estimated at \$4 433 billion.

Construction: key sector responsible for building infrastructure necessary for growth

Region	Value	Share of world market
	(\$ billion)	(%)
North America	860	19.4
European Union	1 355	30.5
Eastern Europe	48	1.1
Former USSR	261	5.9
Asia (except Japan)	559	12.6
Japan	993	22.4
South and Central America	213	4.8
Africa	70	1.6
Oceania	74	1.7
TOTAL	4 433	100.0
Source: Industry Canada estimates	based on United Nations data.	

Table 1. World Construction Activity, 1992

The size of construction activity relative to other segments of an economy is largely determined by the level of a country's development. The relative size of construction sectors in less developed countries is typically quite low, reflecting the fact that they lack the infrastructure necessary for growth. As countries industrialize, major capital investments are undertaken and the construction sector tends to grow faster than other portions of the economy. As the industrialization process progresses, the pace of construction tends to slow down. The facilities and infrastructure

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necessary for growth, once built, stimulate the growth of other sectors. In advanced industrialized countries, an increasing proportion of construction activity is devoted to maintaining existing built assets and the proportion of overall gross domestic product (GDP) devoted to construction tends to drop.

The Process

Many different industries are involved Construction is a multifaceted process involving a broad number of players and industries. Real estate developers, property owners, construction material, equipment and machinery manufacturers, financial institutions, government regulators and planners, architects, engineers and construction contractors all play key roles in determining the cost, quality and length of time necessary to complete a project.

The construction process involves seven main phases:

- developing the concept
- securing financing
- developing the design
- obtaining regulatory approval
- building the project
- maintaining the asset once the project is complete
- demolishing the asset at the end of its life.

Developers conceptualize project and arrange financing Ultimate responsibility for the success or failure of the project rests with the owner or real estate developer. It is they who first conceptualize the project, establish its basic parameters, undertake feasibility studies to confirm its viability, arrange financing, guide the project through the regulatory approval process and hire all of the key firms involved in the project. All major aspects of the project must meet with their approval (e.g. its design, the construction techniques employed and the materials used).

Manufacturers provideManufacturers of building material and construction machinery and equipment play a criticalstate-of-the-art materi-
als and machineryManufacturers of building material and construction machinery and equipment play a critical
innovative role. Most major technological advances in construction have been made as the
result of the development of new materials or advances in machinery and equipment. The
ability of these sectors to provide high-quality products at a reasonable cost is important in
determining how the cost and quality of a nation's capital stock compares internationally.

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Similarly, financial institutions and government regulators play an important role in establishing the overall business environment in which the sector operates. They are largely responsible for determining the ease with which financing is obtained and project approval granted and play a significant role in the uptake of technological innovations.

Design issues fall under the purview of a number of professions, such as architects, interior designers, engineers and urban planners. Architects and engineers do not generally play a significant role in small-scale projects unless their participation is required by legislation.¹ On larger projects, the architect provides the overall design concept, which includes the exterior and functional programming. The engineer develops the structural design and input requirements. In industrial and major civil works projects (e.g. dams, highways, petrochemical plants), where function is of greater concern than aesthetics, the engineer usually undertakes the lead. In projects such as commercial, institutional and residential complexes, where consumer acceptance of the design is critical, the architect leads.

In the opening stages of a project, the architect and engineer develop preliminary designs and cost estimates, undertake cost-benefit analysis, evaluate environmental impacts and prepare supporting documentation used to market the proposal to potential financiers and government authorities involved in the approval process. Once support in principle has been obtained from financiers and approving agencies, detailed plans, specifications and cost estimates are developed. Construction documents are also prepared at this time.

The design professional with lead responsibilities generally acts as the project manager, although on large projects this function is often performed by a firm specializing in project management. Project managers represent the owner during the construction phase of the project. Their job is to ensure that all project components and processes are integrated. The project manager generally handles the overall bidding process and engages the general contractor.

The task of constructing the project falls to the contracting industry.² This sector consists of general contractors, who undertake the construction of entire structures, and trade contractors, who perform specialized services such as site preparation, structural work (steel or concrete), mechanical and electrical systems installation, and other interior and exterior work. The latter normally operate as subcontractor to the general contractor.

Architects provide overall design concept; engineers develop structural design and input requirements

General contractors assume overall responsibility for constructing projects

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Trade contractors perform specialized services and normally operate as subcontractors

Initial construction costs represent 20–30% of total life cycle costs general contractor schedules the arrival of building products, materials and machinery on the site, hires and coordinates the activity of trade subcontractors, supervises the construction, undertakes quality control and ensures that building code and other regulations are followed.

Overall responsibility for the construction of a project rests with the general contractor. The

Once the project is complete it generally undergoes some form of final inspection or commissioning process whereby the project is shown to be complete and functioning properly. At this point, responsibility for the operation of the project and maintaining its condition is generally transferred to the owner. These are not trivial responsibilities. The initial construction costs generally represent only 20–30 percent of the total costs owners face over an asset's total life.

Owners often use in-house resources to manage their properties and to carry out repairs and maintenance. However, in recent years, in recognition of the complexity and cost of these tasks, many owners have begun to contract these functions out to specialists in the property management and construction industries.

Major renovationsAs structures age, styles change and technology improves, owners often find it necessary toimprove performanceundertake major renovations of their property to improve its performance and appearance. Thisand appearancegenerally involves the repair and replacement of deteriorated components and the upgrade
of systems that have become obsolete. Renovations can be very complicated and expensive.
They generally involve all of the major processes involved in new construction.

At some point,At some point, however, owners often find that it is not cost-effective to undertake a renovation.it is more cost-effective
to demolish assetA decision is then taken to demolish the asset. On larger projects, this type of work is generally
undertaken by demolition specialists who salvage those materials that can be reused or recycled,
handle the disposal of any hazardous wastes that may be present and carry out the demolition.

This Sector Competitiveness Framework focusses primarily on those phases of the construction process that are carried out by the contracting industry: building, maintenance and demolition. It has been produced in concert with two other Sector Competitiveness Frameworks covering industries involved in the construction process: *Architecture* and *Consulting Engineering*. Due to the impact that these and other sectors have on the construction process, this document will note instances where issues outside the control of the contracting industry affect the cost and quality of construction.

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2.2 North American Context

Construction is an ancient sector, with roots extending far into the past. Much of the way in which projects are constructed is determined by local tradition and geographic factors such as material availability and environmental challenges (cold, dampness, termites). These factors influence the approaches to regulation that are adopted, the materials that are used, structural and aesthetic features of the design, and the division of responsibilities among the various professions and trades. While entrenched traditional ways of doing things help ensure consistency in both quality and cost, they also reduce the flexibility of the construction process and hinder the adoption of new innovative approaches.

The construction industry in North America has fewer long-established traditions than other, more established cultures. The construction processes employed do reflect the continent's predominantly European roots; however, a more flexible, laissez-faire system has emerged here than exists in other regions. Important differences also exist in attitudes to cost and quality. European and Japanese markets tend to require construction to be of very high quality and durability. In North America, greater emphasis is placed on the cost efficiency and speed of construction. In addition, shortages of skilled construction workers, which have been a problem in much of North America, have helped fuel the development of innovations in construction machinery, equipment and techniques. As a consequence, the productivity and costs of North American construction have been very competitive with those of other developed nations.

In recent years, the competitive advantage favouring North American construction projects has diminished. Changes in Europe and Japan (the broadening of the European Union, deregulation, the lowering of both tariff and non-tariff barriers) have removed some of the impediments that have added to the cost of construction in these nations. As a consequence, the gap in construction costs between North America and its other major trading partners has narrowed significantly.

2.3 Canadian Industry Snapshot

The Canadian contracting industry is composed primarily of a large number of small and highly specialized companies. In 1995, the latest year for which statistics are available, the industry comprised 20 000 general contractors and 107 500 trade contractors. In that year, the total Canadian construction market stood at approximately \$100 billion. Roughly two thirds (\$66 billion) of this activity was carried out by the contracting industry. The balance was undertaken by the in-house resources of establishments not primarily engaged in construction (e.g. utilities, governments, private companies).³ All together, the industry employed 724 000 workers in 1995 (5.4 percent of total Canadian employment).

Local tradition and geographic factors are important

North American construction costs are very competitive

Canadian contracting

number of small, highly

comprises a large

specialized firms

3 key factors have a profound impact

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The market for construction is characterized by three key factors that have had a profound impact on the industry's structure and performance:

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- *High cyclicality:* Construction is one of Canada's most cyclical industries, subject to massive and unpredictable swings in demand. The construction sector is three times as volatile as the service sector and nearly 50 percent more volatile than the manufacturing sector (Figure 1).
- Geographic diversity: Construction projects are spread evenly across the country in direct proportion to demographic and economic factors.
- Strong local presence: Construction is a site-specific activity, requiring hands-on management and knowledge of local labour conditions and regulations. Non-tariff barriers have also reinforced this need to be located in the same region.



Figure 1. Comparison of Employment Instability, 1976–95

Source: Statistics Canada, Labour Force Survey, Matrix 3451.

The result is an industry that is highly fragmented, specialized and composed primarily of small companies. The cyclical nature of the construction market has had an immense impact on the industry's structure. Over the years, it has evolved into one that is adapted primarily to operating successfully in a feast-or-famine market environment.

In order to limit their financial exposure to market downturns, firms in the industry operate with overheads that are very low relative to the size of the projects that they undertake. Financing and surety instruments have been developed to facilitate this. Contractors traditionally use bank and supplier credit to finance their operations, and equipment is often leased or financed through

Flexibility and responsiveness are important

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a chattel mortgage. Performance bonds are available to limit the risk of engaging a contractor with a limited asset base. Labour force and hiring practices in the construction industry are also geared to the boom-bust cycle. Most workers are hired on a project basis, often through union (and in some provinces non-union) hiring halls. Only a strategic nucleus of key employees is employed over the long term. As a consequence, firms are able to expand and contract their operations (and enter and exit the industry) in a relatively fluid manner in response to changing business conditions.⁴

Companies have also tended to limit their overheads by being highly specialized and by operating within clearly defined areas of responsibility. They come together to construct a specific project and then go their separate ways. Very few Canadian firms provide the full range of services required to carry out the entire construction process (e.g. development, design, engineering, construction). Indeed, few construction contracting firms perform all of the contracting functions. Rather, the construction contracting sector consists, for the most part, of general contractors who undertake overall responsibility for the construction of a project and trade contractors who perform specialized services. Trade contractors normally operate as subcontractors to general contractors on new construction, but will often contract directly with the owner on repair and renovation contracts.

Contracting firms also tend to specialize by confining their activities to a specific market area. The construction market comprises three major subsectors. Each accounts for approximately one third of the total market. All three are quite distinct. They respond to different market forces, use different construction techniques and materials and employ different labour forces. These markets are:

- *Residential construction:* This market includes all dwellings from single-family homes to large apartment buildings. It is driven primarily by demographic factors, amount of disposable income and the cost of borrowing.
- *Institutional, commercial and industrial construction:* This market encompasses all buildings that are not residential, such as medical and educational facilities, offices, stores, hotels, plants and warehouses. The strength of this market is determined by factors affecting the investment plans of the goods-producing and service sectors and by demographic factors affecting the demand for institutional services.
- *Engineering construction:* This market covers all non-building construction projects, such as roads, sewers and water, bridges, dams, railways, ports, airports, pipelines, and oil and gas facilities. This market is influenced primarily by government spending on infrastructure and expenditures by the resource sector.

Contractors are generally highly specialized

Construction market comprises 3 subsectors

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Specialization, low overheads, the need to operate locally and geographic dispersion have resulted in an industry that is composed primarily of a large number of very small firms. In 1995, only 1 percent of general contractors had revenues exceeding \$20 million, while 80 percent had revenues less than \$250 000. Trade contractors were, of course, much smaller; 80 percent had revenues under \$250 000, while 4 percent had revenues over \$1 million.

Construction firms are primarily Canadian owned and controlled The need to have a strong local presence has also resulted in the industry being primarily Canadian owned and controlled. Only a handful of foreign-controlled contractors operate in Canada; for example, Bechtel Canada Inc., Fluor Daniel Canada Inc., Dumez Nord Amerique Inc. They are, for the most part, subsidiaries of large international firms. These companies generally entered the Canadian market to construct a major project for which they possessed unique niche capabilities. Once the project was completed, they maintained a Canadian presence, though they now generally operate at significantly reduced levels. For the same reasons, Canadian-owned firms do not generally operate internationally, although there are a few notable exceptions to this rule; for example, PCL Construction Inc., Ellis Don Construction Ltd., BFC Corp. It is estimated that less than 1 percent of Canadian contractors' revenues come from international projects.

Significant number of
Aboriginal firms have
been createdConstruction contracting is also an industry in which there are a significant number of
Aboriginal firms. These firms play a major role in serving their own communities, and many
have been successful in bidding on projects in the mainstream Canadian economy. Many
Aboriginal people have well-developed skills in the building trades and carry out a significant
proportion of housing and commercial construction within their communities.

The industry associations representing the construction industry reflect the fragmented nature of its structure. Each specialty is represented by its own association.

Contractors are represented by two associations: the Canadian Home Builders Association (CHBA), which represents residential contractors, and the Canadian Construction Association (CCA), which represents non-residential contractors. Both act as umbrella organizations for provincial and regional member associations. CCA member associations also include specialty trade contractor associations.

Developers are represented by four bodies: the Building Owners and Managers Association of

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Canada, the Canadian Institute of Public Real Estate Companies, the Real Estate Institute of Canada and the Urban Development Institute of Canada. Architects are represented by the Royal Architectural Institute of Canada and engineers by the Association of Consulting Engineers of Canada.

Membership in associations is generally voluntary. The only exceptions are architects and engineers, who must pay annual licensing fees to each of the provincial associations in whose provinces they wish to practice, and contractors in Quebec, who are required to join a designated association in order to perform work.

Government plays a unique role in the construction process as both a regulator and a property owner. As a regulator, it plays a key role in establishing the overall business environment for construction. Nationally, the federal government plays an important role in developing model national codes for construction⁵ and establishing the parameters for federal environmental assessments. Provincial governments establish the construction codes used in the province (the national model codes with some minor modifications),⁶ labour standards, environmental regulations and the parameters surrounding municipal zoning regulations. Municipalities set zoning requirements and are responsible for approving building applications, issuing building permits and conducting building inspections.

As a property owner, governments and government-funded institutions account for approximately one third of non-residential construction activity. Their size gives them the potential to have a significant impact on the cost and quality of construction by stabilizing the market, facilitating technology transfer and demonstrating best practice management techniques. However, many in the industry believe that this potential is not being fully realized and are concerned that the current trend to pass increasing responsibilities to municipalities (many of whom have limited management and financial resources) will worsen the situation.

2.4 Performance

Historically, the development of the Canadian construction industry has been closely linked to:

- major infrastructure undertakings that spurred the development of engineering construction
- periods of sustained economic expansion that spurred investment in institutional, commercial and industrial construction
- increases in the size and wealth of Canada's population, which resulted in significant growth in residential construction.

Governments play a unique role as both regulator and property owner

Governments

account for one third of non-residential construction activity



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Canada has a strong, efficient, well-established construction industry In the process, Canada has developed a strong, efficient, well-established construction industry with a solid reputation for reliability and innovative design. Niche strengths include cold weather construction, the design and construction of hydro-electric power projects and the repair and renovation of salt-damaged structures.

In recent years (beginning with the 1990 recession), the industry has endured the most prolonged period of stagnation it has had to contend with since the Great Depression of the 1930s (Figure 2).



Figure 2. Construction Output

This has been due to a combination of cyclical, demographic and structural factors. The market for institutional, commercial and industrial real estate has been depressed by government spending cuts excess building capacity constructed during the 1980s and slow growth in Canada's domestic economy. The market for engineering construction has been hurt by government spending cuts. The residential construction market has been hit by declines in disposable income and a reduction in the rate of household formation. In addition, all markets have been hurt by increases in real interest rates.

It has recently endured a prolonged period of stagnation

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Significant structural changes in the investment patterns of the service sector have also contributed to a lowering in demand for construction (Figure 3). Over the years, due to increasing investments in new technologies by the service sector (for example, in information technology and electronic commerce), the proportion of service sector investment devoted to construction has declined, dropping from nearly 70 percent of the sector's investment in 1955 to less than 50 percent in 1993.

Significant structural changes have occurred to investment patterns

Figure 3. Investment in Construction



Total = investment in construction as a share of total investment. Goods = investment in construction by the goods sector as a share of total investment by the goods sector.

Services = investment in construction by the services sector as a share of total investment by the services sector.

Source: Statistics Canada, Capital and Repair Expenditures: Construction and Machinery and Equipment, Matrix 1190.

During this period, investment in construction by the goods sector stayed relatively constant at roughly 40 percent of the sector's investment by the goods sector. As a consequence, there has been a similar, though slightly more moderate, decline in the proportion of total Canadian investment devoted to construction. It fell from a high of 58 percent total investment in 1957 to 45 percent in 1993.

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Repair and renovation work are becoming more important Stagnation in the Canadian construction market has been confined primarily to the market for new construction. Repair, renovation and retrofit work has continued largely unabated. This type of work is considerably more labour intensive than new construction. Its increasing relative importance, coupled with changes in the composition of demand for construction and lower profits, has contributed to a decline in measures of productivity of the construction industry (Figure 4).



Figure 4. Comparison of Labour Productivity Growth Rates

Source: Statistics Canada, Indexes of Real Gross Domestic Product per Person-hour Worked of Persons at Work, Matrix 7927.

More construction work is being carried out in-house by property owners The increasing importance of repair and renovation activity has also had an impact on the amount of construction work available to the contracting industry. A large amount of repair and renovation work is carried out in-house by property owners. As the amount of repair and renovation has increased, the proportion of construction work carried out by the contracting industry has declined. Construction contractors used to perform roughly four fifths of Canadian construction. This has now dropped to about two thirds of total construction activity (Figure 5).

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Figure 5. Contracting Activity as a Share of Total Construction Activity in an Average Firm

Source: Statistics Canada, Total Value of Construction Work Performed, Matrix 2850.

The impact of slack markets, rising costs and declining market share on the industry's performance has been devastating. Profit margins have plunged and continue to remain quite low (Figure 6).



Figure 6. Construction Contracting Net Profit Margins (pre-tax profit divided by total revenue)

Source: Statistics Canada, unpublished data from Quarterly Financial Statistics for Enteprises Database.

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In addition to having to confront slack market conditions, the construction industry is also being challenged by important changes to other elements of its business environment. Depressed domestic markets have caused the industry to look increasingly to foreign markets for growth. It is beginning to identify and confront barriers that limit its access to these markets. Important changes are occurring in the way in which investments in construction are being carried out. The number of construction projects being developed as design-build projects and as private-public partnerships is increasing significantly. Industry and owners are working to develop best practices in these areas. New environmental regulations are opening up new market opportunities for the industry. However, they are also increasing the due-diligence responsibilities required of construction firms and could result in delays and increased construction costs. The industry is being challenged to respond to cost, quality and environmental issues through greater innovation. The construction industry has a strong tradition in human resources development and will have to work to ensure that this continues.

3 CHANGING CONDITIONS AND INDUSTRY RESPONSE: KEY ISSUES

3.1 Innovation

Construction is often portrayed as a mature sector that is slow to innovate and resistant to technical change. Much is often made of the fact that expenditures on research and development (R&D) by the contracting industry are far lower⁷ than those of other sectors (Figure 7).



Figure 7. R&D as a Share of Contribution to Real GDP, by Sector

This portrait of the industry is not accurate. It ignores the R&D expenditures of the engineering and architecture industries.⁸ It also ignores the flexibility of the sector. Change and adaptation to change are critical for the success of firms operating in the industry. The technologies used in construction are continuously being upgraded and improved. The view that the sector is conservative and hesitant to change reflects a misunderstanding of the innovative process as it applies to construction. Innovation is generally defined as *the act of developing a new or improved product, process or organizational system and successfully introducing it into the marketplace*.

Source: Statistics Canada, Industrial Research and Development, Catalogue No. 88-202-XPB.

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Architects, engineers and contractors play a key role in introducing new innovations into the market The architecture, engineering and contracting industries play a key role in introducing new innovations into the construction market. This generally involves members of the sector using their own personal knowledge and skills to adapt state-of-the-art technologies from other sectors into innovative designs and construction processes. This process does not require significant investments in R&D by individual firms, but rather is dependent on the vast storehouse of accumulated knowledge that has been achieved over the years through the activity of many workers in the sector.

Innovation in construction is embodied in five main elements:

- the construction materials and systems used
- the project's design
- the construction processes employed
- the organizational methods used
- the machinery and equipment employed by the design and contracting industries.

Construction Materials and Systems

Material suppliers constantly improve performance of their products The materials and systems used in construction are in a constant state of evolution. An important factor stimulating these advances is competition between competing materials. Constructed works can be produced from a wide variety of different substances. For example, structural components can and are made from as diverse a group of materials as wood, concrete, steel, aluminum and plastics. As a result, suppliers to the sector are constantly attempting to improve the performance of their products in order to gain market share from other substitutable materials and to distinguish their products from others made from the same material.

Major advances have also been made in many of the systems incorporated into a construction project (e.g. the electrical, mechanical, security and elevator systems). Advances in information technologies have resulted in significant advances in the automation of these systems and in the development of entirely new applications for these technologies (e.g. remote sensing systems installed in roads and bridges, sophisticated energy-saving systems).

Design

New innovative designs cannot generally be guarded by copyright or other IP protection

The architecture and engineering communities play a critical role incorporating the progress made in other sectors into new construction techniques and designs. The motivation for developing new designs is usually either to achieve economic efficiencies (through the use of new materials or methods) or the need to solve a problem that requires the development of a design

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that breaks new ground. Innovative developments in construction processes and designs cannot generally be guarded by a patent or other form of intellectual property (IP) protection. As a result, the innovative efforts of architects and engineers operating in the private sector tend to be carried out on a project basis; that is, by developing innovative solutions to a particular problem. Aspects of this work that have more general applications are guarded, to the extent that they can be, as trade secrets and are not disseminated to the industry at large.

As a consequence, innovations in design generally result in small, incremental advances that on their own do not have much of a visible effect, but collectively result in large changes.

Construction Processes

Construction processes are continually evolving to improve the speed, cost efficiency and quality of construction. Improvements in construction techniques, such as the use of standardized interchangeable prefabricated components, and advances in construction machinery, such as laser-guided earth-moving equipment, have reduced and simplified the amount of work required on construction sites. This has resulted in significant cost and time savings and more consistent quality.

Organizational Systems

Significant improvements have been made to the organizational structures of firms operating in the construction industries. These innovative developments have been assisted by improvements in computer management systems, which have facilitated the implementation of advanced management techniques. New project management methods and software are allowing firms to reduce construction costs, shorten schedules through better coordination of activities and improve quality. Alternative forms of project delivery such as design-build and public-private partnerships are also facilitating the development of more efficient organizational structures.

Machinery and Equipment

Although new construction machinery is continually appearing on the marketplace, including some robotics equipment (e.g. painting robots), the most important technological advances in recent years have been in the area of information technologies. Improvements in design, estimating and scheduling software have provided industry with powerful tools with which to develop improved designs and construction processes. Developments in electronic communications are increasing industry awareness of business opportunities and permitting firms to



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operate more effectively in areas that are further removed from their headquarters. Human resources development, an important industry strength, is being facilitated by the development of new training systems, such as CD-ROM training packages. These new systems do not require workers to travel to a classroom and give management greater flexibility in scheduling training sessions.

Barriers to Innovation

Despite the progress that has been made, many stakeholders (particularly suppliers to the industry) are dissatisfied with the pace at which new innovations are being adopted. A recent study⁹ found that, although Canada compares favourably with other countries, it could still take up to 30 years for an innovation to enter into widespread use. There are a number of reasons for this, the most important ones being:

- high risks
- industry fragmentation
- separation of benefits and risks
- limited knowledge
- regulations.

Risks

The process of innovation is always risky. A large number of innovations fail to perform as anticipated, and this danger must be considered any time an innovative product is purchased. In construction, the risk of failure poses special problems:

- *Large sums at stake:* Construction projects are expensive, often the largest single capital investment that the purchaser will ever make, be it a house, road, office tower or factory.
- *Long risk period:* Constructed works are built to last an extremely long time (25 years for a road, 50 to 100 years for most buildings). This also makes it difficult to quickly assess the performance of a new innovation.
- *Risks difficult to confine:* Because construction materials and systems are highly integrated, it is often impossible to replace a failed innovative component without redoing much of the construction. Therefore, risks generally cannot be confined to just the innovation in question.¹⁰

As a result investors will often forego the potential cost savings of a new, but as yet unproven, innovation in favour of the less efficient performance of a known material or process.

Despite progress, innovations can still take up to 30 years to enter into widespread use

Innovation always

involves risk

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Fragmentation

The fragmentation of the sector into small, specialized companies, while a necessary response to the cyclical nature of the business environment, inhibits the ability of firms to innovate. They often lack the resources necessary to fund speculative research into innovative approaches or to search out, evaluate and adopt new innovative developments (their receptive capacity is low). Also, specialization limits the degree to which innovative solutions are found through the synergy that arises from working with other disciplines and specialists.

Separation of Benefits and Risks

Innovative technologies are developed and used most effectively in situations where those making the decision to pursue an innovation are its primary beneficiaries. Firms in the construction sector have been very quick to adapt new machinery and equipment that have a direct impact on the cost efficiency of their operations (e.g. the use of design, estimating and scheduling software). They have also proven very adept at developing new construction processes and management techniques that improve their competitiveness.

A major problem inhibiting innovation in construction stems from a breakdown in risk-reward flows. Architects and engineers bear significant risks when incorporating innovative materials, techniques and processes into their designs,¹¹ but receive little if any financial benefit if these innovations are successful. Instead, the ultimate beneficiaries of many successful innovations are project owners (who benefit from improved performance and reduced costs) and any firms or individuals who hold intellectual property rights to the innovations in question (e.g. construction material manufacturers).

As a result, architects and engineers are often reluctant to introduce untried technologies into their designs.

Limited Knowledge

All firms are interested in acquiring new technologies that improve the efficiency of their operations, assist them to enter niche markets (e.g. environmental and retrofitting technologies) or improve the cost and quality of their output. Here companies face three basic hurdles: finding the technology, evaluating it and negotiating both an agreement to license it (assuming it is proprietary) and an agreement to use it from other parties involved in the project. All of these tasks are complex and difficult to accomplish, particularly for the small and medium-sized enterprises that characterize most of the firms in the construction industry. As a consequence, many innovations with strong potential either are not used or take a considerable length of time to enter into general use. Fragmentation hinders innovation

Breakdown in risk-reward flows inhibits innovation

3 basic hurdles: finding technology, evaluating it and negotiating its use С

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Innovative practices likely not to conform with local codes

Regulations

Regulatory processes also pose important impediments to innovation. Innovative practices, almost by definition, differ from the established way of doing things and hence are more likely to not conform with local fire and building codes.

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The various codes across Canada all have provisions to accept alternatives and equivalencies. But, this is at the discretion of the local building, electrical, plumbing and fire inspectors, who often interpret the codes very narrowly. In some cases, acceptance can be obtained by getting an engineer's or architect's report or by going to a body that has powers to approve the use of a building material as an exception. However, this can be a long and expensive process and does not guarantee success.

In many cases, municipal building and fire inspectors and their related departments are reluctant to approve anything that is not specified in the appropriate building and fire codes and/or that does not have an appropriate certification (e.g. Canadian Standards Association, Underwriters Laboratories of Canada). Here an important issue relates to municipal liability. A municipality through its role in plans approval and building inspection assumes some liability if problems occur. Even in cases where the designs are professionally produced and the innovations have an architect's or engineer's stamp on them, some liability remains with the municipality, although much has been shifted to the professional.

For this reason, Canada's national model construction codes play an important role in facilitating the adoption of new innovations. Committees of experts representing all stakeholders in the process continually review the codes to ensure that they provide the best, most cost-effective technical solutions that meet the code's health, safety, structural sufficiency and access criteria. It is generally accepted that this activity has substantially accelerated the speed with which new innovations are able to enter into common practice.

Steps are now being taken to change the construction codes from a prescriptive system, which specifies the approach to be taken, to a performance-based one, where any approach can be taken, provided that it meets the codes' performance requirements. This should make it easier for new innovative approaches to be developed. However, it will pose significant new challenges for building inspectors.

Canada's national model construction codes play important role in facilitating adoption of new innovations Ν

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3.2 Trade

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A superior knowledge of local conditions (regulations, markets, labour force) generally gives local construction firms a distinct competitive advantage. Despite this or perhaps because of this, non-tariff barriers have historically played an important role inhibiting trade. When outside firms are attracted to an area by a particularly large project or buoyant market conditions or because they possess specialized skills, strong feelings are generated that this work should go to local firms. If public or institutional funding is associated with the project, immense pressure will often be brought to bear to ensure that the project is structured and designed so that local involvement will be maximized.

The advent of the Agreement on Internal Trade (AIT), the bilateral agreements between Quebec and Ontario and between Quebec and New Brunswick, the North American Free Trade Agreement (NAFTA) and the General Agreement on Trade in Services (GATS) have removed many obvious barriers to trade. The terms of the AIT prohibit governments from discriminating against out-of-province contractors and contain provisions that facilitate the mobility of workers. The AIT also requires all government construction contracts over \$100 000 to be open to bidding from any firm operating in Canada and obliges governments to make these opportunities known to everyone.

The NAFTA's investment, temporary entry, rules-of-origin and procurement provisions give firms the right to establish themselves in any jurisdiction, to have their executives, managers, architects, engineers and employees with highly specialized skills work temporarily at any job site, to bring to the job site any equipment that is manufactured in North America and to bid on any government construction contract valued at more than \$6.5 million or any government-owned corporation contract over \$8 million.

Under the GATS, most developed nations have agreed to be bound by provisions similar to those contained in the NAFTA. Some developing nations have also signed the agreement, but their terms of accession to the agreement vary markedly. The threshold on government construction contracts (roughly \$8.5 million¹²) is slightly higher than that of the NAFTA and does not apply to procurement by government-owned corporations.

Due to the trade liberalizing effects of these agreements, Canadian construction firms, particularly those whose local markets are depressed, are beginning to become more interested in exporting their services. In the past, very few companies have ventured into foreign markets. A limited number of firms have been active in the U.S. market. These have generally been Knowledge of local conditions gives local firms distinct competitive advantage

Canadian firms are becoming more

interested in exporting

their services

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larger companies that have for the most part operated through subsidiaries. Some companies have also undertaken work in developing countries, but this has usually been limited to cases where financing was made available through the Export Development Corporation (EDC), the Canadian International Development Agency (CIDA) or the multilateral development banks. Overall, it is estimated that less than 1 percent of the revenues of construction firms have been obtained through exports.

This is now beginning to change. Companies are beginning to do more work in neighbouring provinces and in adjacent parts of the United States. This activity is not confined to the larger firms. Indeed, many of the more successful exporters are small and medium-sized companies with highly specialized expertise (e.g. trenchless excavation, slip-form construction, concrete restoration). Because of the importance of having a strong local presence, many Canadian firms are choosing to form alliances with local companies rather than establishing their own operation and are exporting their project management skills.

Companies are also beginning to explore opportunities outside of North America. Many developing nations, particularly those in Asia and South America, are turning to public-private partnerships as a means of satisfying the infrastructure demands created by their rapid urban and economic growth. International financial institutions such as the World Bank and the Asian Development Bank are also increasingly seeking private sponsorship and risk-taking in the infrastructure projects that they support. The fall of the Iron Curtain has opened up the market in eastern Europe, and some Canadian firms, particularly those whose owners have cultural and family links, are beginning to do work there.

However, the industry is facing a number of problems that limit its ability to take full advantage of the opportunities presented in the international marketplace. Non-tariff barriers continue to be a problem. Despite progress in the AIT, NAFTA and GATS, market entry is still often impeded by local regulations, technical requirements, product standards and discriminatory approval processes.

Financing, bonding, per-
formance guarantees,
insurance and legal
services are oftenFirms are also inhibited by the substantial up-front costs involved in bidding on international
projects and in establishing a presence in foreign markets. Companies pursuing international
projects often find it difficult to access financing and investment capital and to assemble the
necessary financial packages. Financing, bonding, performance guarantees, insurance and
legal services for offshore projects are often unavailable in Canada
for offshore projectsunavailable in Canada
for offshore projectscanadian industry has also indicated that competitors from other developed
nations often have access to financial guarantees that are not available in Canada.

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Despite the fact that they possess strong technical capabilities, Canadian firms have had little success in winning bids for infrastructure projects conceived as public-private partnerships. Although many nations have used public-private partnerships for some time to procure their infrastructure needs, Canadian governments are only now beginning to use this mechanism. As a result, few Canadian firms have the experience necessary to successfully compete in international markets for public-private partnerships.

Public-private partnerships require participants to take on significantly increased risks and to arrange for financing. Most Canadian firms lack the expertise necessary to assess the risks of international projects, are unused to forming the consortia necessary to develop a project and have not developed strong links with potential sources of capital. Furthermore, the Canadian financial sector has equally little experience with public-private projects and often cannot offer the financing or the financial advice needed.

As Canadian firms increase their pursuit of foreign market opportunities, many of the problems that have restricted their ability to export are becoming more apparent. Over the past year, various initiatives have been launched to address them. It is expected that as the market for public-private partnerships increases in Canada and Canadian consortia develop the skills necessary to service the domestic market, there is likely to be a noticeable increase in the amount of international work sought.¹³

Efforts are also continuing to improve the overall environment for trade in construction services. Negotiations on the AIT are attempting to expand the agreement to include procurement by municipalities, universities, schools and hospitals. In the NAFTA, working groups are looking at ways to improve temporary entrance, procurement and investment provisions. Progress is also being made on harmonizing standards. In the GATS, negotiators are focussing on means of reducing subsidies and expanding the scope of the agreement's government procurement, investment and competition policy provisions.

3.3 Investment

Almost half of the moneys invested by business in Canada are devoted to the construction of new construction projects (i.e. buildings and engineered works) or the maintenance and repair of existing ones. Hence, the cost effectiveness, quality and speed in which this activity is carried out are important determinants of the productivity of these investments. Canadian governments are only now beginning to use public-private partnerships

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Traditionally, projects have been procured via design-bid-build method

Design-build and public-private partnerships are being used more frequently for procurement Although the Canadian construction industry is very competitive, its highly fragmented nature has often been viewed as being responsible for a number of problems. Chief among these are:

- inefficiencies arising from the division of design and construction responsibilities
- a failure to focus on life cycle costs rather than lowest initial cost.

Efforts to find a solution to these problems have in recent years focussed on the manner in which construction projects are developed. Traditionally, projects have been procured via the design-bid-build method. Under this system, a project's plans and specifications are developed by a team of design professionals; that is, architects and engineers. The project is then put out for tender and is built by the lowest bidding contractor. Critics have pointed out that design-bid-build reinforces the traditional divisions between the various sectors and emphasizes the lowest initial cost approach to construction.

Two alternative procurement systems are being championed as offering solutions to these problems. These are: design-build and public-private partnerships. Neither is a particularly new development and each has its weaknesses. However, frustrations with the existing situation and an evolution in thinking about the role of government has given both greater prominence.

Design-Build

With design-build contracts, owners specify the time lines and performance criteria sought for a project. In response, design-build teams comprising architects, engineers, contractors and in many cases building material suppliers submit project proposals that indicate the projects' design, cost and completion date. The owner then evaluates the submissions and selects the winning proposal.

Design-build projects offer owners numerous advantages. Chief among these are:

- multiple design solutions with firm prices from which to choose
- early establishment (at the proponent stage) of a fixed price
- accelerated project delivery
- lower costs due to designer/builder synergy
- reduction in adversarial relationships among the parties working on the project (design-build projects involve a team approach)
- stronger performance guarantees with a single point of contract responsibility
- reduction in the amount of supervision required of the owner (the design-build team is fully responsible for all aspects of the work).

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Case studies in the United States have found the design-build approach to generate significant savings: 15–18 percent in time, 12–14 percent in cost and millions of dollars in reduced litigation costs.¹⁴ Canadian experience has shown similar potential.¹⁵

However, these savings can be difficult to realize. In order for design-build to work effectively and efficiently, owners are required to determine their needs early in the development process and spell these out in considerable detail in performance terms. Owners must then commit to a contract before all the details of the project are known, and rely heavily on the performance specifications that they established. Owners must also relinquish much of the design control that they have traditionally held (this is essential for savings to be realized in time and through innovative design solutions).

The industry is also challenged by the design-build system. With a design-build project, the industry is required to take on greater responsibility and financial risk. Design-build proposals are expensive to prepare, generally accounting for between one third and one half of the completed project's design costs. In addition to the higher cost of bidding, the industry faces greater uncertainty in the bid evaluation process. Evaluating dissimilar competing proposals is a complex and difficult task. It is inherently more subjective and less transparent. As a consequence, there is a much higher likelihood that losing firms will believe they were unfairly treated. Design-build contracts also often transfer many of the responsibilities and risks formerly borne by the owner to the design-build team.

In order to reduce the risk of entering design-build competitions and to overcome some of the pitfalls that could arise in the process, firms are developing new best practices approaches. Design-build competitions are generally structured in one of four ways:

- *Stipulated sum/best value:* Here the budget is fixed and projects are evaluated for best value for this price.
- *Best value for money:* Weighted criteria are used to evaluate the cost and quality of the proposals.
- *Meet criteria/low bid:* All bids that are judged to have met the performance criteria set by the owner are then evaluated on a low bid basis.
- *Bridging design:* The owner's request for proposal provides design specifications that are fairly complete. Bidders then determine how to complete the project in the most cost-effective manner, with the contract being awarded to the lowest bidder.

Design-build approach generates significant savings

With design-build, industry is required to take on greater responsibility and financial risk

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Normally, a multi-tiered process is followed. The owner first issues a request for qualifications (RFQ), briefly outlining the parameters of the project and the skills sought in the design-build team. Through the RFQ process, the number of competitors is narrowed down to between three and five of the most qualified bidders. A request for proposals (RFP) is then issued to these qualifying firms. It outlines, in performance terms, the results expected for the project.¹⁶ The RFP also generally indicates the evaluation process that will be followed and the criteria that will be used to judge the proposals. Once the proposals are received, they are evaluated according to the criteria outlined in the RFP. A jury of professionals is often formed to carry out the evaluation. Having a jury that operates at arm's length from the owner provides greater transparency to the process. Also, since the jury is comprised of individuals with strong technical expertise, the cost of bidding can often be significantly reduced.¹⁷ Still, regardless of the efforts made to reduce the cost of bidding, it is always a significant factor. In recognition of this, design-build competitions often contain provisions to compensate losing bidders for a portion of their bidding costs.¹⁸

Work is continuing
on developing broad
consensus on best prac-
tices for design-buildWork to develop a broad consensus on the best practices to be followed with design-build is
continuing. The greatest divergence of opinion lies on how risks and responsibilities should
be apportioned. As a consequence, industry (and in some cases owners) remain hesitant to
embrace the process. Due to the high costs and added risks involved, firms with experience in
design-build projects have indicated that they will enter into design-build competitions only if
they feel they have a good chance of winning, have confidence that the selection process will
be transparent and fair, and judge the risks and responsibilities they will have to bear to be
reasonable.

The industry is also concerned that the trend to design-build may result in its being overused. There are many instances where design-build competitions are inappropriate. Most obvious are those cases where subjective criteria such as aesthetics are an important concern. Design-build competitions also eliminate the vigorous competition that occurs within the contracting industry over a fixed design (with a design-build project, the prime contractor and each of the relevant subcontractors are chosen when the design-build team is formed). As a result, design-build competitions will achieve little, and may in fact cost more, in cases where the prospective gains made from innovative solutions are small.

Another criticism that is levelled at design-build is that it results in an overall reduction in quality. Most of the savings that accrue to a design-build project result from the development of innovative, cost-saving ways to meet the minimum performance requirements established

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in the RFP. In most cases, these savings are achieved by finding instances where traditional design solutions would result in standards that exceed the project's performance specifications. Inappropriately high standards can add greatly to a project's initial cost. However, lowering them may result in false economies if this results in higher costs over the project's life.

The initial cost of constructing a project represents only a small fraction (20–30 percent) of its life cycle cost. Life cycle costs are difficult to predict in a measurable manner and hence are often impossible to include, in a non-subjective way, in a performance specification. This poses the greatest difficulties for the public sector, for whom transparency in the evaluation process is of paramount importance. One way to overcome this problem is to have industry take a greater stake in the outcome through a public-private partnership.

Public-Private Partnerships

The acceleration of interest in public-private partnerships in Canada comes at a time when governments at all levels are increasingly focussed on deficit reduction. This has resulted in:

- the downsizing of many government departments
- the transfer of many responsibilities to municipalities
- the postponement of some necessary expenditures
- the re-evaluation of what constitutes a public good
- the privatization of many functions and services.

There is increasing recognition that the efficient delivery of services by government in many cases is hampered by conflicting objectives and the politicization of operational issues regarding investment, pricing and employment. For example, public officials often find it difficult to authorize new expensive investments that would require price increases or to make changes that would significantly reduce wages or employment. Public-private partnerships offer a solution to many of these problems and are being used increasingly as a means to reduce costs, finance projects and accelerate the process of constructing infrastructure.

Like design-build, public-private partnerships can be developed in a wide variety of forms.¹⁹ All have at least two key features in common:

- all are design-build projects
- all require the industry to take a long-term interest in the project.

Public-private partnerships are being used to reduce costs, finance projects and accelerate construction By having the industry take a longer financial stake in the project and compete vigorously for the right to build and deliver it, the synergies that resulted in immediate savings in design-build can be used to reap longer-term benefits in the form of reduced maintenance and operational costs.

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The experience of other nations with public-private partnerships has been very encouraging. According to the Auditor General of the United Kingdom, life cycle cost reductions of 10–30 percent were realized on those projects developed as public-private partnerships. The World Bank has also reported that the projects it supported as public-private partnerships have performed better than traditional projects. It is not clear that savings of this magnitude will always be achieved. The potential gains from involving the private sector in infrastructure provision depend on how inefficient the public sector was to start with and the degree of competition that occurs between rival private sector bidders for the right to build and deliver the project. This latter factor is an important determinant of cost reductions. Replacing a public sector monopoly with a private sector one, without competition, is unlikely to generate significant savings. However, technological advances are reducing the extent to which natural monopolies exist and, in those cases where monopolies are unavoidable, measures can be taken to ensure that competitive forces are present.

Movement to public-private partnerships has been slow in Canada In Canada, the movement to public-private partnerships has been quite slow. It has only been in the past few years that the number of public-private partnerships has begun to grow. The scale of these projects varies tremendously, ranging from Ontario's \$925 million Highway 407 project to a \$660 000 wastewater treatment plant constructed in Annapolis County, Nova Scotia. Important savings have been generated by these projects and innovative solutions found for infrastructure problems.²⁰ Nonetheless, controversy continues to dog public-private partnerships, and the business climate surrounding them remains very unsettled.

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Governments at all levels are indicating a strong interest in examining public-private partnership approaches.²¹ However, when they do, it often becomes apparent that their expectations far exceed reality regarding the risks and rewards that private industry is willing to accept. Canadian practice with public-private partnerships is still quite limited and as a consequence there are few relevant models to show how to go about structuring and financing the privatization of infrastructure. Other developed nations, such as the United Kingdom, which have greater experience, have developed best practices approaches that work smoothly for them.

This lack of experience is causing problems that are very real. This has had important consequences. The number of private sector companies willing to enter into public-private partnership competitions in Canada is lower than it would otherwise be. Those that do enter anyway have indicated that they often attach a substantial risk premium to their bids.

There is an urgent need for stakeholders to establish national best practices in this area, along the same lines as those that are being developed for design-build projects. All would benefit from such a development. The reduced uncertainty resulting from a more benign business climate would encourage greater competition from private industry and significantly reduce the risk premiums contained in bids.

3.4 Human Resources

The construction industry employed approximately 747 800 workers in 1997, representing 5.4 percent of total Canadian employment. Employment in the industry is concentrated in the construction trades (59 percent), followed by management occupations (17 percent) and clerical occupations (9 percent). Among the construction trades, carpenters, electricians and labourers are most numerous (12 percent, 6 percent and 6 percent, respectively, of the industry total).

Workers and employers in the construction contracting industry have a relationship that is very different from the more stable relationships that characterize most work situations. Tradespeople in the industry are generally hired on a project basis and change employers often. In the unionized sector of the industry, union hiring halls act as labour exchanges, allocating work to members on a rotating basis (as a consequence, the relationship between workers and their union is often more important than that with any one individual employer). In the nonunion sector, work is found on a word-of-mouth basis and through labour brokers. In some provinces, notably Alberta and British Columbia, non-union labour exchanges have also been established by employer associations. Government expectations often exceed reality regarding risks and rewards that private industry is willing to accept Unions play an important role in the construction industry, with approximately 35–40 percent of the construction industry labour force being affiliated with a union.²² The majority belong

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to craft unions. (There are 14 building trades unions operating in Canada, each of which represents one or several crafts.²³) In addition, some industrial unions have construction trades as members.

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Tradespeople are generally hired on a project basis

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Construction union strength varies regionally. Union representation is strongest in central Canada, particularly in Quebec, where union membership is mandatory in the non-residential sector. In the western provinces, non-union contractors are gaining ground amid fierce cost competition, especially in the residential and commercial sectors. A few provinces and the federal government have also enacted "fair wage laws," which stipulate wages and other conditions that must be observed for workers on publicly funded construction sites. (One of the non-wage conditions in British Columbia's fair wage legislation is that a certain proportion of the work force must be registered apprentices.)

Because of the project-specific nature of work in the construction industry, unemployment is considerably higher than in other sectors of the economy. Even in boom times, workers spend a significant amount of time between jobs. Also, due to the strong seasonal and cyclical fluctuations that affect the industry, peaks and troughs in employment are very pronounced.



Figure 8. Comparison of Unemployment Rates

Source: Statistics Canada, Labour Force Survey, Matrix 3451.

Even in boom times, workers spend significant periods between jobs

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As a result, in order to attract and keep workers, the industry offers wages that are generally higher than those for similar occupations in more stable sectors. The skill levels of workers in the industry are also relatively high. As a consequence, median earnings in the sector are typically above the national average ($$30\ 499$ versus $$28\ 045$ in 1990).²⁴

Training for most of the construction trade occupations is accomplished through an apprenticeship system. The short-term nature of employee-employer relationships, coupled with the pronounced cyclical swings that affect the industry, pose significant challenges for apprenticeship training in the industry. In the face of these problems, the industry has been remarkably successful in addressing its training needs. The construction industry is the single largest participant in apprenticeship training in Canada (approximately 50 percent of all apprentices) and supplies skilled workers to many other sectors employing these trades.

In most provinces, apprenticeship in the unionized portion of the construction industry has been administered by union-employer joint training boards or similar organizations. Under this arrangement, apprentices are indentured to a training coordination body and work on a sequence of jobs, usually for a variety of employers. These organizations track the progress of individual apprentices and attempt to assist in preserving the continuity of training, thus improving an apprentice's chance of successfully completing training. By establishing a co-operative system, which has avoided the chronic under-training found in other industries. the construction unions and their employers have played a central role in creating an effective trades training system for the construction industry. In many cases, the unions and unionized employers have established training trust funds based on assets derived from provisions in collective agreements. These funds have supported upgrading training for practising trades practitioners and, in some cases, have been used to establish and maintain trades training institutions. (Most apprenticeship training, however, utilizes technical training courses offered by public institutions such as community colleges and technical schools.) Over the past decade, the volume of training in the non-union side of the industry has increased considerably, although the craft unions and their employers have remained important players in ensuring the quality and volume of trades apprenticeship training.²⁵

Apprenticeship training is a provincial responsibility. However, for the past three decades, the federal government has played an important role funding most of the in-class portion of this training. This situation is now changing and the structure of the administrative and advisory structures underlying the system is under review in most cases. Direct federal involvement in training is being withdrawn in recognition of provincial mandates over apprenticeship and other forms of training. Some federal funds supporting apprenticeship may be available to provinces through federal-provincial labour market agreements. However, the new federal

Construction trains half of all Canadian apprentices

Direct federal involvement in training is being withdrawn in recognition of provincial mandates over apprenticeship and other training C O N S T R U C T I O N

funding formulas and the effect of fiscal cutbacks at the provincial level may require the apprenticeship system to adapt to operating with fewer financial resources from public sources. If system efficiencies do not increase to compensate, the shortfall may be borne by users of the training system. The challenge to the apprenticeship system is to adjust to the new funding environment through greater interprovincial cooperation and greater operating efficiencies. New training techniques, some utilizing new technology such as multimedia, may be of benefit in lowering the cost of training.

To promote interprovincial mobility, the provinces and territories, with the assistance of the federal government, have instituted a program of mutual recognition of trade qualifications — the Interprovincial Standards Program, sometimes called the Red Seal program. In some industry sectors, for example, boilermaking and millwrighting, short-term interprovincial movement of labour is significant in facilitating labour market efficiency.

While the Interprovincial Standards Program has effectively reduced barriers to the geographic mobility of certified trades practitioners, it does not deal with apprentices having partial training. Trainees must resort to *ad hoc* arrangements with apprenticeship officials when leaving one province and resuming training in another. Fewer than 1 percent of apprentices are estimated to be interprovincially mobile. There are concerns within the construction industry that the provincial apprenticeship reforms presently under way may result in dissimilar programs, which could hinder interprovincial mobility of apprentices.

The construction industry has also developed institutions to serve management training. The owners of small and medium-sized enterprises, such as those that make up the construction contracting sector, typically find that they face gaps in some of their management skills. Many are former tradespeople who have made the transition from employee to employer. They have seldom received any formal management training, which is not generally available as part of an apprenticeship. Several national contractors' associations have developed the Gold Seal program, which recognizes individuals' management skills according to national guidelines. The topic of national standards for management training continues to be under active discussion within the industry.²⁶

Technological change is beginning to have a significant impact on the skills required of both workers and management.²⁷ New materials and methods in construction are being introduced, as are new methods of planning and organizing construction activities. The use of computerized machinery and equipment and of computer assisted design and planning techniques is rapidly becoming a requirement to remain competitive. As a consequence, the industry is faced with the challenge of continuously upgrading its skill levels.

The Red Seal program has been successful in improving labour mobility

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The impact of technical change on the industry is uneven and has resulted in a need for tradespecific labour market strategies. At the time of writing this paper, 11 national construction industry trade-level committees have been formed, with funding from Human Resources Development Canada's (HRDC) National Sectoral Adjustment Service (NSAS). These *ad hoc* committees have been mandated to develop ten-year human resources strategies covering each respective trade, each spanning the entire construction industry. When these and any additional strategies and supporting research projects have been completed, they will be combined to form a view of the entire construction trades labour market. Recommendations involving apprenticeship coming from individual trade strategies will be referred to provincial government apprenticeship advisory structures for consideration for action. HRDC is prepared to provide further assistance to industry or trade groups through the NSAS, although no funding can be provided for the permanent support of trade-level human resources planning bodies. In the case of labour market issues where provincial jurisdiction applies, a condition of funding will be provincial concurrence and participation of members of relevant provincial advisory structures.

3.5 Sustainable Development

The construction industry plays a critical role in most issues concerning the environment:

- *Energy conservation:* Roughly one third of Canada's total energy consumption is used for the operation of buildings (heating and cooling systems, lighting, elevators). Road transportation, the next largest use, accounts for about a quarter of total energy use.
- *Waste management:* The construction and demolition industry is the largest single industrial source of waste going to landfill, accounting for between one quarter and one third of the total waste stream.
- *Hazardous materials:* The construction process often involves the handling and disposal of hazardous and dangerous materials such as asbestos, polychlorinated biphenyls (PCBs), lead paint, urea formaldehyde and contaminated soil.
- *Water quality:* The sewer and water systems of many Canadian municipalities are in poor condition, costly to operate and lacking in capacity. The construction industry can play an important role in addressing these problems.
- *Indoor environment:* It is becoming increasingly apparent that the quality of a building's indoor environment its air, lighting and acoustics has an important impact on health and performance. These are issues that are largely determined by the design of a building and its mechanical systems. Well-designed retrofit projects can often address current indoor environment problems.

One third of energy consumption is used to heat and operate buildings



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Environmental regulations: New regulatory measures and environmental assessment requirements are increasing the cost, complexity and time required to carry out construction projects.

The construction industry is responding to these developments. The greatest successes have occurred in areas where costs could be reduced or new markets pursued. Companies are developing specialized skills in retrofitting buildings to minimize energy and water costs. Many have developed innovative financing programs linking their payments to the energy savings that they create. Others firms are developing expertise in the treatment of hazardous material (e.g. asbestos and lead paint removal, soil rehabilitation) and are aggressively pursuing markets created by new regulations in this area. Consortia are being formed with expertise in the financing and operation of water and sewage treatment facilities.

Industry is adopting new, cost-effective methods to reduce construction and demolition waste

The industry is also developing new, waste-reducing practices in order to address concerns being raised by provincial environment ministries and landfill administrators (here a major impetus is to avoid the imposition of more restrictive regulations). New uses are being found for discarded material, creating new products and markets. A new retail sector dealing in used building materials is emerging.

Due to tenant pressure, building owners are becoming more concerned with air quality, lighting and acoustic issues.²⁸ Building material and equipment manufacturers are responding by developing, for example, better air exchangers, filters and non-toxic building materials. Companies in the construction industry are becoming skilled at examining indoor environment issues and at developing measures to address them.

However, while advances have been made in addressing sustainable development issues, progress has been uneven. For example, substantial success has been made in addressing energy efficiency issues, but this has at times been at the expense of indoor air quality. Major improvements have been made in the energy efficiency of automobiles and trucks, but many of these gains have not been realized due to inadequacies in Canada's highway system, which suffers from congestion and poor maintenance. Case studies have shown that the volume of construction and demolition waste can be substantially reduced without having an adverse impact on costs. However, difficulties are being experienced in applying these techniques in practice. Environmental regulations and due diligence requirements are becoming increasingly complex. Many small companies are finding it difficult to understand and comply with them. Developers are finding that environmental assessments are increasing the cost of projects and the time required to complete them.

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To achieve optimum results, an approach is required that integrates environmental issues into the development, design and construction processes. This can be achieved only through the cooperation of all stakeholders (owners, building material manufacturers, architects, engineers, contractors, regulators). Because of the fragmented nature of the industry, this is difficult to achieve. A number of industry-sponsored initiatives are now under way in an attempt to build the consensus necessary for progress. Government as an important stakeholder, both as an owner and as a regulator, could play an important role in assisting and facilitating these efforts.

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4 GROWTH PROSPECTS FOR THE INDUSTRY

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Like many mature industries, the market for construction is growing at a pace that is somewhat lower than that of the economy as a whole. As a consequence, the industry's share of GDP has declined. In 1955, at the height of the post-World War II building boom, the total value of construction activity accounted for over 20 percent of Canadian GDP. This figure includes all costs associated with construction, including material and equipment costs and the value-added of the architecture and engineering and construction industries. In that year, construction industry value-added represented 10 percent of GDP.²⁹ As the Canadian economy developed and matured, construction's share of GDP has declined. The total value of construction activity now accounts for 15 percent of GDP, while construction industry value-added represents roughly 5 percent (Figure 9).



Figure 9. Construction Output as a Share of GDP

Source: Statistics Canada, Gross Domestic Product, Matrix 6627.

This decrease in relative size is not in itself a major concern. It reflects to a large extent the strong growth that has occurred in other sectors, particularly in the service sector. However, in recent years, evidence has emerged that points to a significant structural change in demand for construction.

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There has been a pronounced dampening in the capital stock formation of constructed works. After growing at a fairly steady rate since the end of World War II (average annual rate of 3.7 percent), the growth rate in the value of net capital stock for both engineered works and industrial, commercial and institutional (ICI) buildings has levelled off. This occurred around 1980 for engineering construction and around 1990 for the ICI sector (Figure 10). These shifts are made vividly apparent when net capital stock is viewed on a per capita basis (Figure 11).

Capital stock formation has levelled off



Figure 10. Net Stock of Capital, Real Value

Source: Statistics Canada, Flows and Stocks of Fixed Non-residential Capital in Canada, Matrix 8590.



Figure 11. Net Stock Capital Per Capita, Real Value

Source: Statistics Canada, Flows and Stocks of Fixed Non-residential Capital in Canada, Matrix 8590.

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Some of this slackening in demand may be due to cyclical factors. However, since growth in the capital stock of machinery and equipment has not been similarly affected (its growth rate has in fact accelerated), it would appear that something more fundamental is occurring.

Some stakeholders within industry have expressed concerns that the construction market may be entering a post-industrial phase, where much of the infrastructure and buildings required by the Canadian economy for growth have already been built.

This conclusion, if correct, would have immense implications for the industry. The most prominent impacts are:

- an overall dampening in the demand for new construction
- an increase in the proportion of repair and renovation activity
- an associated decrease in the overall productivity of the industry
- an increase in the amount of construction activity performed in-house.

The fact that these developments are beginning to be felt, reinforces concerns that the construction industry may be entering a difficult period of adjustment and restructuring.

4.2 Current and Anticipated Competitiveness Challenges

The chief strengths of the construction contracting industry are its resiliency and responsiveness in adapting to changes in its business environment. If the industry is indeed facing a weaker, less robust market, it will adapt quickly through rationalization.

A major challenge facing the contracting industry is to undertake measures to alter and improve its business climate. The sheer size of the construction market, the number of industries and stakeholders involved, and the degree of fragmentation that exists within the contracting industry and most of the other industries involved in construction make progress very difficult. Important issues have been identified that affect the overall competitiveness of the construction sector. Developing measures to address them will be difficult but they need to be addressed nonetheless.

Innovation

There is general agreement that substantial savings could be achieved by increasing the pace at which new technologies are adopted and by undertaking additional research in certain key areas. The use of design-build and public-private partnerships as a means of developing

A major challenge facing industry is to undertake measures to improve its business climate

The pace at which new technologies are adopted can be improved

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projects appears to offer a partial solution to some of the problems that are being experienced. These organizational innovations are important. They provide increased incentives for stakeholders to improve the coordination of their activities and to use innovative products and processes. However, in order to achieve significant results, a coordinated approach involving the cooperation and participation of all key stakeholders is required. Stakeholders have indicated that new initiatives in the areas of technology assessment and information dissemination would be particularly helpful.

Trade

Despite the progress that has been made, contractors still continue to face significant problems and barriers when operating outside their local markets. The industry continues to push for improvements to the Agreement on Internal Trade, the North American Free Trade Agreement and the General Agreement on Trade in Services. Problems have also been identified in the way in which these agreements are administered, and efforts are being made to improve the manner in which they are functioning.

The exporting efforts of Canadian industry are also being hindered by their limited experience in projects developed as public-private partnerships. This method is being used increasingly in international markets as a vehicle for delivering projects. Domestic experience in this area is critical to international success.

Investment

The increasing use of alternative delivery systems for construction projects (i.e. design-build and public-private partnerships) is giving rise to a host of new challenges. These issues include the development of :

- new criteria to determine which delivery system is most appropriate
- new bidding systems to limit bidding costs and ensure a transparent evaluation process
- new contract languages to ensure that risks and rewards are adequately shared
- new financial and surety instruments to permit the market to function more smoothly.

None of these issues can be resolved without the full and active participation of all stakeholders with an interest in construction.

Limited experience with public-private partnerships is

hindering exports

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Human Resources

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The construction contracting industry has been remarkably successful in addressing its training needs. In coming years, the industry will be challenged by the accelerated use of new technologies (particularly information technologies) and by reorganizations to the training system that are being considered in many provinces. Many contractors would like the industry to assume greater control over some aspects of apprenticeship training in order to improve the currency and relevance of existing trade standards and address issues relating to the quality and format of instruction.

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Sustainable Development

Increased public awareness of sustainable development issues will present the construction industry with many new market opportunities. Measures taken to improve energy conservation, reduce greenhouse gas emissions, address water quality and indoor environment concerns, and deal with hazardous waste will all involve a substantial amount of design and construction work.

Efforts are under way to develop voluntary best practice solutions to forestall need for regulations

At the same time, the industry is likely to have to contend with additional regulations, which will increase the due diligence responsibilities imposed on firms and may add to the cost, complexity and time required to complete a project. The construction contracting industry is working with other stakeholders to ensure that the regulatory burden imposed by these measures is not onerous. Efforts are also under way to develop voluntary best practices solutions, which would avoid the need for regulations.³⁰

4.3 Future Opportunities

In addressing the innovation, trade, investment, human resources and sustainable development challenges that it is facing, the construction industry will emerge stronger and more competitive than ever.

All of these issues are intertwined. Success in developing and adopting new innovations will not only lower the cost and improve the quality of domestic construction, but also will open up significant export opportunities. Similarly, the development of best practices approaches for design-build and public-private partnerships will lower the cost of construction in Canada and at the same time foster greater innovation. Companies that have been successful domestically with design-build projects and public-private partnerships will be in a much better position to win international projects. The same is true for companies that have unique expertise in addressing environmental problems. Finally, success in all of these areas is predicated on the industry's having access to a highly skilled work force.

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4.4 The Bottom Line

The Canadian construction market will continue to experience large, unpredictable swings in demand. Overall, though, the market for new construction is expected to grow at a slow pace in the medium to long term. For this reason, repair, renovation and retrofit work should become relatively more important.

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A sluggish Canadian market will encourage more construction contracting firms to seek out foreign market opportunities. However, because of the difficulties that are likely to be experienced, the majority of firms will continue to focus solely on the domestic market. Slow but steady progress is likely to be experienced in the area of innovation, while more substantial progress is anticipated for public-private partnerships.

Important changes are occurring in the manner in which construction projects are being procured. The increasing use of design-build and public-private partnerships will pose important challenges for the sector, as will increased environmental regulations. Best practices will eventually be developed to deal with these issues, but until they are the sector is likely to endure a period of heightened risk.

The Canadian contracting industry has proven itself to be very flexible and resilient. It will respond to changes in its business environment. It will also, if required by owners, assume new increased risks, but this will be accompanied by an increase in the cost of construction.

Profits, which have been low, will, through a process of rationalization and adaptation, return to historic levels.

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Annex A ENDNOTES

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1. Provincial regulations allow designers and non-professionals to design many small-scale buildings. In the case of Ontario, any member of the general public can design and have built a building under 600 m² in floor area and three storeys or less in building height, provided that the building is used for residential, business and personal services, mercantile, and medium or low hazard industrial occupancies only. All buildings that are larger or involving assembly, institutional or high hazard industrial occupancies must be designed by either architects, engineers or both. In practice, architects and engineers design most non-residential buildings and multiple-unit dwellings, but do not play a major role in the design of most single-family homes.

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- 2. This division of construction activities into a number of specialist industries is largely a North American phenomenon. In Europe and Asia, construction companies generally perform all of the design, engineering, project management, general contracting and trade contracting functions using in-house resources.
- 3. In-house construction activity is largely confined to repair and renovation work. The contracting industry undertakes most new construction and about 50 percent of repair and renovation work.
- 4. A high proportion of Canadian bankruptcies (roughly 14 percent) occur in the construction contracting industry.
- 5. The National Research Council is responsible for developing and maintaining national model codes for building, plumbing, fire and energy. The Canadian Standards Association is responsible for the national electrical code.
- 6. There are exceptions to this. Some provinces (for example, Newfoundland and Prince Edward Island) delegate construction code standards to their municipalities. Also, two cities (Montreal and Vancouver) set their own construction codes. Still, the actual codes used have, in practice, never been significantly different from the national model codes.

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- 7. The low level of research and development by the construction industry is also often linked to falling productivity levels in the industry. However, as noted earlier in this document, the decline in productivity is largely due to changes in the composition of demand for construction (there are fewer large projects and more repair and renovation work) and a significant decline in profits.
- 8. Comparable statistics are not available for the architecture and engineering industries. It is clear, however, that these industries (particularly engineering) are much more R&D intensive than the contracting industry.
- 9. Canada Mortgage and Housing Corporation, *Regulatory Obstacles to Innovative Housing* (Ottawa: CMHC, 1998).
- 10. Witness the costs involved in replacing urea-formaldehyde insulation.
- 11. They are legally responsible for the health, safety and suitability of their designs.
- 12. The actual amount is five million SDR (Special Drawing Rights), which represents the value of a basket of currencies. As a result, the actual amount in Canadian dollars varies.
- 13. Canadian Highways International Corp. (CHIC), the consortium undertaking construction of Highway 407, has recently won the contract to build a similar highway in Israel. Strait Crossings Development Inc., the consortium that built and is now operating the Confederation Bridge linking Prince Edward Island and New Brunswick, is also actively seeking international projects in India, Israel, the Philippines and China.
- 14. Proceedings "Succeeding in Design-Build" Conference Series, Orlando, Florida, June 25, 1997.
- 15. A recent Department of National Defence case study compared the construction of two air-craft hangars. One, in Bagotville, Quebec, was built using the traditional design-build method. The other, in Greenwood, Nova Scotia, was a design-build project. The design-build hangar, despite being 45 percent larger (28 208 m² versus 19 500 m²), took one third the time to complete (11 months versus 30 months) and cost three quarters the price (\$17.3 million versus \$23.1 million). Per square metre, a 57-percent savings was realized (\$613/m² versus \$1 084/m²).



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- 16. In the case of a building, these criteria would include such factors as its size, level of finish, energy use and date of completion.
- 17. If individuals with strong technical skills evaluate the proposals, a number of measures can be taken to cut down their preparation costs. These people have the expertise to make informed decisions with a minimum of information. As a result, models and extensive detailed drawings can be eliminated, greatly reducing the cost of preparing a proposal.
- 18. In cases where models are required, this is often set at 0.3 percent of the project's cost.
- 19. The Canada Council for Public-Private Partnerships has identified nine basic categories of PPPs: merchant facility, build-own-operate, build-own-operate-transfer, build-transfer-operate, lease/purchase, turnkey, developer financing, operations and maintenance, and contract services.
- 20. Ontario has indicated that, by entering into a public-private partnership on Highway 407, a 25-percent (\$300 million) reduction in costs was achieved, and the completion date was accelerated by 15 years.
- 21. Canada Council for Public-Private Partnerships, Public Opinion Research, 1996.
- 22. The distribution of work volume between union and non-union forces may differ from this level, since union members may sometimes work on non-union projects.
- 23. These unions also have significant additional membership in other industries.
- 24. Census of Canada, 1991.
- 25. For recent estimates of trades training volume in the union and non-union portions of the construction industry, see Statistics Canada, *National Apprenticed Trades Survey, 1997*, Ottawa.
- 26. See, for example, Piping Trades National Committee, "Pipe Trades National Human Resources Needs Analysis: Final Report," a report prepared by the ARA Consulting Group, with assistance from Human Resources Development Canada, Toronto, 1997.

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27. L. Tardif Construction Consultants, "Technical Changes in Construction and Their Effects on the Construction Labour Market," Montreal, 1993.

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- 28. Surveys of commercial tenants have consistently shown that they stress a need for better air quality, energy efficiency and lighting and for more environmentally friendly buildings. One recent survey revealed that nearly 25 percent of office tenants were considering moving for reasons related to building comfort.
- 29. Construction industry value-added comprises the value-added of construction contracting activity and construction work performed in-house.
- 30. For example, new standards for construction and demolition waste are being developed by the industry in Manitoba. These measures will increase the reuse and recycling of materials and substantially reduce the amount of waste going to landfill, without imposing a significant regulatory burden.

