Institute for Research in Construction

Strategic Plan 2004-09




National Research Council Canada
Conseil national de recherches Canada

Institute for Research in Construction
Institut de recherche en construction

CNRC · NRC

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IRC Strategic Plan
2004-09

1.0 EXECUTIVE SUMMARY

1.1 The Opportunity for IRC

The construction sector is large and vital to the success of the nation. It is responsible for building Canada's physical infrastructure and provides shelter and transportation facilities for its citizens, businesses, industries and institutions. An efficient and profitable construction sector is a key fundamental for national success. It has a major influence on the economic wealth, the societal well-being, and sustainability of the built environment.

Many other industrial sectors, notably manufacturing, have undertaken radical structural changes and product improvements. One outcome was the development of significant strategic partnership arrangements to share risk and rewards throughout their supply-chains. In contrast, although some international consolidation has occurred, the construction sector has remained essentially unchanged during the twentieth century. It remains largely configured around the traditional project model in which trades-people, professionals, contractors and clients work in short-term, low-bid contractual arrangements that entail high financial risk and a propensity for litigation.

To remain competitive in today's global markets, the Canadian construction industry has to contend with four interrelated challenges:

- Develop an innovation-based culture
- Cope with societal and environmental pressures to reduce waste and minimize the use of raw materials
- Deal with enduring market demands (such as failing infrastructure, aging population, sustainability and concerns over indoor air quality), and
- Manage risk and the increasing cost of insurance

The magnitude and complexity of these issues have contributed to a growing realization by industry participants that a "whole sector" adjustment to emerging innovation and business systems is critical to its long-term health and prosperity. Many of the potential solutions under consideration will only work if there is a greater cohesion in what has historically been a very fragmented industry.

The capability of the Canadian construction sector to deliver the most difficult projects, under the harshest of conditions, is as good as that of any nation in the world. However, the productivity growth in the sector has lagged compared to other sectors by over 50%

since 1960, with most of the lag occurring in the past two decades. Improving this record and integrating society's performance expectations into tangible products and services is not possible within the present structures and approaches of the industry.

There is widespread agreement that the sector is capable of much higher achievement in many areas, if it could unleash its full innovative potential. The National Steering Committee on Innovation for Construction (NSCIC) is a private-sector committee committed to creating an innovative construction sector that provides the best socio-economic value for Canada. Recently, the NSCIC responded to the Federal Government announcement on Canada's Innovation Strategy by recommending the following set of goals. While ambitious, the NSCIC believes they are achievable.

Measure	**5-year change**
Capital Cost	-25%
Project Delivery Time	-25%
Predictability	+50%
Defects	-50%
Accidents	-50%
Productivity	+25%
Revenue & Profits	+25%
Research and Innovation industry investment	+100%
Projects with 'sustainability' in procurement criteria	25% of all projects
Projects procured based on life-cycle cost	25% of all projects

Public sector clients for construction products and services have much to gain from these changes. Even if only 50% of the change is actually achieved, with total Canadian public sector expenditures on construction in excess of $25 billion per year, this would result in savings of over $3 billion per year for governments in Canada. Clearly the opportunities and leverage are large in comparison to the costs.

If the construction sector is to achieve its full potential, then substantial and systemic changes in its culture and structure are needed. This in turn will require a range of innovations in business processes as well as technologies and products. In short, **the dramatic shift of the construction sector into the knowledge-based economy, integrating information technology and becoming capable of rapid response to the more demanding performance expectations of a market growing in sophistication, represents the opportunity for IRC.**

1.2 Seizing the Opportunity

Seizing the opportunity presented by the construction sector's shift into the knowledge-based economy requires a new vision for IRC, supported by enhanced and new core competencies. Existing core competencies in building and maintaining stakeholder networks and in construction materials and systems performance will be enhanced to better respond to changing priorities. New competencies will be added to address the unique characteristics of construction process technologies.

The built environment continues to evolve as the construction industry adapts to changes in societal needs. As the Canadian industry strives for increased productivity to gain competitive advantage in a global market place, changing societal expectations demand new technology and solutions in areas such as health, security, and sustainability. Economically, Canadian citizens benefit from a strong industry that is competitive and profitable. Socially, Canadian citizens also benefit from a safe, sound and durable built environment.

In response to the confluence of current societal expectations and industry initiatives, IRC has adopted the following Mission and Vision:

Mission

To improve the lives of Canadians through a vibrant construction sector that provides a quality and cost-effective built environment

Vision

A recognized leader in the development of a quality built environment through research, innovation and the creation of integrated solutions

To achieve its vision, IRC needs to adjust its strategic direction. It needs to respond to the changes it is seeing by realigning its current activities and acquiring new capabilities. Key elements of this future include the need for uniform building regulations supported by objective-based model requirements and for innovation, not only in new technologies but also in the approach used in their development and implementation. To improve its productivity and its end product, industry must move to a more integrated construction process. New solutions can best be developed and implemented through cooperation and collaboration within IRC/NRC, with other research and technology centres throughout Canada and the world and with the industry itself.

Strategy

To be an enabler
for the transition of the construction industry
into the knowledge-based economy

To implement this strategy IRC has established four **Strategic Objectives**:

A. To develop the knowledge and technologies essential to the creation of a quality and cost-effective built environment.
B. To provide integrated decision-making tools that enable the construction sector to respond to changing performance expectations.
C. To develop construction process technologies critical to improved productivity of the construction industry.
D. To become a responsive organization, well positioned to enable the transition of the sector.

Becoming a recognized leader suggests an aggressive strategy that requires refocusing of current activities and immediate investment in new directions. Finding the resources to ensure success is a major challenge.

2.0 THE CONSTRUCTION SECTOR

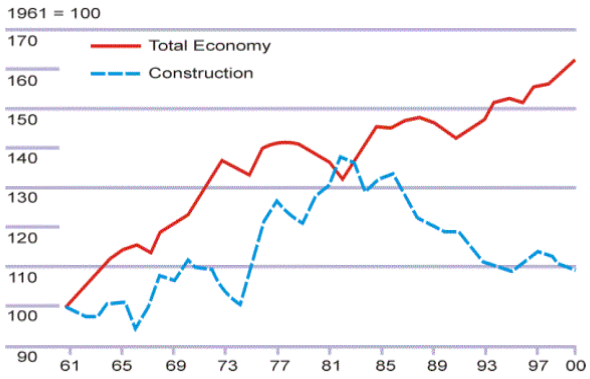
With total revenues of $107.3 billion in 2001, the construction sector is one of Canada's largest and most valuable sectors. It is responsible for building the nation's physical infrastructure and provides shelter and transportation facilities for its citizens, businesses, industries and institutions. The products of construction have a major bearing on the quality of life of Canadians and largely define the built environment in which most Canadians live, work and play. The costs of its services and products are a major determinant to the nation's competitiveness. An efficient and profitable construction sector is a key fundamental for national success.

A sector of socio-economic importance:

- *11.2% of GDP;*
- *215,000 enterprises - 853,400 employees in construction, 182,000 in building products, 136,200 in engineering and architecture;*
- *Employs 50% of Canada's apprentices;*
- *Creates the physical infrastructure critical to attracting and supporting efficient businesses;*
- *Maintains and repairs over $5 trillion of assets;*
- *Generates the safe, clean and efficient urban environment that Canadians expect;*
- *Creates the facilities for delivering services to individual Canadians- clean water, utilities etc;*

Productivity growth in the construction sector has, however, lagged behind that of the business sector average by over 50% since 1960, with most of the lag occurring in the past two decades. There is widespread agreement that the sector is capable of much higher achievement, if it could unleash its full potential.

Total Factor Productivity in the Business and Construction Sectors, 1961-2000

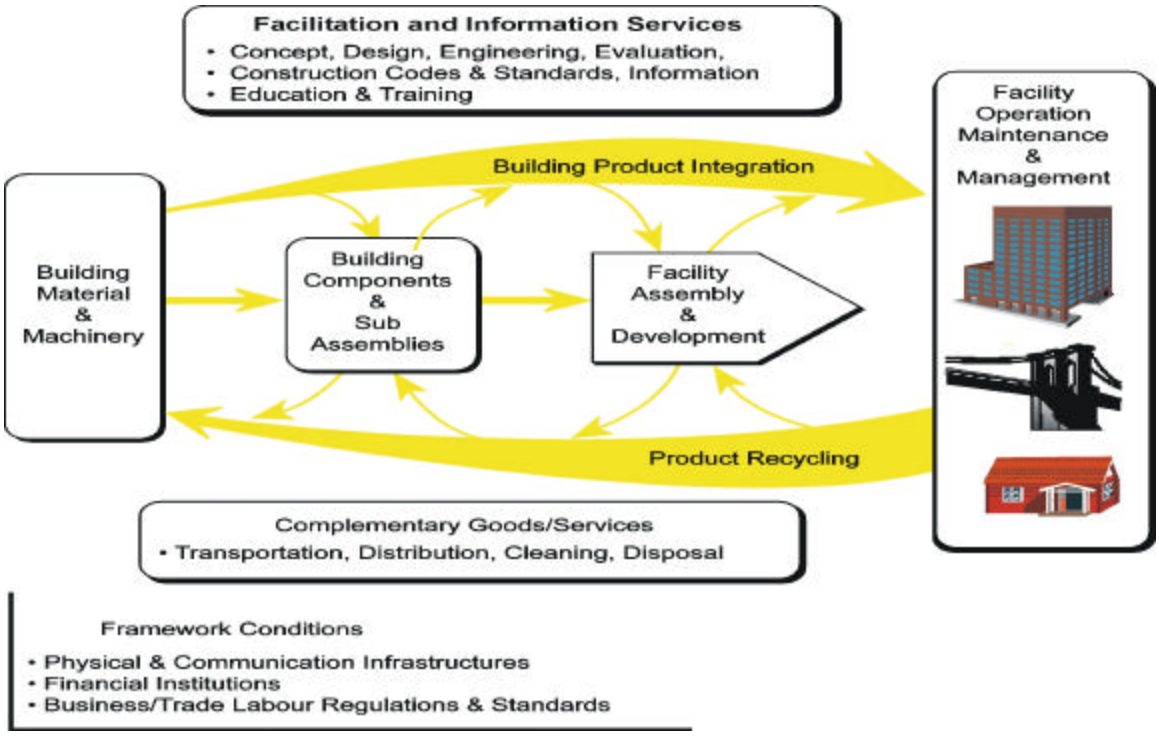


Source: Capital Stock Data, Aggregate Productivity Measures, Statistics Canada

The construction sector and its dedicated supply chain are much larger than defined by traditional "construction" statistics, which are limited to value-added site activities of general contractors and specialty trades. The sector includes the design of buildings and infrastructure (engineering and architectural services), the manufacture of building products and of machinery and equipment for construction, operation and maintenance, and disposal of facilities.

The major players involved in the construction sector include:

- The client community of facility/building owners, operators and managers ,
- The design community including architects and engineers,
- The supply chain of building materials suppliers, machinery manufacturers, building product component manufacturers, sub-assemblers (trade specialty and installers), developers and facility assemblers (or general contractors),
- The facilitators and providers of knowledge/information such as evaluators, information services, professional associations, scientists, education and training providers,
- Providers of complementary goods and services such as transportation, distribution, cleaning, demolition and disposal, and
- The major economic drivers that provide the general framework conditions for the business environment such as the physical and communication infrastructure, financial institutions, insurance, general labour, regulations and standards.



The construction sector places a major environmental footprint on the nation through its consumption of primary resources, consumption of energy in the constructed facilities and its waste disposal practices during construction and deconstruction.

Environmental Impact
- *Constructed facilities account for 35-40% of national energy consumption;*
- *Generates >25% of Canada's solid waste;*
- *Consumes >50% of primary natural resources.*

The industry remains deeply fragmented and is characterized by very small companies (95% have less than 10 employees) represented by a multitude of agencies and associations, often at a regional rather than national level, with no central focus or champion. Additionally, the industry has no representation at senior levels of government.

The sector has historically suffered from inconsistent profitability and has invested too little in capital and, mainly due to its fragmented structure, in human resources and R&D. Real R&D expenditures have actually fallen over the past two decades to less than 0.1% of revenue. Many of the sector's clients are not satisfied with the overall value of its products and the quality of its services. Substantial and systemic changes in the culture and structure of the sector are needed if the sector's full potential is to be achieved. This in turn will require a range of innovations in business processes as well as technologies and products. Typically, an innovation will only receive wide acceptance and dissemination if it is acceptable to a wide variety of stakeholders including regulatory, standards, legal, contractual, labour, safety, and environmental authorities. It is important that this 'innovation system' work smoothly and not produce inadvertent barriers to innovation. To make progress, a sector-wide approach is needed.

3.0 ENVIRONMENTAL SCAN

The Canadian construction sector is facing several fundamental challenges, threats and opportunities; together driving change in the industry and in the technologies it embraces.

3.1 Drivers for Change

Recently, the National Steering Committee on Innovation for Construction (NSCIC) responded to the Federal Government announcement on Canada's Innovation Strategy. That response serves as the basis for identifying drivers that impact on the construction industry and on the potential role for IRC. Further insights are obtained from other sources such as official statistics and recent government and municipal priorities, forecasts from the Conference Board of Canada and from other countries' national construction sector reports/initiatives, and input from construction research agencies around the world.

- Construction is becoming more complex and faces new challenges – low sector productivity is a serious challenge as is the integration of new materials and technologies such as IT.
- Society is expecting
  - Faster results – fast pace of change seen in other sectors is now expected in the construction industry
  - Quick access to information – needed to support faster and more reliable decision making
  - Predictable quality and costs – products that meet the required quality and durability, delivered on time and within budget
- Globalization of the industry and the market place is creating international competition for projects and expertise; internationally, consolidation is taking place across the design, construction and supply chain
- Security is an emerging issue – for both human and natural-sourced threats
- Industrialization; – increasing modularization and prefabrication is being taken up by early adopters
- Demand for integration of design and construction processes to improve productivity
- Infrastructure is deteriorating across Canada – often accelerated by our climate
  - Growing deficit in maintenance and replacement - $57B and growing at $2B a year
- Natural resources are being challenged
  - The sector is a major energy user – 35-40% of the total national energy consumption
  - Energy supplies - Canada's heavy reliance on fossil fuels suggests that energy efficiency is an important mid-term focus for Canada
  - Construction consumes over 50% of primary resources - large dimension lumber is becoming scarce – substitution is occurring including new engineered wood products

- Challenges of Climate Change
  - Impact of climatic extremes – changes in environmental loads (snow, temperature, rain, etc.), changes in water tables, thawing of permafrost
  - Kyoto is only the tip of the iceberg – further measures foreseeable in the near future will impact the sector
- Demographic changes
  - Aging population – increased demand for specialized facilities and more automation, lower personal mobility
  - Scarcity of labour – trades-people aging, immigrants that were traditional source of trades are now channeled to hi-tech sector, increasing pull of the hi-tech and service industries are exacerbating the skills shortage issue
- Indoor health one of top 10 health risks in the world – aging population spending more time indoors exacerbating the problem, apparent increase in population sensitivity.
- Canadians more aware of sustainability
  - Construction wastes constitute at least 25% of total – in some areas representing over 40% of all waste – represents both environmental challenges and lost opportunities
  - Environment – societal pressure is growing to reduce the environmental footprint of construction
  - Industry - need for a construction industry that is stable
- Risk management / impact of insurance
  - Industry needs help in assessing and managing the risks associated with the introduction of new materials, technologies and practices
  - Industry needs full information on the performance of new and existing materials/technologies
  - Unforeseen events – cost of insurance becoming prohibitive and inhibiting new projects and innovation, impact of human sourced and environmental events are at historic highs

Canada's construction industry is facing the same challenges as the industry in countries throughout the developed world. The difference is that many other countries (for example Australia, the United Kingdom and the United States) are responding by developing national strategies designed to bring industry together to tackle barriers to progress.

3.2 Technology Directions

Technological reviews and foresights within Canada and around the world provide insight into the types of technologies needed to enhance industry performance. These are identified in technology roadmap documents, technology forecasts and plans from major construction associations and research organizations including NSERC Centres of Excellence. Environmental and economic concerns, and enhanced use of information technology consistently arise as over-riding background themes. Opportunities to enhance industry performance through new technologies include:

- Enabling knowledge (Tools for integrating the design, construction and operation processes, interoperability of software and business systems, validated decision making tools, and repositories of credible information will underpin applying information technology to improve industry productivity.)

- Sustainable materials and systems (Improved performance in specific applications and minimal environmental impact need both innovative materials - composites and nano-materials - and more effective use of existing materials and systems.)

- Design process (Design goals and methods will evolve to meet societal demands for health, comfort, safety and security, and adapt to increasing use of automation and manufactured assemblies. Renovation and adaptation are major challenges.)

- Life cycle of built environment (Environmental and economic sustainability, especially for infrastructure, will promote a focus on cost-effective performance across the life cycle, including operation and maintenance, rehabilitation, and re-use.)

- Advanced systems & services (Smart buildings and infrastructure will use integrated sensors and IT to enhance performance and monitor for maintenance; adaptation for effective retrofit may be a key issue.)

- Regulatory systems (Basic requirements for public confidence require advanced decision and support tools to establish acceptable levels of performance and risk.)

- Accelerated acceptance of new technology (Making it work in practice requires economic and performance data, delivered via demonstration projects, credible product evaluation systems, and systematic knowledge transfer to the design and regulatory sectors.)

4.0 THE INSTITUTE

4.1 Current Situation

Since its beginnings in 1947 as the Division of Building Research, the Institute for Research in Construction (IRC) has evolved its focus in response to changing industry expectations. It has played a significant role in bringing together the industry to address a number of national issues:

- Initially it assumed the challenge of developing a model building code that could be adopted by regulators throughout the country. Canada's building regulatory system is now fully endorsed by the provinces and territories and is among the best in the world.
- Building in the North created unique challenges that were tackled by IRC, such as determining the capacity of ice roads and developing reliable approaches for building foundations on permafrost.
- The energy crisis in the mid-seventies led IRC to develop and study new conservation technologies and to create a model code for energy conservation.
- Emerging health and other indoor environment problems resulted in the establishment of an integrated indoor environment program.
- IRC was among the first to identify the need for fundamental research into the maintenance and repair of Canada's deteriorating infrastructure and established the largest research team in North America to address these issues.
- Recognizing the worldwide move to performance-based regulations, IRC is supporting a national program aimed at moving Canada's code documents to an objective-based model – new codes will be published in 2005.
- Contributing to regional economic growth, IRC initiated the process of establishing a Centre for Sustainable Infrastructure Research in Regina to contribute to a larger cluster effort on "Communities of Tomorrow" in collaboration with the University of Regina, the city and industrial stakeholders.

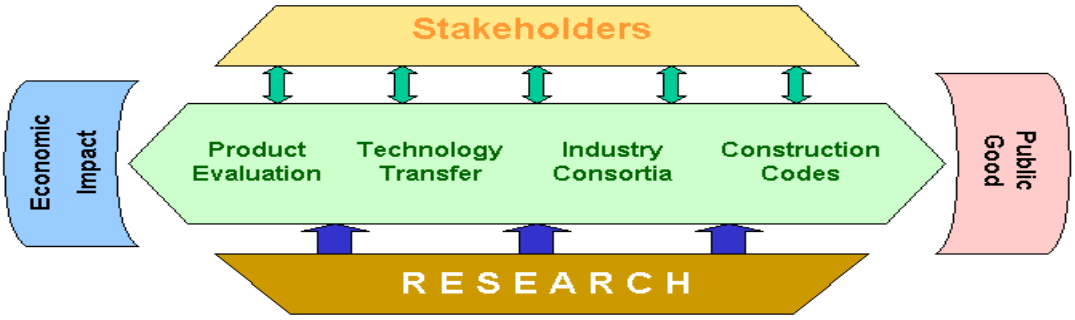
Today, IRC's effort represents over 20% of the construction R&D in Canada. Working with industry, public sector and technical partners, IRC continues to respond to new issues affecting the construction sector through three closely linked main platforms:

- **Research and Technology Development**: Multi-party collaborative research with industry partners ensures IRC is responsive to market priorities. IRC assumes a leadership role on issues central to national competitiveness and public good, such as infrastructure rehabilitation, service life-cycle prediction, product evaluation and quality of the indoor environment. IRC works closely with IRAP to link industrial needs to technology sources and to deliver that technology to the widely-dispersed industry.
- **Codes and Standards**: Because of its fragmented nature, the construction sector relies heavily on codes and standards to establish a level playing field for marketplace competition while respecting societal expectations for health and safety. IRC plays a national leadership role in developing construction regulation. It produces model

building and fire codes and guides of practice. It supports technical standards and it facilitates a uniform and streamlined Canadian code development process. Related work in IRC's other core competencies such as fire and building envelopes provides the technological solutions and expertise needed by the regulatory process, including risk/cost and life cycle cost assessments.

- **Information Management**: IRC conducts generic research in areas critical to Canadian needs. This work, which is conducted in collaboration with national and international research organizations and universities, generates the knowledge and core competencies to meet the mid and long-term needs of Canada's construction industry. Knowledge and technologies are synthesised and disseminated to industry thus providing them access to international technology sources and simultaneously building international confidence in Canadian construction technologies and regulatory process and facilitating export opportunities.

IRC Positioning



The Institute is structured with five Programs (four focused on research and one on codes and evaluation) supported by essential technology transfer and administrative groups:

Building Envelope and Structure The Building Envelope & Structure program develops and applies technologies for design, construction, and operation of durable, energy-efficient, and cost-effective building systems. This addresses both new construction and repair or renovation, for all types of buildings. Expanding from a traditional emphasis on systems for cold climates, it encompasses evaluation for conditions in key export markets. To be fully responsive to stakeholder needs the program integrates materials science, system performance and modelling capabilities.

Codes and Evaluation The Codes and Evaluation program is a client and stakeholder driven program with two significant deliverables to the Canadian construction industry.

The first deliverable is a set of National Model Codes, and related documents, promoting uniformity and efficiency in construction while addressing public health and safety. This is achieved by convening both public and private stakeholders to provide a national focus for the development of objective, flexible and technically sound model building and fire codes that address Canadian needs for a safe and sustainable built environment.

The second deliverable is a technical evaluation service that facilitates acceptance of new and innovative construction materials, products and services nationally and internationally. The program promotes industry development and commercialization (nationally and internationally) of innovative construction products through flexible, technically credible evaluations and linkages with foreign assessment organizations. It is also an international leader in the advancement of common approaches to objective-based codes.

Fire Risk Management The Fire Risk Management program systematically integrates fire modeling and experimental competencies with specific expertise in fire resistance, fire detection and suppression, fire development, smoke production and movement, human factors and fire risk assessment, to develop methodologies and technologies that will save lives and reduce the total cost of fire in Canada. While primarily directed towards buildings, elements of the program may have applications that serve both buildings and other structures and equipment.

Indoor Environment The Indoor Environment program integrates experimental, analytical and modeling competencies in the areas of lighting, acoustics, ventilation, indoor air quality, thermal comfort and energy efficiency with those in human factors to provide cost-effective technologies to design and operate indoor environments that maximize the comfort, productivity, health and safety of building occupants. The uniqueness of the Indoor Environment program lies in its integrated multi-disciplinary projects that embrace all aspects of indoor environment competencies and expertise from other IRC programs.

Urban Infrastructure Rehabilitation The Urban Infrastructure Rehabilitation program focuses its research and technology transfer efforts on cost-effective technologies to increase the durability of urban lifelines and to improve municipal asset management practices. The program integrates laboratory and full-scale instrumentation, materials development and testing, and analytical and statistical modeling competencies in the areas of urban road structure, pavement crack sealing, buried pipe performance, risk-based water quality performance and leak detection, non-destructive evaluation, concrete repair, corrosion protection, asset management and decision support for rehabilitation of bridge decks and pipeline systems.

Industry Liaison and Outreach, Marketing and Other Shared Services The Industry Liaison and Outreach group plans and delivers technology transfer activities such as communications, technical publications, on-line information services and industry association networking. Marketing supports the business development needs of the programs, including client relations and negotiations. Leadership for administrative

support services including planning, finance, contracts management, human resource management, computer infrastructure, building management, translation, graphics, editorial, ISO 9000 and project management is provided by the Director General's Office.

4.2 IRC Roles Envisioned by the Construction Sector

The construction sector continues to look to IRC to maintain its role of bringing together disparate players to create consensus on issues related to codes and technology R&D. In the course of recent consultations, participants also repeatedly expressed a desire that IRC expand its roles in the construction sector to:

- fill the leadership void and foster an integrated industry that speaks with a united voice;
- develop a national strategy for R&D and innovation;
- address problems related to liability;
- capitalize on available knowledge and expertise, partner nationally and internationally with R&D organizations, industry associations, universities and other government departments;
- provide leadership in R&D-related to the integration of the design and construction processes, sustainability and green product evaluations;
- speed up transition of research to use, by encouraging innovation take-up, demonstrations and showcasing successes;
- promote life-cycle costing by enhancing public awareness, integrating it into procurement processes and creating an inventory of materials;
- help rationalize the regulatory system for new products, systems and ideas.

The response to these challenges will require a realignment of IRC's current core competencies in **Construction Materials and Systems Performance** and **Building Stakeholder Networks**. In addition, it will necessitate the development of a new core competency in **Construction Process Technologies**.

5.0 THE STRATEGIC PLAN

IRC Mission

To improve the lives of Canadians through a vibrant construction sector that provides a quality and cost-effective built environment

Improving the lives of Canadians through a quality built environment requires a vibrant construction sector that is capable of adopting and adapting new technology in response to societal and business drivers. Its capacity to respond depends on its ability to follow the lead of other industry sectors and make the transition into the knowledge-based economy. IRC will enable this transition by partnering with its stakeholders to realize three key outcomes:

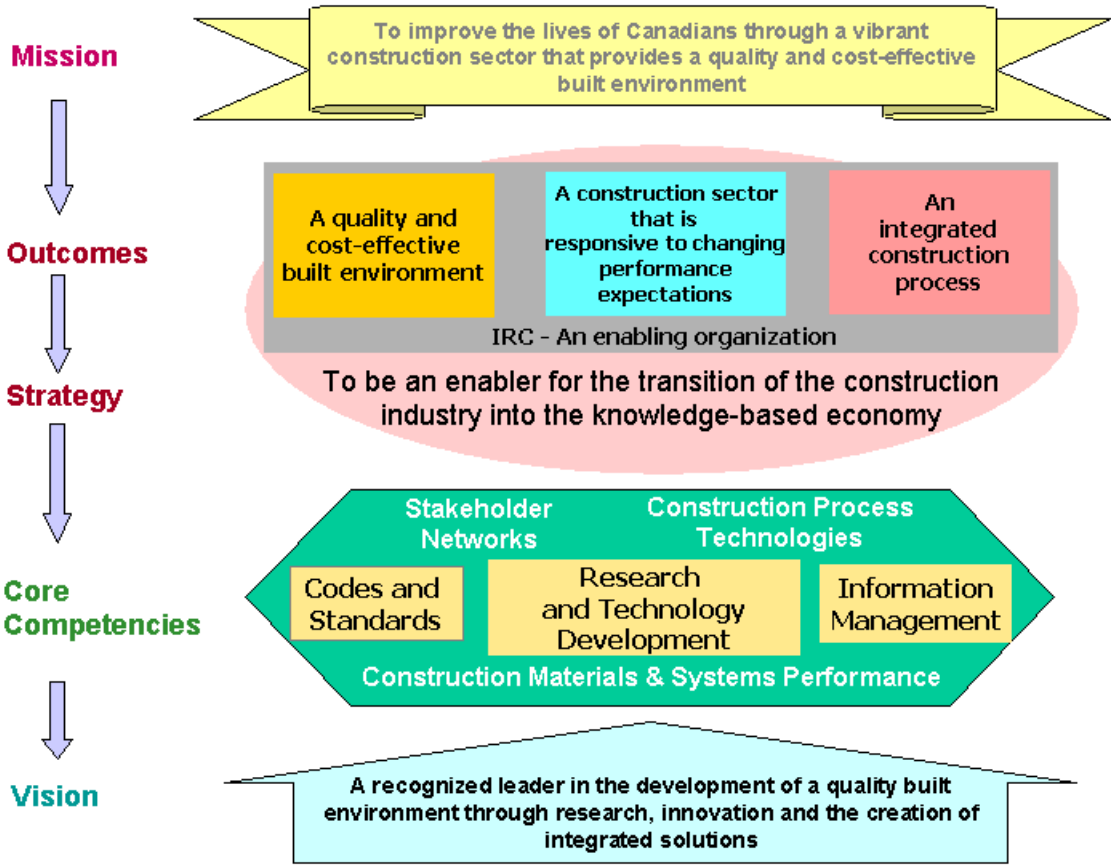
- A quality and cost-effective built environment
- A construction sector that is responsive to changing performance expectations
- An integrated construction process

However, to do so, IRC as an organization must maintain and enhance its ability to embrace and champion innovation and to respond to emerging research, technology and regulatory needs. An outcome for IRC is that it must be **an enabling organization.**

IRC will implement its strategy through its three platforms of codes and standards, research and technology development, and information management. Each of these platforms is well established within the construction sector. Required core competencies will be provided through strengthening of existing competencies in building stakeholder networks and in construction materials and system performance and augmented with a new competency in construction process technologies. By enabling the industry transition, IRC will fulfill its vision.

IRC Vision

A recognized leader in the development of a quality built environment through research, innovation and the creation of integrated solutions



5.1 Strategic Objectives and Actions

IRC Strategy

To be an enabler for the transition of the construction industry into the knowledge-based economy

Success will be achieved through four key objectives. Within each of these objectives, specific actions are established to ensure success. These are articulated in Tables A, B, C and D below.

A. To develop the knowledge and technologies essential to the creation of a quality and cost-effective built environment

1. Re-align and strengthen IRC research programs to priority areas in collaboration with national and international partners.
2. Align IRC initiatives to capitalize on funded government priorities on sustainable urban infrastructure and climate change mitigation and adaptation.
3. Create a cross-program IRC initiative in sustainable built environments, including a new regional component on sustainable northern communities.
4. Create a cross-program initiative on the effect of the indoor environment on health of occupants (in collaboration with HC, CIHR and universities).

B. To provide integrated decision-making tools that enable the construction sector to respond to changing performance expectations

1. Facilitate adoption and advancement of Objective-Based Codes by construction sector.
2. Support industry's move to performance-based principles through development of performance-based decision tools.
3. Develop tools to integrate life-cycle costing into decision-making.
4. Assist industry in developing a strategy to mitigate risk in adoption and use of new/existing construction practices & technologies.

C. To develop construction process technologies critical to improved productivity of the construction industry

1. Develop a national construction R&D strategy.
2. Establish a new research initiative on technologies aimed at integrating the construction process.
3. Reduce the time to transfer knowledge into practice.

D. To become a responsive organization, well positioned to enable the transition of the sector

1. Build competencies and facilities to support emerging thrusts.
2. Ensure maximum benefit from IRC global linkages to become a recognized gateway for construction technology information and to support international competitiveness.
3. Enhance internal processes and management framework to improve alignment with stakeholder needs and improve the flexibility and responsiveness of the Institute.
4. Demonstrate and integrate Employee Philosophy principles in IRC's work environment.

6.0 ALIGNMENT WITH NRC VISION 2006

Outstanding Employees – Outstanding Employer

Successful implementation of the strategic plan relies on outstanding people at all levels of the Institute as well as a work environment that allows them to innovate and excel in their work. IRC's strategic plan calls for the institute to enhance and build on current competencies and facilities to support current and emerging thrusts. IRC will develop and implement human resources and competency development plans to ensure that critical mass and excellence are in place for all priority areas. In addition, IRC will continue its efforts to demonstrate and integrate NRC's Employment Philosophy principles in all operations. This will include a review and improvement of internal processes and management framework to enhance the efficiency, flexibility and responsiveness of the institute.

Excellence and Leadership in Research and Development

A core value of IRC is excellence in all that it does. It underpins the longstanding leadership role that IRC has shown through its research, codes and product evaluation activities in responding to changing expectations of society and the industry. Through its new strategic plan, IRC will embark on several new initiatives demonstrating leadership in addressing areas most important to the sector, such as construction process technologies, indoor health, climate change and sustainable built environments.

Technology Clusters

Diversity, fragmentation and the geographically distributed nature of the construction industry make the creation of technology clusters particularly challenging. IRC's new technology cluster in Regina (with IRC's Centre for Sustainable Infrastructure Research) will be used as a model to establish other community-based centers for targeted research and technology transfer where a strong research partner, university and a receptor industry capacity exist. The plan envisages two new such clusters, one on construction process technologies and the other on sustainable northern communities. A third initiative to deal with technology transfer and applications will also be considered.

Value for Canada

Introduction of the objective-based codes in 2005 will generate new opportunities for the adoption of innovation in construction. By the end of this five-year planning cycle, IRC should be in a position to provide the knowledge to move into performance-based code requirements in key areas identified by the code community. Performance-based decision-making tools will be developed to assist industry in responding to changing performance expectations. Under this plan, IRC will also develop a framework and business case for initiatives to speed up the transition of technologies from research to practice. This will include a model for management of resulting IP and partnerships with other organizations with similar goals and early adopters to disseminate and demonstrate new technologies.

Global Reach

IRC is well connected internationally. Working with IRAP and other partners, IRC will review, strengthen and forge new global linkages and alliances to ensure maximum relevance and benefit to Canada's construction sector. IRC provides a critical technical support role to other government departments within their mandates to promote exports of construction technologies. Its credibility with respect to research excellence, support to Canada's strong building regulatory system and international connections will continue to open new trade opportunities in other countries (similar to past successes in Japan and Russia). Enhanced research collaborations and technology mining will bring international expertise to bear on industry issues in Canada.

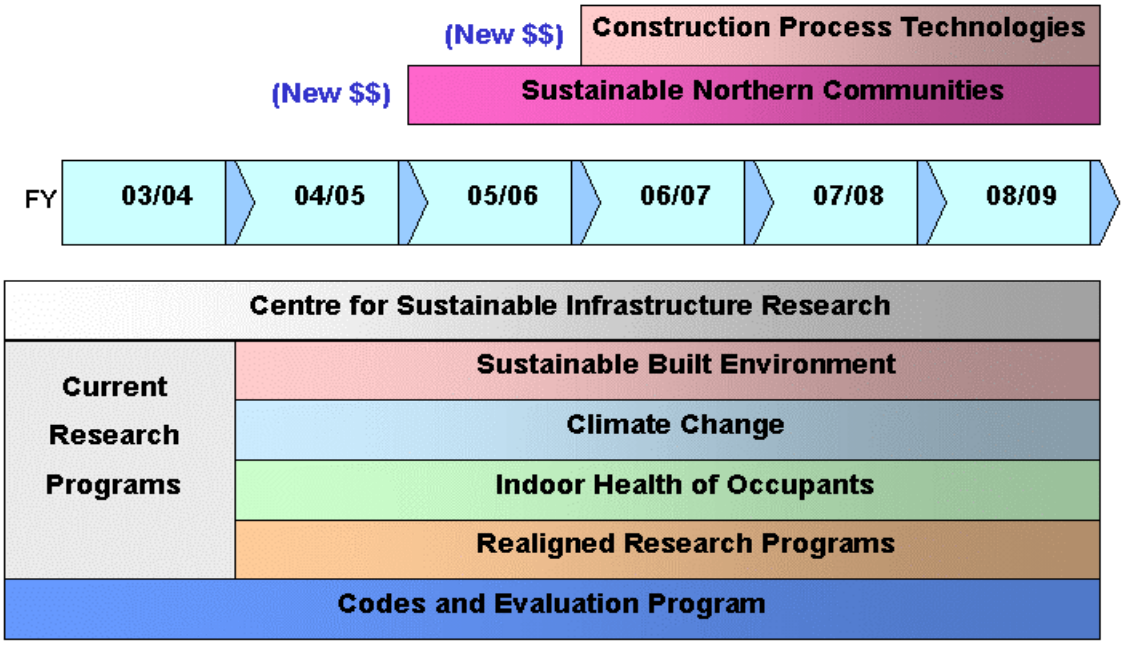
Alignment of Strategic Objectives

NRC / Industry	Outstanding People	Excellence & Leadership in R&D	Technology Clusters	Value for Canada	Global Reach
Foster integrated action		C.1, C.2		B.4	
Capitalize on knowledge	D.1, D.3, D.4	A.1			D.2
Provide leadership in R&D		A.1, A.2, A.3, A.4, B.3, C.2	A.2, A.3, C.3		A.1, A.2, A.3, A.4, B.1, B.2, B.3, B.4, C.2
Speed up transition to practice		C.3		B.1, B.2, B.4, C.3	
Rationalize regulatory system for innovation				B.1, B.2, B.3	

7.0 DELIVERING ON THE STRATEGY

In delivering its Strategic Plan 2004-09, the Institute will operate under its existing structure, with five Programs (four focused on research and one on codes and evaluation) supported by essential technology transfer and administrative groups. The development of Canada's national model codes and the evaluation of innovative construction products require expert support from current IRC's research programs. It is essential to maintain the linkage to these technical competencies and the current organizational structure has proven to be highly effective in this regard.

Implementation of the Strategic Plan 2004-09 will require a detailed review of IRC's competencies and capabilities. Based on an early assessment, it is expected that many of the goals and objectives in the plan will be implemented through realignment and focusing of priorities within the programs coupled with enhanced cross-program consolidation. It also will require a shift in culture to become more responsive to the changing needs of the construction sector. IRC will make an initial modest investment in the new initiatives, but the ability to fully undertake them (e.g. construction process integration and sustainable northern communities) will be dependent on the securing of additional resources for new community-based technology clusters. Current and new initiatives are depicted in the figure below and elaborated in Annex A.



In all its activities, IRC will be guided by its **core values**:

At IRC, we

- **Have respect for all**
- **Exhibit honesty and integrity**
- **Strive for excellence in all that we do**
- **Are collaborative at all levels**
- **Are connected with our stakeholders and responsive to their needs**
- **Are results-oriented**

7.1 Implementation Process

A detailed implementation plan based on the strategic will be established to begin immediately following Council approval of IRC's Strategic Plan 2004-09. To ensure full implementation on 1 April 2004, key elements of that plan will include:

- Forming Implementation Coordination Team and assign Leader
- Translating strategic objectives into required actions
- Mapping required actions against current capability assessment
- Prioritizing required actions
- Preparing staff communication plans highlighting involvement of opinion leaders and early adopters
- Initiating task-specific teams to produce plans for priority action items
- Finalizing detailed plans to implement priority actions
- Incorporating priority actions into Annual Program Planning activities
- Implementing strategic plan to coincide with the beginning of FY 2004-05

7.2 Performance Framework

IRC's existing performance framework will be adjusted to reflect the changes resulting from the Strategic Plan 2004-09 and aligned with NRC's Performance Management Framework.

Annex A. Future Activities and Initiatives 2004-09

A.1 Future Activities

Building Envelope and Structure

- Continue to develop and promote life-cycle costing within the building envelope design process
- Advance the field of nanotechnology in concrete
- Continue developing and promoting the use of moisture management tools and predicting the performance of materials/systems
- Within the area of Climate Change, use its unique weathering facilities to understand the performance of systems under severe weather such as sudden high-wind events, high moisture and temperature extremes as they relate to roofs and façades

Codes and Evaluation

- Launch objective-based series of codes in 2005
- Develop and launch training program for objective-based codes
- Develop and implement new strategic plan for Canada's national codes system
- Initiate development of 2010 model codes
- Produce province-specific codes
- Develop support tools for facilitating innovation under objective-based codes

Fire Risk Management

- In collaboration with Carleton University, develop and apply modeling of active fire protection methods to address fire detection/suppression, smoke movement and materials performance in transportation systems
- Undertake research to establish acceptable fire performance of houses
- Develop passive fire protection techniques for light and heavy weight construction
- Understand human factors/performance in fires
- Develop fire cost/risk assessment methodologies
- Develop reference fires (design fires)

Indoor Environment

- Promote national initiative on indoor health, and extend indoor environment research to health impacts through potential cluster and partnerships with health-related agencies
- Continue develop cost effective design tools and guidelines to improve indoor environment while maximizing occupants' comfort and health
- Develop integrated solutions for office and residential buildings that integrate physical and subjective performance
- Understand propagation of structural noise and its impact on transmission loss, and develop best practice and recommendations for building regulations
- Develop guidelines and tools to mitigate indoor contaminants in buildings

- Develop integrated solutions for advanced ventilation technology in residential buildings, that maximize energy-efficiency and indoor air quality
- Assess and develop guidelines for automated and intelligent lighting control systems

Urban Infrastructure Rehabilitation

- Develop robust decision-making tools for aging water distributions systems and sewer collection systems
- Develop non-destructive/non-intrusive tools to inspect and monitor buried pipes that can be used to translate distress indicators into condition states
- Develop, in partnership with the University and City of Regina, infrastructure decision-support systems and technologies for sustainable use and management of potable, storm and waste waters including the political, social and economic dimensions
- Develop technologies and guidelines to avoid the premature deterioration of rehabilitated urban roads leading to quality construction and reduced life-cycle costs
- Develop tools and decision support models for life-cycle analysis and design of highway bridges

A.2 New Cross-Program Initiatives

Sustainable Built Environment Human activities – industrialization, urbanization and construction - have profound impacts on the world's environment as well as on the quality of life. As a result, there is a growing appreciation that the management and use of natural resources need to be improved and that the quantity of waste and pollution generated by human activity need to be reduced on a large scale. This will require a reduction and, if possible, elimination of unsustainable patterns of production and consumption. As a result, emphasis is growing on industrial sustainability because this is increasingly recognised as a key means of reducing environmental impacts and improving quality of life.

A Sustainable Built Environment (SBE) is about achieving the three pillars of environmental compatibility, economic viability and social responsibility (often described as *people, planet and prosperity),* in the context of construction industry/built environment, and viewed in a local, regional, national and global context.

IRC will engage the construction sector to establish an understanding and approach to SBE and to seek industry consensus on priority research issues. IRC will then utilize its cross-program multi disciplinary competencies and linkages to other NRC initiatives to establish an internationally recognized initiative to deal with these priorities. IRC's Centre for Sustainable Infrastructure Research in Regina will be a key player and example in this area.

Climate Change Climate change is impacting on the built environment in unexpected ways (e.g. permafrost deterioration, structural load alterations due to variability in snow accumulation, wind and rain patterns, an aging sewage infrastructure coping with heavy rain events, higher temperature and humidity levels causing more frequent smog in larger cities, increased demand for air conditioning). The number and impact of weather-related disasters in Canada has increased dramatically over the last 15-20 years (from $500 million between 1983 and 1987 to $1.5 billion between 1993 and 1997). It is therefore critical that the effects of these extremes on materials and systems used to provide shelter and to support transportation be investigated.

The built environment and the construction industry are major contributors to greenhouses gas emissions (e.g. 30-40% of the countries total energy consumption). Addressing Canada's response to the Kyoto target is the current government priority, but very restrictive measures and aggressive new technologies will be required by 2010 to further reduce greenhouse gas emissions (post-Kyoto).

IRC will complement other government departments and NRC research efforts in the mitigation of climate change (e.g. greenhouse gas reductions). It will capitalize on in-house IRC expertise on energy efficiency and durability of materials and systems and modify or develop facilities to simulate harsher weather conditions. It will also contribute to Canada's response to the Kyoto target by assessing the impact of energy conservation strategies on indoor air quality and the health of occupants. As needed, IRC will facilitate any revisions to the national model codes needed to accommodate changes in environmental loads resulting from climate variations.

Indoor Health In its 2002 version of World Health Report, the World Health Organization has identified Indoor Air Pollution as among the top ten risks, globally and regionally, in terms of the burden of the disease they cause.

In Canada, unhealthy indoor environments affect absenteeism and lack of productivity at work, thus causing losses to the economy estimated at billions of dollars. Research suggests that 1% of improved indoor environment can increase productivity by an average of 10%, let alone produce substantial cost savings in health care. The impact of indoor environment is more relevant in Canada, because of extreme climatic conditions combined with the fact that Canadians spend about 90% of their time indoors. The Canadian industry lacks the knowledge and information on causes and an understanding of the indoor environment as it affects the health and well being of occupants.

IRC will engage key federal organizations and collaborate with them in the development of a major initiative on the effect of indoor environment on the health of occupants. It will take advantage of the various programs and expertise offered by IRC, such as codes, product evaluation and research, and the skills and knowledge of other organizations, such as Health Canada and CIHR-funded academic researchers, to ensure a comprehensive initiative focused on evidence-based results and innovative resolutions to this issue.

A.3 New Community-Based Cluster Initiatives

In addition to refocusing program activities and initiating cross-program initiatives, IRC will be pursuing new initiatives to respond to the changing priorities of Canada's construction sector:

Construction Process Technologies

The construction process encompasses several distinct stages within separate areas of responsibility: project conception, architectural layout, detail specifications, engineering design, facility assembly, monitoring and maintenance, demolition and site reuse. There is very little integration of these activities and sectors, which limits the possibility for enhanced productivity within the overall construction cycle. For the most part, industry lags in adopting new practices and technologies. It suffers from a great divergence in tools and technologies from company to company and across supply chains.

By developing fully integrated and highly automated processes across all phases of the project life cycle, through the use of information technologies and advanced practices, IRC, in partnership with universities, international organizations and technology sources will provide the industry with the tools needed to reduce the time, enhance quality and improve the cost-effectiveness of construction. This initiative will be established as a technology cluster in a suitable region.

Sustainable Northern Communities

Northern governments are aspiring to self-reliance; a driver in favour of building the capacity of a northern construction industry, despite the presence of a southern capacity to supply builders, materials and technologies in the north. Building a house in the North is prohibitive when compared to the rest of Canada (e.g. it costs about $65 per ft² in Edmonton but $180-225 per ft² in Kivalliq.) Most of the differences in costs are attributed to freight and accommodation costs for imported labour. Activities related to indigenous materials and local skills thus would have a tremendous impact on construction costs.

Internationally, the market for northern technologies is fertile. Greenland is building some autonomy from Denmark and is eager to develop trade with the Canadian territories. Alaska is another lucrative market for innovative solutions. In addition, with its large population, diverse economy and reforming industrial base, Russia offers good long-term opportunities for potential suppliers and investors.

IRC has a historical presence in the North (e.g. permafrost and snow load research). This combined with its internationally recognized model codes and research credibility and its linkages to IRAP and other government departments such as CMHC and NRCan, put it in an ideal position to bring technology solutions to bear on the unique issues facing the northern construction community.

Annex B: References, Abbreviations and Acronyms

B.1 References

- NSCIC response to the Federal Government Announcement on Canada's Innovation Strategy http://www.nscic.ca/docs/App3b.pdf
- IRC web site for technology review results http://irc.nrc-cnrc.gc.ca/sp0409/roadmap.html
- IRC web site for environmental scan results http://irc.nrc-cnrc.gc.ca/sp0409/escan.pdf

B.2 Abbreviations and Acronyms

- CCBFC Canadian Commission on Building and Fire Codes
- CCMC Canadian Construction Materials Centre
- CIHR Canadian Institutes of Health Research
- CMHC Canada Mortgage and Housing Corporation
- FIATECH Fully Integrated and Automated Technology
- GDP Gross Domestic Product
- HC Health Canada
- IP Intellectual property
- IRAP Industrial Research Assistance Program
- IRC Institute for Research in Construction
- LCC Lifecycle costing
- NRC National Research Council
- NRCan Natural Resources Canada
- NSERC National Science and Engineering Research Council
- NSCIC National Steering Committee on Innovation for Construction
- SBE Sustainable built environment