Nordicity Group Ltd.
Le Groupe Nordicité ltée

THE IMPACT OF STANDARDS ON THE DIFFUSION OF TECHNOLOGY AND INDUSTRIAL COMPETITIVENESS

VOLUME I
MAIN STUDY

Prepared for:
Industry Canada
and Co-sponsors

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THE EFFECTS OF STANDARDS ON TECHNOLOGY DIFFUSION

SUMMARY REPORT

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1.0 INTRODUCTION

1.1 Mandate and Studies

A consortium of federal government departments and agencies commissioned this study in order to investigate the role that standards and regulations play in the technological innovation process and how they impact the international competitiveness of Canadian firms.

The study, launched in November 1992, had five components which resulted in five reports:

- The Effects of Standards on Technology Diffusion, An Overview
- A Study of the Effects of Standards and Regulations on Technology Diffusion; Communications and Information Technology Sector
- The Effects of Standards on Technology Diffusion in the Building Construction Industry
- Technology Diffusion and the International Standards Setting Environment: Implications for Canada
- The Effects of Standards on Technology Diffusion: Synthesis Report

During the course of the work program, seven other adjunct studies were undertaken to explore specific issues which arose. The reports which resulted from these studies were the following:

- Federal Microcomputer Procurement
- Procurement, Standards and Competitiveness; A Comparison of Selected Countries
- Versailles Project on Advanced Materials and Standards (VAMAS); A Case Study
- Technical Areas of Shared Interest Between the International Organization for Standardization (ISO) and Sector Branches of Industry and Science Canada

- ISO 9000 Feasibility Study for Electronic Charting in the Canadian Hydrographic Service

- ISO 9000 and the Residential Construction Industry

- The Link Between the Canadian Technology Network (CTN) and a Firm Level Standards Impact Test (SIT)

The main findings, conclusions and recommendations of these studies are presented in the following sections.

1.2 Study Process

The study process entailed a series of **interviews** with key public and private sector experts and stakeholders in the standards development environment and a **literature review** of Canadian and international documents and reports on the roles of standards and regulation, trends in technology development and diffusion, and government industrial strategies and competitiveness.

In addition, a **Panel of Experts** was convened to advise the study team on issues and directions for the study, and to review the draft reports. The panel of experts met four times with the study team during the course of the project. As well, advice was sought on an individual basis. The individuals who participated in the Panel were the following: Graham Cameron (metrology expert); John Gilbert (telecommunications standards expert); Roy Phillips (immediate past Chairman of the International Organization for Standardization); Philip Preston (standards consultant); Grant Wilson (building construction standards expert) and John Woods (past Executive Director of the Standards Council of Canada).

Finally, an inter-departmental **Steering Committee**, led by Industry, Science and Technology Canada (ISTC),[1] oversaw the entire study, meeting with the study team periodically to review progress, to discuss issues, and to evaluate the draft reports. The Steering Committee included representatives from ISTC, Consumer and Corporate Affairs (CCA), Department of Communications (DOC), External Affairs and International Trade Canada, National Research Council, Standards Council of Canada, and Department of Supply and Services.

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1 The federal government has since been reorganized and ISTC, CCA and DOC are now part of a new department called Industry Canada. External Affairs and International Trade Canada is now Foreign Affairs and International Trade Canada and Supply and Services has become Government Services.

To give a more precise orientation to the study mandate, the Panel of Experts suggested that it would be useful at the outset to formulate a "mission statement" as a guide for the study. The Steering Committee agreed to this idea and the following statement was endorsed:

> "To carry out a study of standardization and regulatory processes which will make recommendations to give Canadian firms the capacity to promptly develop or acquire new and current technologies, to maximize their industrial competitiveness. This statement implies a need for Canada to maintain an efficient, productive and well-informed national technological and standards development infrastructure, as a base for effective participation in international and regional standardization."

2.0 SYNTHESIS

The synthesis report summarizes the principal findings, conclusions and recommendations of the original four studies.

Product, process and performance standards originate from three sources; the marketplace which establishes de facto standards through market forces; standards development organizations (SDOs) which develop standards based on consensus; and governments which set regulatory standards. The globalization of the world economy and the associated international technology flows are increasingly shifting the focus for standards setting from national to the regional and international levels. As well, with increasing deregulation, standards are becoming a viable alternative.

The Europeans are leading in developing European Community wide regional standards. The Canada-U.S. Free Trade Agreement (FTA) and the North American Free Trade Agreement (NAFTA) are driving the harmonization of standards in North America. In the Far East there are nascent attempts at forming regional standards groups such as within the Association of South East Asian Nations (ASEAN).

In parallel, there has been increasing acceptance of international standards. It has been estimated, for example, that some 85 per cent of CEN and CENELEC (two major European standardization organizations) standards are now identical to international standards. As well, the number of international standards set by the International Organization for Standardization (ISO), the principal world standardization organization, nearly doubled between 1982 and 1992.

The growth in international sourcing of technology and components, the need to ensure the inter-operability of communications systems world-wide, not to mention the increasing number of global environmental problems are some of the major driving forces leading to the growing need for international standards. To anticipate areas requiring standardization attention, the ISO, along with a sister agency, the International Electrotechnical Commission (IEC), have reviewed 149 technological areas to establish priorities for the 1990s. It is not surprising that several environmental, health and information technology areas were identified as needing urgent standardization attention. Moreover, with rapid technological change, the ISO/IEC have recognized that standardization concerns are increasingly being incorporated into research and development (R&D) programs so that acceptable terminology and measurement techniques can be developed to set the stage for standards-setting downstream.

This dynamic was well illustrated in the two case studies undertaken. In the communications and information technology sector, standards-setting is now leading technology introduction and diffusion, rather than following it, as it was a decade ago. Even in the more traditional, slower moving, building construction industry, the focus of the second case study, there is a growing realization that technology and globalization are becoming more and more tightly linked to standards-setting. A methodology was developed, based on these two cases, to facilitate the investigation of the impact of standards on other sectors.

Through these cases and other work, a number of key issues were identified. Many of these issues related to Canada's involvement in the international standards setting process, because in a small open economy, which imports a large amount of technology and exports large volumes of primary and manufactured goods, Canadian firms need to have intelligence on and be able to influence emerging standards to create a business environment that leads to improved competitiveness. The issues identified are related to the lack of a strategic approach to standards, the lack of awareness of the strategic importance of standards, the impact of budgetary constraints on international standards activities and the limited involvement of small and medium-sized enterprises (SMEs) in the standardization process.

To address these issues it is recommended that:

- A Policy Development Committee, in collaboration with the Standards Council of Canada, provincial governments, industry and universities, undertake an issue identification and strategic positioning exercise to develop an agenda of priorities to enhance industrial technological competitiveness through domestic and international standards development activities.

- A Policy Implementation Working Group be established to develop implementation plans for priorities and issues as identified by the Policy Development Committee, and to promote and co-ordinate standards policy development initiatives in consultation with other organizations.

- A full time dedicated Secretariat, comprised of secondments from participating government departments, be established to assist the task force and working group to carry out their respective responsibilities.

- A comprehensive awareness/education program be developed and implemented to enhance the awareness of the importance of standards and their relationship to technology development and diffusion.

- Much greater emphasis be placed on encouraging and supporting proactive participation in the international standard-setting activities, including the dissemination of information acquired through participation in these activities.

- Mechanisms to acquire, evaluate and disseminate sectoral and firm level standards intelligence be identified and established in collaboration with various government departments and agencies.

The Panel of Experts set in place for the study concurred with the above recommendations.

The 14,000 Canadians involved in national and international standards-setting activities are a major resource to be used to support the implementation of these recommendations.

3.0 ADJUNCT STUDIES

3.1 Procurement

Procurement is a lever that can be used to encourage firms to adopt new standards.

For example, Canadian government, as well as some governments in other countries, have been using procurement to encourage suppliers to adopt the ISO 9000 series of quality standards. Two reports were prepared on the use of procurement to encourage the adoption of ISO 9000 standards; one on federal microcomputer procurement and the other on a comparison of selected countries.

The conclusion of the federal microcomputer procurement study was that the federal government policy of including ISO 9000 quality standards as a requirement in microcomputer requirement has had significant impact and is a useful step in encouraging firms to improve their overall production quality.

As shown in Exhibit 3-1, other countries are also using procurement to encourage firms to adopt ISO 9000 quality standards. As well, specific programs have been developed in some countries to assist firms in adopting ISO 9000 quality standards.

In Canada, the ISO 9000 series has been formally adopted by the Department of Defence and by the Department of Government Services, for procurement purposes. However, opportunities for program assistance to encourage the actual adoption of quality standards, particularly SMEs, with all the industrial competitiveness benefits that accrue as a result, have not been fully explored.

One program ideally suited for this purpose is the Advanced Manufacturing Technology Applications Program (AMTAP), of Industry Canada. Parts of this program (involving technology diffusion activities) are being transferred to the National Research Council. The status of the rest of the program elements is still unclear, but this program could be used to complement the Supplier Quality Initiative that is now under way by Industry Canada and the Department of Government Services.

3.2 Linkages Between ISO and ISC

An analysis of technical areas of shared interest between the International Organization for Standardization (ISO) and the Sector Branches of Industry and Science Canada (as at May 1993) indicated a very strong correlation. Some 67 per cent of the 180 Technical Committees and 72 per cent of the Sub-Committees and Working Groups of ISO operate in technical areas of direct interest to the Sector Branches.

Exhibit 3-1
Comparative Analysis of Countries: Policies and Programs

	Procurement Policy Related to Quality	SME Support Programs Related to Quality (e.g. ISO 9000 series)	Number of Firms with ISO 9000 Registration[1]
EUROPE			
European Community	EC directives encourage use of ISO 9000 for procurement purposes.	Support for standards activities incorporated in R&D programs (e.g. RACE). Pilot program to aid 700 firms conform to ISO 9000.	25,000
United Kingdom	Mandatory requirements to conform to BS 5750 (ISO 9000) -- to qualify for defense procurement. Other departments also uphold BS 5750.	Major support program, Enterprise Initiative, for quality management assistance.	20,000
France	Standards linked to industrial strategy and to public procurement -- European standards take precedent.	Direct assistance program to assist SMEs with standards (Partenaires pour l'Europe) and research tax credits include standards related expenses.	1,100
Belgium	No clear policies, but firms are responsive to European standards requirements and EC directives.	Promotional programs to inform firms on adapting to European and international standards.	?
PACIFIC RIM			
Japan	Japanese industrial standards only used for government procurement. Companies conform to international standards primarily for trade purposes.	No specific programs, but "kohsetsushi" (networks/centers for research and technology) aid SMEs adapt to new technology and standards.	300
Australia	Formally adopted ISO 9000 (AS-3900) in contract procurement (for military and civilian applications).	National Industry Extension Service provides advice and training packages/workshops for quality enhancement of firms.	?
New Zealand	Formally adopted ISO 9000 (NZS-9000) in contract procurement (for military and civilian applications).	ExcelleNZ program provides quality enhancement packages (workshops/consulting), and Enterprise Growth Development Scheme provides assistance for SMEs to improve quality systems.	?
NORTH AMERICA			
United States	Formally adopted ISO 9000 for defense procurement -- subject to phasing in. Some activities under way for studying other procurement applications.	Many Federal and State programs could be tapped to assist SMEs adopt international standards. Manufacturing Technology Centers program is active in assisting companies with ISO 9000 standards.	621
Canada	Formally adopted ISO 9000 for defense and other non-military procurement -- subject to phasing in.	Federal regional development programs are suitable for assistance to SMEs to adapt to ISO 9000 series. TOP program funding for NQI. Other federal and provincial programs could be tapped for quality standards.	381

1 Respective country figures are approximations based on unofficial accounts, and reported at different points in time over the past 6 months. Many additional firms are in the process of applying for registration all over the world.

The standardization process in play at ISO provides a valuable source of technical and market intelligence for those who can gain access to the information generated by the various committees, sub-committees and working groups.

3.3 VAMAS: A Case Study

The Versailles Project on Advanced Materials and Standards (VAMAS) focuses on international collaboration on pre-standards measurement research, intercomparison of test results and the consolidation of existing information on priorities for standardization in the area of advanced materials. As such, it provides a particularly good case study within the context of the mandate of the overall study on standards and technology diffusion for the following reasons:

- VAMAS deals with issues at the research and development (R&D) stage, a stage which is becoming increasingly important in the standards-setting process. Issues related to the transition from R&D results to standards can be better appreciated;

- there is a major focus on metrology which is an important basis for standards-setting;

- the international focus provides information on the dynamics of pre-standards collaborative research at the international level and on the linkages with international standardization bodies such as the International Organization for Standardization;

- Canadian participation in an international pre-standardization activity can be better appreciated; and

- the 10 year history of VAMAS, which was established in 1982, provides sufficient historical depth to study the evolution of the project.

The major findings of this case study relate to the difficulties encountered in translating research results into standards. This can be attributed to a number of factors:

- the perceived mandate of researchers that the work is finished once the technical information is passed on;

- the general lack of understanding of the standardization process by researchers;

- the lack of appreciation of the mandate and the work of VAMAS and the role of IMI by the Standards Council of Canada;

- the lack of a "champion" and resources to ensure that the research results are translated into standards; and

- the fact that the Canadian representative to VAMAS, IMI, does not consider pre-standard work to be part of its mission.

Others have also experienced similar problems and have set in place mechanisms to overcome them. For example, research and development projects funded under the European Community's RACE (Research on Advanced Communication in Europe) have a standards dimension incorporated into them. The research results are reviewed by the RACE Industrial Consortium (RIC) for standardization implications. RIC, which is an accredited body to the European Telecommunications Standards Institute (ETSI), transmits the relevant RACE contributions to the various ETSI committees. In this way the early translation of research results into standards is assured.

The major conclusions of the study were the following:

- the difficulty of establishing close ties between the research and standards community at a time when such links are considered important and are being established in other countries;

- the lack of industry support which reflects, at least in part, the structure of Canadian industry in the materials sector (e.g. foreign ownership, limited domestic technological development); and

- the lack of government policy and strategy in AIM that would give clearer directions to participation in initiatives such as VAMAS.

These issues illustrate that generally, a much more coherent and strategic approach to technology and standards is needed.

The findings of this case study led to the following generic recommendation:

- Canadian involvement in pre-standard research activities, at either the national or international level, should be undertaken within a strategic framework where funding, policy directions and the resulting benefits are made clear and the links between the agencies undertaking the research and those responsible for downstream standardization activities are established at the outset.

3.4 ISO 9000 Feasibility Study for Electronic Charting in the Canadian Hydrographic Service

The purpose of this study was to investigate for the Canadian Hydrographic Service (CHS) the feasibility of implementing a quality management system (QMS) for the electronic charting function.

The study is jointly funded with Industry Canada. Industry Canada's interest in the study involves showing how ISO 9000 registration could help Canadian industry become more competitive and could provide opportunities for introducing international quality requirements in government contract procurement.

The study approach involved the following steps:

- ISO 9000 awareness seminars for CHS staff in the regions and headquarters, and for a number of contractors involved in the electronic charting business;
- site visits and discussion groups to obtain feedback and data from participants in the electronic charting activities;
- assessment of electronic charting production activities against ISO 9000 requirements;
- identification of requirements for implementation of ISO 9000 in CHS.

A number of issues were raised by regional staff and suppliers. These issues are discussed in the report. Generally, the response from regional staff and suppliers was very positive regarding the CHS ISO 9000 initiative.

The options for implementation that were considered involved the functional scope (electronic charting functions), the institutional scope (Headquarters, Regional Offices, Nautical Data International, and suppliers) and the selection of an ISO 9000 model (ISO 9001, 9002 or 9003).

The study team concluded that the CHS should:

> Implement ISO 9001 for CHS electronic charting production, with a functional and institutional scope that covers electronic charting production processes across the board (i.e, covers Headquarters, Regional Offices, Nautical Data International and suppliers). The electronic charting quality management system, once in place, should be registered with an accredited Canadian registration organization.

The advantages of introducing an ISO 9000 Quality Management System (QMS) include:

- Increased Efficiencies: The establishment of a QMS will provide the infrastructure for an improved organization which actively promotes efficiencies in the production processes; the process of documenting procedures opens opportunities for streamlining and integration.

- Customer Satisfaction: It assures clients that products are developed, produced and distributed using the best known management practices including standards of operation and quality checks.

- Litigation: It will be essential to have a QMS which ensures that state-of-the-art professional practices are in place at all stages of the ENC production process.

- Cost Savings: It is much cheaper to correct mistakes early in a process, rather than afterwards.

The proposed implementation plan involves approximately 412 to 442 person days of CHS staff time, over an 18 month period.

The first year would be devoted to introducing and implementing the system. The second year is for proceeding with the registration process involved to get electronic charting production certified for ISO 9001.

A two year budget is required to start with. The first year is comprised mostly of training costs of $25,500. The second year represents an estimated registration fee of $47,700 for six sites (including Headquarters, four regional offices for Nautical Data International Inc.).

These cost figures do not include travel costs and expenses of auditors and trainers, and they do not include the costs of follow-up audits, in case of noncompliances discovered, or for surveillance purposes after registration (certification).

While it is preferable to require suppliers, especially software developers, to comply with ISO 9001, it would also be possible to control for quality, in supplier-CHS contractual situations involving electronic charting production, through the contract review and purchasing elements of a CHS ISO 9001 registration. Thus, the option of supplier registration could be made voluntary, if suppliers are not ready or able to commit to implementation within the same time frame as CHS. However, for manufacturers (namely OSL) of the complete ECDIS product, as installed on ships, registration to ISO 9001 would clearly provide the necessary quality assurance needed to achieve market advantages and defence against litigation, and provide for after-sales servicing requirements.

3.5 ISO 9000 and the Residential Construction Industry

This study, prepared for Canada Mortgage and Housing Corporation (CMHC), provides the housing industry with some facts about the ISO 9000 standards (e.g., what they are and why they are important) and discusses the implications of these standards for the residential construction sector.

The purpose of the study was to provide sufficient information to engender an appreciation of ISO 9000 as it could apply to the residential construction industry, and to identify areas for follow-up work and for a possible role for CMHC in this regard.

Information gathered for this study was based on a number of personal and telephone interviews with experts in Canada, the United States and Europe, and a review of the growing literature on ISO 9000.

The study demonstrates how the standards are proliferating in Europe, North America and other parts of the world. Managing for best quality results is now not only desirable, but necessary. It means better profitability, enhanced competitiveness, and in many situations survival for the producer.

Already in North America there are several companies, including manufacturers of housing components, architects and construction engineering firms that are either certified for ISO 9000 or are in the process of becoming compliant with ISO 9000 requirements.

In addition, several residential construction sector associations have begun to examine and/or encourage their members to become ISO 9000 certified (e.g., Canadian Manufactured Housing Institute and the Council of Forest Industries (COFI)). Other applications include the Canadian Construction Materials Centre (CCMC), which is introducing conformance to ISO 9000 as a minimum requirement for quality assurance to be used by proponents requesting evaluations of new and improved products.

This study also showed the relevance of applying each of the twenty different elements of ISO 9001 to the manufactured housing and residential construction business. The relation of ISO 9000 series to existing standards in the residential construction industry is a complementary one. The need for quality assurance in workmanship and inspection processes, at the building construction phase is well recognized by the industry. ISO 9000 provides a recognized standard for introducing quality management as a tool for ensuring quality as well as safety, and offers some protection against risk and liability to builders and manufacturers of housing products.

The report also showed that a clearly appropriate application of ISO 9000 within the industry is in the area of manufactured housing. The Canadian manufactured housing industry is currently involved in expanding its export potentials in U.S., Japan and several countries in Europe. These countries have all officially adopted ISO 9000, and its requirements are increasingly becoming the method for quality assurance in contractual situations. The Canadian manufactured housing industry could benefit by introducing ISO 9000 as a competitive tool, as a means for assuring international customers that internationally recognized mechanisms for quality are sustained in the production processes of Canadian companies.

The study also provides a description of the ISO 9000 registration process as it applies in Canada, and recommends a role for CMHC regarding ISO 9000 standards as they could be implemented in the housing sector. ISO 9000 could be one tool for promoting quality in the housing industry, which is one of CMHC's mandates. CMHC could provide training and disseminate information on ISO 9000 applications and trends within the housing industry. A number of specific areas of application for the housing industry are of particular interest to CMHC, such as social housing procurement (contractual) requirements, quality assurance for situations with high liabilities and risks, and private sector supplier-contractor relationships.

3.6 The Link Between the CTN and a Firm Level Standards Impact Test (SIT)

Small and medium-sized enterprises (SMEs) are usually in a responsive mode vis-à-vis standards, with all the volatility that that entails. SMEs have asked for better intelligence regarding standards which led to the following recommendation:

> "Mechanisms to acquire, evaluate and disseminate sectoral and firm level standards intelligence be identified and established in collaboration with various government departments and agencies."(see p.7)

The federal government's proposed Canadian Technology Network (CTN) is to provide a standards intelligence service. This service would provide the basic information that firms have requested. However, this information could also be used to illustrate how standards would impact on the performance of firms. Such a Standards Impact Test (SIT) could be a value-added service provided through the CTN. The clients for this service would be firms and government agencies interested in evaluating the impact of standards on industrial performance.

Industry Canada has developed, in cooperation with the Canadian Manufacturers Association and Treasury Board, a Business Impact Test (BIT) which shows how regulations impact on the performance of firms. A similar approach could be used to develop a SIT.

This study showed **conceptually** how a standards impact test (SIT) could be structured and how it would be delivered to firms, especially small and medium-sized enterprises (SMEs) through the proposed Canadian Technology Network (CTN).

The study recommended that:

- the designers of the CTN involve the Canadian standards development organizations in shaping the proposed standards information resource;
- a SIT be developed through consultations with industry; and,
- the BIT be modified to deal with standards.

By moving in this way, both firms and government will gain a much better appreciation of the impact of standards development on industrial competitiveness.

3.7 The Market/Technology Intelligence Value of JTC1 Activities

The dynamics of international voluntary standards are a source of market and technology intelligence. To assess the value of this intelligence a case study was undertaken of selected activities of the Joint ISO/IEC Committee on information technology (JTC1).

The pilot study did indicate that JTC1 activities did have market/technology intelligence value. However, the extent to which value can be extracted is dependent on the ability to track specific JTC1 activities and documents and on active participation in JTC1 SCs and WGs or having access directly, or indirectly through trip reports, to individuals who do participate.

A first, relatively easy level of entry into the world of JTC1 is to track the evolution of approved New Work Items (NWIs) in the JTC1 system as they are translated into draft standards.

A second, and relatively more difficult, level of entry is to understand the issues related to the evolution of Working Documents (WDs), Committee Drafts (CDs) and Draft International Standards (DISs). The documents themselves provide very technical information which needs to be cast in a broader context if maximum market/technology intelligence is to be extracted. The participants involved in developing a consensus on these documents are the best venue to obtaining this intelligence.

It was recommended that a comprehensive market study be undertaken to determine the scope of the opportunity. Such a study would help to shape the content of the proposed electronic data bases and the pricing of services. It would also support the development of a business plan.

It was also recommended that the Standards Council of Canada investigate the extent of the leverage that its accreditation of participants to JTC1 SCs and WGs has in extracting more substantive trip reports from these participants.

This approach to extracting market/technology intelligence from ISO activities should also be explored for other priority sectors.

4.0 GENERAL CONCLUSION

With the globalization of the world economy, standards and regulations are increasingly being used as strategic tools in the international marketplace. In recent years a strategic system has been overlaid onto the classical standards and regulations system (Exhibit 4-1).

Exhibit 4-1
Evolution of Standards/Regulatory Systems

CLASSICAL SYSTEM	TRANSITIONAL SYSTEM	STRATEGIC SYSTEM
MAIN FOCUS ON HEALTH, SAFETY AND CONSUMER PROTECTION	INCREASING AWARENESS OF THE IMPACT OF S&R ON COMPETITIVENESS	RECOGNITION OF THE IMPORTANCE OF S&R IN THE INNOVATION PROCESS
COMMAND AND CONTROL APPROACH	DEREGULATION, INCENTIVES AND VOLUNTARY STANDARDS AS ALTERNATIVES	STRATEGIC POSITIONING OF S&R FOR MARKET AND TECHNOLOGY ADVANTAGE
NATIONAL GOVTS AND INDUSTRIES DOMINATE S&R PROCESSES	SHIFT TO INTERNATIONAL STANDARDS SETTING	CONTINUED SHIFT TO INTERNATIONAL STANDARDS SETTING

GLOBALIZATION OF THE WORLD ECONOMY

NGL/NORDICITY

The study has shown that Canada is in a "catch-up" mode relative to its major competitors in using standards as a strategic tool to improve the competitiveness of Canadian firms. A major problem is the general lack of awareness of the importance of standards outside the standards community. A number of broad (see pages 6-7) and specific (see Section 3) recommendations were made to correct this situation.

The study has shown that the evolution of technical standards is inextricably linked to the development and diffusion of technology. It is only by setting in place mechanisms that recognize this linkage that Canada will be in a position to fully use standards as a strategic tool.

2

Standards, Technology and Competitiveness

"Canada's Challenge"

Industrial Innovation

The Global Reality

- National Economies are becoming increasingly dependent on international trade.

- International trade is becoming increasingly competitive.

- Competitiveness is becoming increasingly technology driven.

- Trade, Competitiveness, technology and standards development process are becoming increasingly interrelated and interdependent.

Canadian Perspective

- Is Canada's National Standard System (NSS) up to the competitiveness challenge?

- How does it rate internationally?

- Is the NSS being used to maximize technology acquisition and diffusion?

- Can the NSS be enhanced and/or improved?

- Are new resources required?

Background

- 1991/92 a task force on technology diffusion recommended a study be carried out on standards and their impact on technology diffusion.

- November 1992, a consortium of government departments, led by Industry Canada, contracted for a study with NGL Consulting Ltd.

Study of the Impact and Effects of Standards and Regulations on the Diffusion of Technology

- Review the standards process in Canada.
- Review the international context of standards
- Study the impacts of standards on technology diffusion in industry sectors.
- Identify and analyze factors which hinder or stimulate technology diffusion.
- Develop recommendations to make better use of standards as a tool to promote competitiveness of Canadian industry.

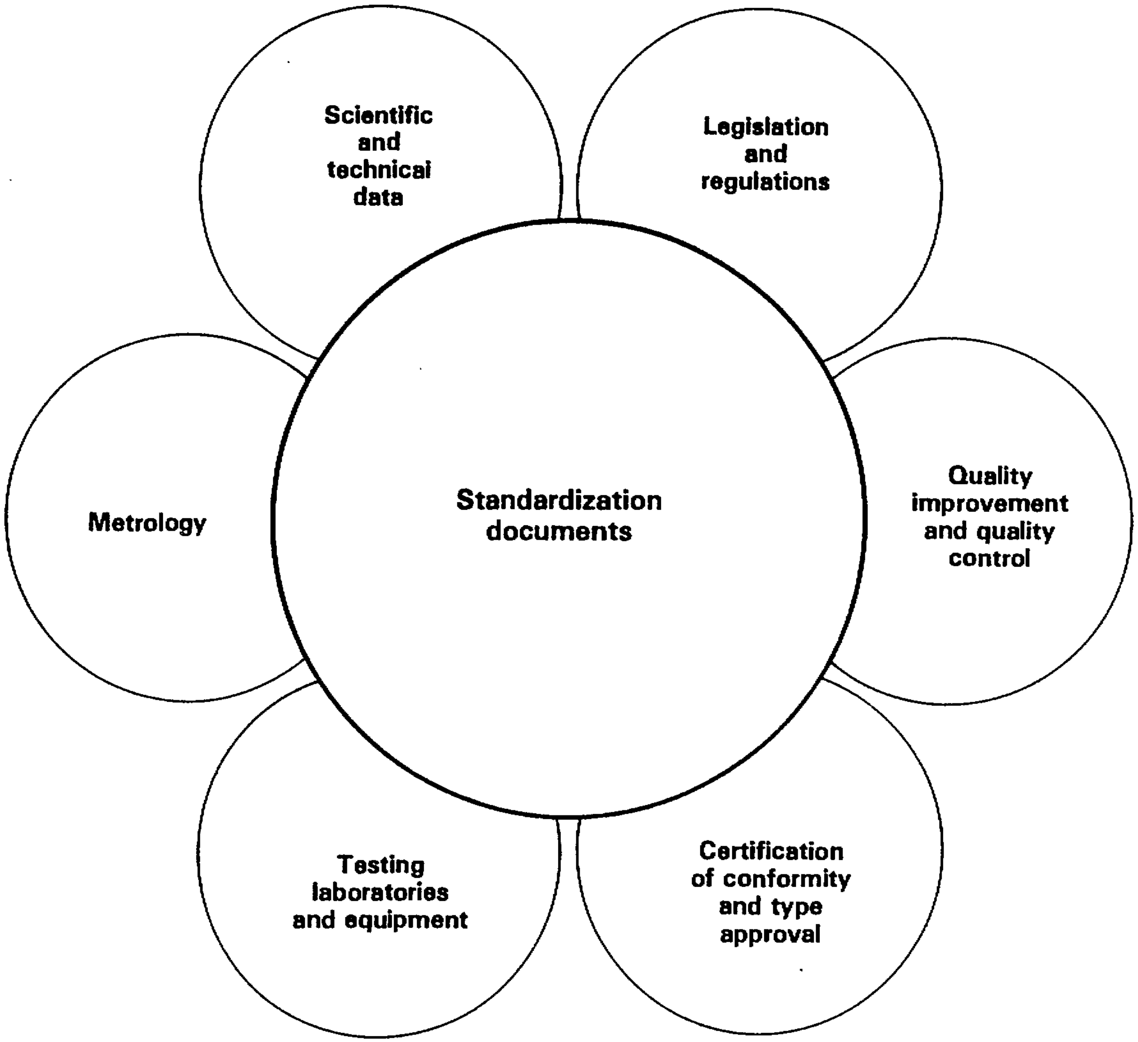
WHAT IS A STANDARD ? -- A POINT OF REFERENCE :

TWO TYPES :

- **Physical constant (etalon)**
  (eg. -- metre; gram; second)
  - **old (Sumeria; Egypt; Magna Carta)**
- **Technical specification (norme)**
  (eg. -- railway gauge; voltage)
  - **change with technology**
  - **gives a position on the state of technology markets and of policy at a given time**

The first type supports the development of the second.

THE WORLD OF STANDARDS DEVELOPMENT:



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MATRIX OF THE STANDARDS UNIVERSE

PROCESS: DEVELOPMENT OF THE STANDARD--BY WHOM AND HOW	APPLICATION*	PURPOSE/TYPE OF STANDARD: PRODUCT DESIGN STANDARD	PERFORMANCE STANDARD	PROCESS STANDARD
INDUSTRY/ MARKETPLACE (DE FACTO)	M	traffic lights	professional qualifications (doctors, etc.)	driving on the right
	V	VCRs	software/computer compatibility	ABM shared networks (telecom)
STANDARDS DEVELOPMENT ORGANIZATIONS (CONSENSUS)	M	electrical sockets	hockey helmets	test methods for flammability of textiles
	V	paper sizes	garment sizing	ISO 9000 series
GOVERNMENTS (REGULATIONS)	M	lawn darts	children's nightwear flammability	food packing
	V	baby walkers	R2000 housing	advertisement approvals

Note: * Application: M = Mandatory V = Voluntary

COUNTRY COMPARISONS :

All our advanced trading partners have national standards bodies that :

- **draw up and secure the approval of national standards;**
- **promote the adoption and application of standards;**
- **maintain quality of products and certify that they comply with standards;**
- **disseminate information on standards and other related technical matters;**
- **represent their country in international standardization work.**

However, countries differ in the level of involvement in the voluntary standards process.

COMPARISON OF NATIONAL STANDARDS SYSTEMS:

NATIONAL STANDARDS ORGANIZATION	FINANCING	GOVERNMENT INVOLVEMENT
UNITED STATES American National Standards Institute (ANSI)	- private, non-profit org. - funds from subscriptions (27%) & sales, certif. & testing (58%)	- technical committees may include federal and state government officials
FRANCE Association française de normalisation (AFNOR)	- 30% government funding - subscriptions, sales certification & testing (70% of funds)	- half of AFNOR Advisory Committee from government - Responsibility of Ministry of industry & Research
UNITED KINGDOM British Standards Institution (BSI)	- 9% government funding - reports to Parliament - funds from sales, certification, testing & subscriptions (88%)	- BSI-government MOU on use of standards in regulation and procurement - government contributes to independent certification organization
JAPAN Japanese Industrial Standards Committee (JESC)	- non-profit - 100% funded by government	- centralized government control, Ministry of Intl. Trade & Industry - extensive industry participation
CANADA Standards Council of Canada (SCC)	- crown corporation - Parliamentary appropriation (70%)	- government members on SCC - government members on advisory committees - government participation in technical committees

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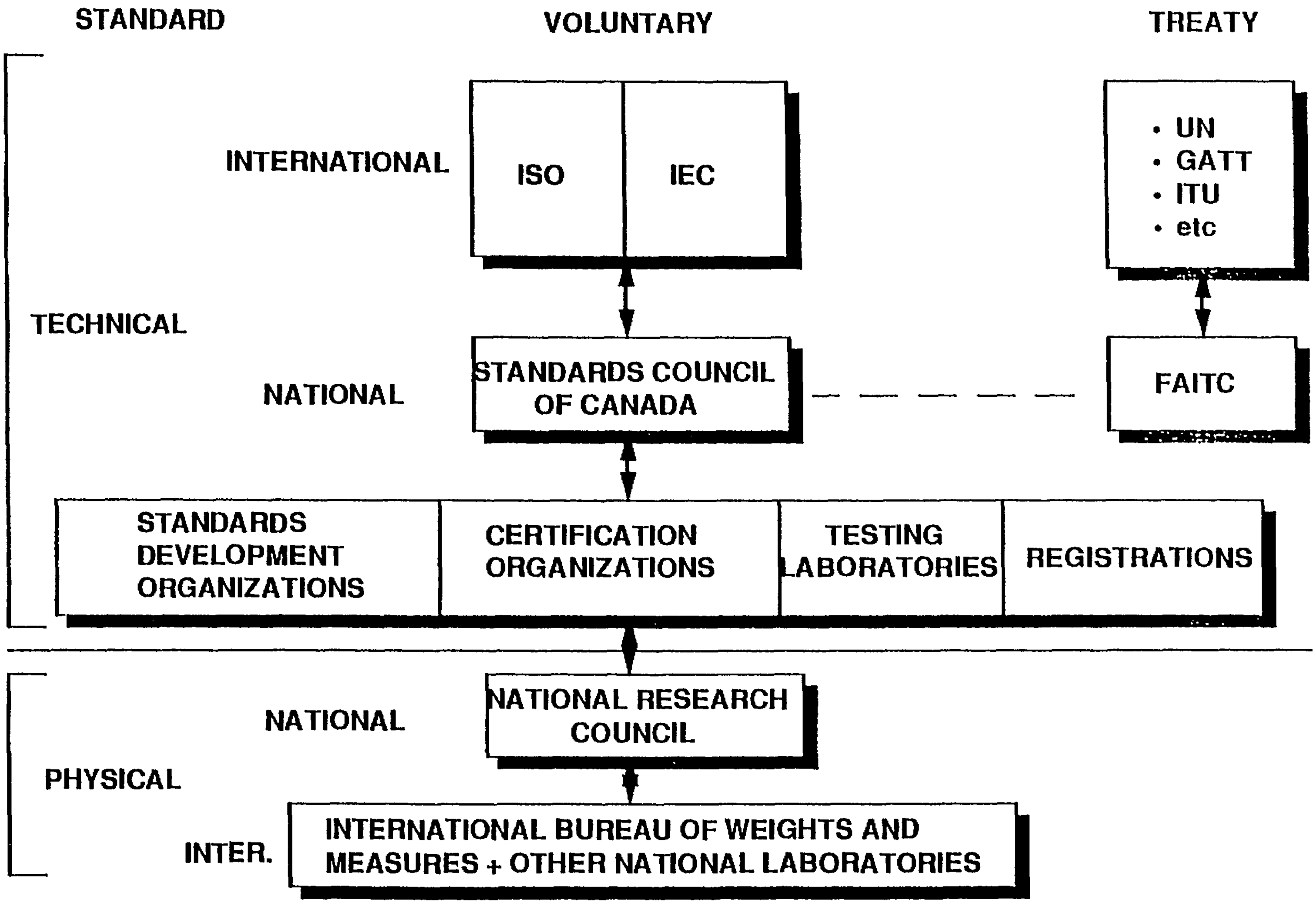
CANADA AND THE STANDARDS WORLD



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GLOBALIZATION AND RAPID TECHNOLOGICAL CHANGE ARE DRIVING STANDARDS DEVELOPMENT:

- **International communications require interoperability of systems which drives the establishment of international standards. These standards can stimulate technology diffusion.**

- **Transborder environmental issues trigger international agreements which set frameworks for technology development.**

- **World-wide industrial production force the development of standards to ensure the compatibility of components.**

- **Short product life cycles increasingly push consideration of standards to the R&D stage to ensure inter-comparability of research results and agreement on measurement techniques in anticipation of setting standards.**

IMPLICATION:

- **A growing requirement to harmonize national, regional and international standards to facilitate technology diffusion.**

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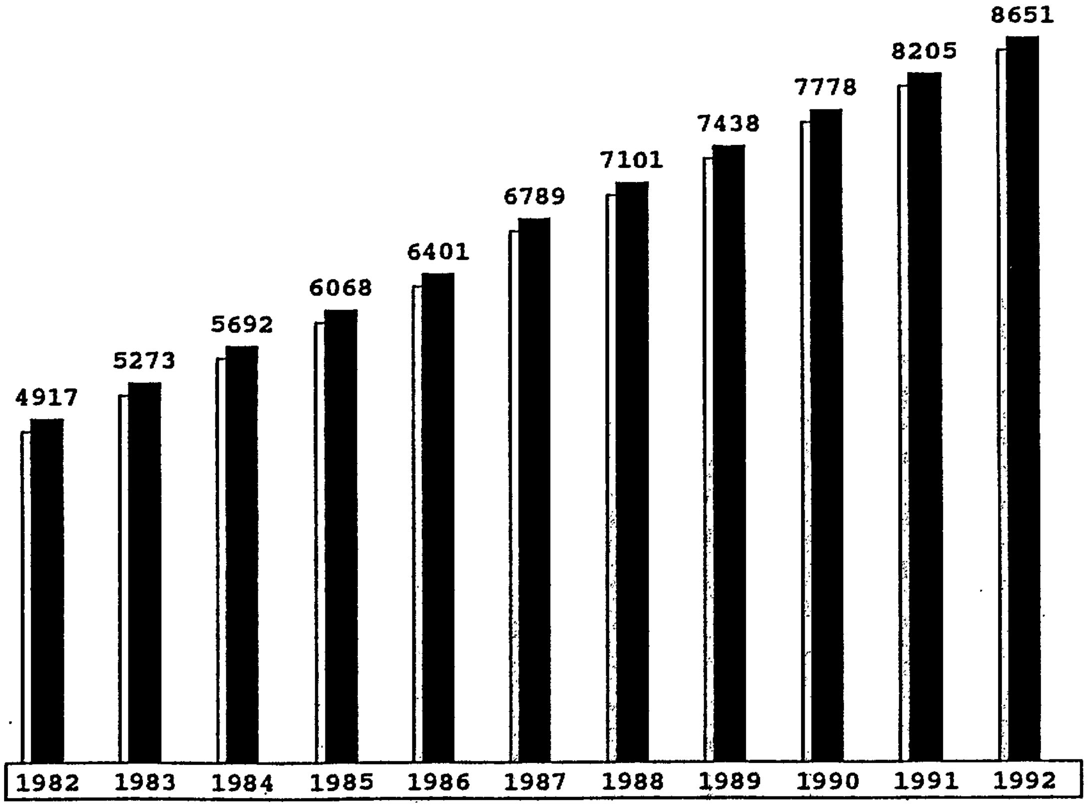
SHIFT TOWARDS INTERNATIONAL STANDARDS:

- International standardisation growing rapidly
  - Growth in ISO standards
  - 85% of European standards are identical to international standards

- Regional standards are displacing national standards
  - Harmonisation of national standards at the European level
  - Chapter 6 of the FTA provides for harmonisation of US and Canadian standards
  - Chapter 9 of NAFTA for U.S., Canadian, and Mexican standards

GROWTH OF INTERNATIONAL STANDARDS (ISO) :

- **From 1946 to 1982 : 4917 standards published (137/year)**
- **From 1982 to 1992 : 3734 standards published (373/year)**



No. of Standards (Cumulative)

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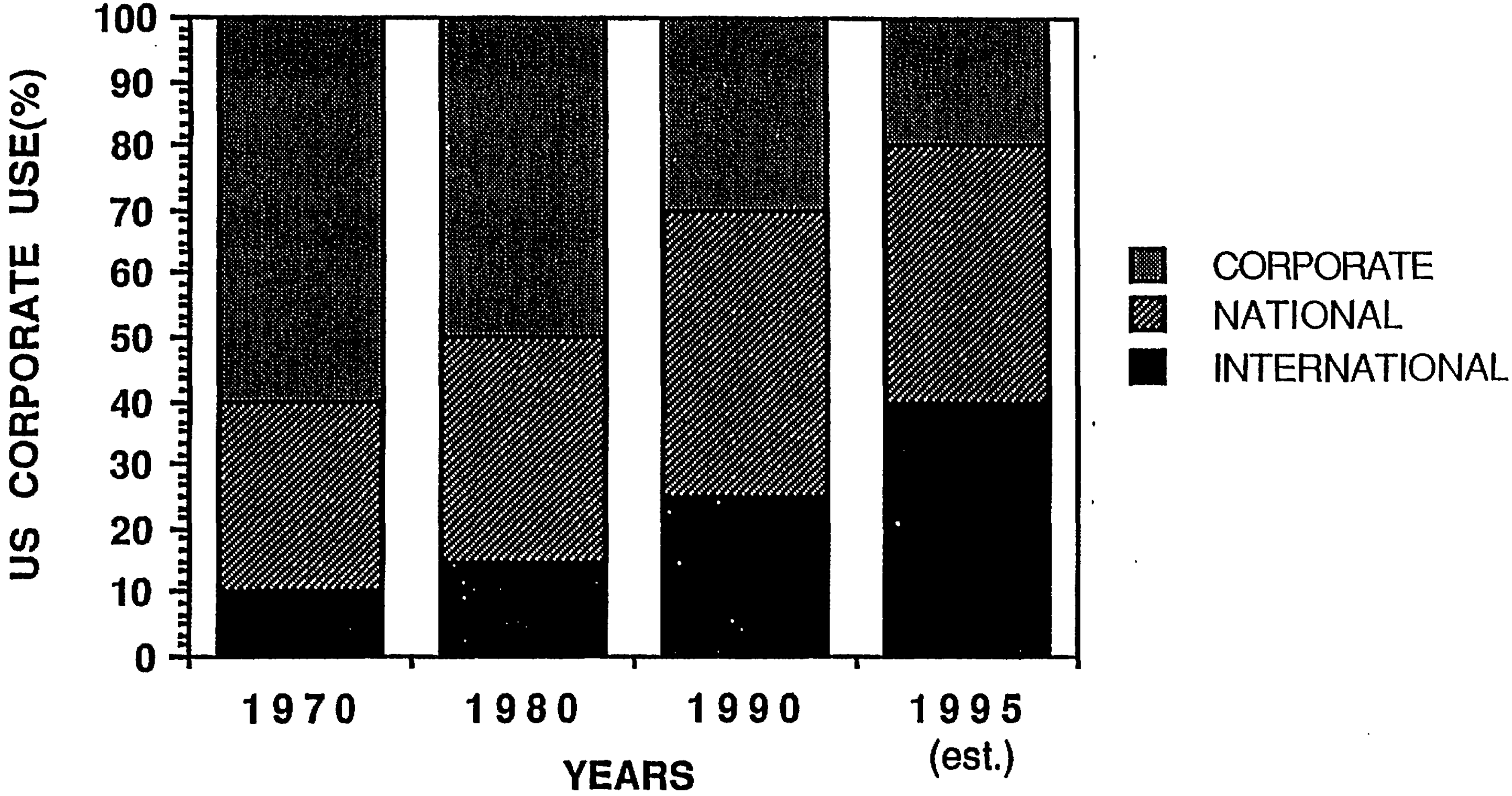
CHANGING PATTERN OF STANDARDS USE:



Source; Fortune, Nov. 1991

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EVOLUTION OF STANDARDS/REGULATORY SYSTEMS:

CLASSICAL SYSTEM	TRANSITIONAL SYSTEM	STRATEGIC SYSTEM
MAIN FOCUS ON HEALTH, SAFETY AND CONSUMER PROTECTION	INCREASING AWARENESS OF THE IMPACT OF S&R ON COMPETITIVENESS	RECOGNITION OF THE IMPORTANCE OF S&R IN THE INNOVATION PROCESS
COMMAND AND CONTROL APPROACH	DEREGULATION, INCENTIVES AND VOLUNTARY STANDARDS AS ALTERNATIVES	STRATEGIC POSITIONING OF S&R FOR MARKET AND TECHNOLOGY ADVANTAGE
NATIONAL GOVTS AND INDUSTRIES DOMINATE S&R PROCESSES	SHIFT TO INTERNATIONAL STANDARDS SETTING	CONTINUED SHIFT TO INTERNATIONAL STANDARDS SETTING

GLOBALIZATION OF THE WORLD ECONOMY

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CANADA, TECHNOLOGY DIFFUSION AND STANDARDS :

- Canada is a major exporter of primary and manufactured goods
- Canada is a major importer of technology, hence a major "taker" of standards
- The technology strategy of most firms is to adopt/adapt technology
- Some firms have technology innovation strategies

IMPLICATION :

- Need to participate in international standards setting activities to get intelligence and to influence

PARTICIPATION IS TECHNOLOGY DIFFUSION

THE NGL STUDY: OVERVIEW

Study Mandate:

"To investigate the role that standards and regulations play in the technological innovation process and how they impact the international competitiveness of Canadian firms".

Approach:

Prepare four reports identifying issues related to the effects of S&R on technology diffusion:

- **An Overview report of Canadian standards structures and processes**
- **Two Case Studies:**
  Telecommunications and
  Building Construction
- **A Review of the International Context for standards-setting and the impacts on technology diffusion**

Synthesize findings in a fifth report which makes recommendations for action

PROCESS :

STEERING COMMITTEE :

The study team reported to a Steering Committee of representatives from: ISC, CCA, DOC, NRC, SCC, EAITC and DSS.

PANEL OF EXPERTS :

The study team was assisted by a Panel made up of the following individuals:

▸ Graham Cameron	Metrology Expert (ex-DND)
▸ John Gilbert	Telecommunications Expert (ex-DOC)
▸ Roy Phillips	Immediate Past Chairman of ISO
▸ Philip Preston	Standards Consultant
▸ Grant Wilson	Construction Expert (ex-DPW)
▸ John Woods	Past Executive Director of SCC

MISSION STATEMENT :

The Panel suggested that a "mission statement" be formulated to guide the study. The Steering Committee concurred and the following statement was drafted:

"To carry out a study of standardization and regulatory processes which will make recommendations to give Canadian firms the capacity to promptly develop or acquire new and current technologies, to maximize their industrial competitiveness. This statement implies a need for Canada to maintain an efficient, productive and well-informed national technological and standards development infra-structure, as a base for effective participation in international and regional standardization."

ADJUNCT STUDIES :

- Federal Microcomputer Procurement and ISO 9000
- Procurement, Standards and Competitiveness: A Comparison of Selected Countries
- Versailles Project on Advanced Materials and Standards (VAMAS): A Case Study
- Technical Areas of Shared Interest Between the ISO and the Sector Branches of Industry Canada
- ISO 9000 Feasibility Study for Electronic Charting in the Canadian Hydrographic Service
- ISO 9000 and the Residential Construction Industry
- The Link Between the Canadian Technology Network (CTN) and a Firm Level Standards Impact Test (SIT)
- An Evaluation of the Market/Technology Intelligence Potential of JTC1

MAJOR ISSUES :

- Lack of awareness of the importance of standards setting activities in regards to technology and industrial development:
  - Canadian standards activities remain largely invisible

- Lack of a strategic approach to standards activities re competitiveness:
  - Canada continues to have an ad hoc approach while other countries (eg., Japan) and regions (eg., EC) have strategic stances linking standards with trade and industrial policy

- Budgetary constraints are adversely affecting the effectiveness of Canadian participation in international standardization activities

- Industry involvement, especially SMEs, in the standardization process is sketchy

- The role of government in policy and strategy development

RECOMMENDATIONS :

- STRATEGIC POSITIONING AND PRIORITIES :

  - **Creation of policy development committee in collaboration with the provinces, industry, SCC, universities -- to set priorities to enhance Canadian competitiveness through participation in domestic and international standardization activities**

  - **Creation of a policy implementation working group, supported by a dedicated secretariat -- to implement priorities established by policy development committee**

  - **Extend the R&D tax credit to include standards related expenses**

  - **Incorporate standards concerns in all publicly funded R&D activities**

  - **Push for the harmonization of federal and provincial standards**

  - **Ensure support for the metrology, testing, certification and accreditation infrastructure**

RECOMMENDATIONS :

- AWARENESS :

Develop a multifaceted awareness/education program. eg. :

- seminars/workshops in government (CCMD) and industry (associations)
- university courses on standards in engineering and MBA programs
- a chair on standards and technology
- include a standards component to IC's science promotion activities
- exchange of personnel between SCC and government departments

RECOMMENDATIONS :

- PARTICIPATION IN INTERNATIONAL STANDARDS DEVELOPMENT ACTIVITIES :
  - **Ensure that resources are available in priority areas**
  - **Establish a standards counsellor function in Geneva to cover** ISO/IEC, ITU, GATT

- INFORMATION AND INTELLIGENCE FOR INDUSTRY (SMEs) :
  - **Government should disseminate sector level standards information/intelligence**
  - **Firm level standards information/intelligence should be provided the private sector (eg., associations). Information, health care and environmental technologies should be targeted.**

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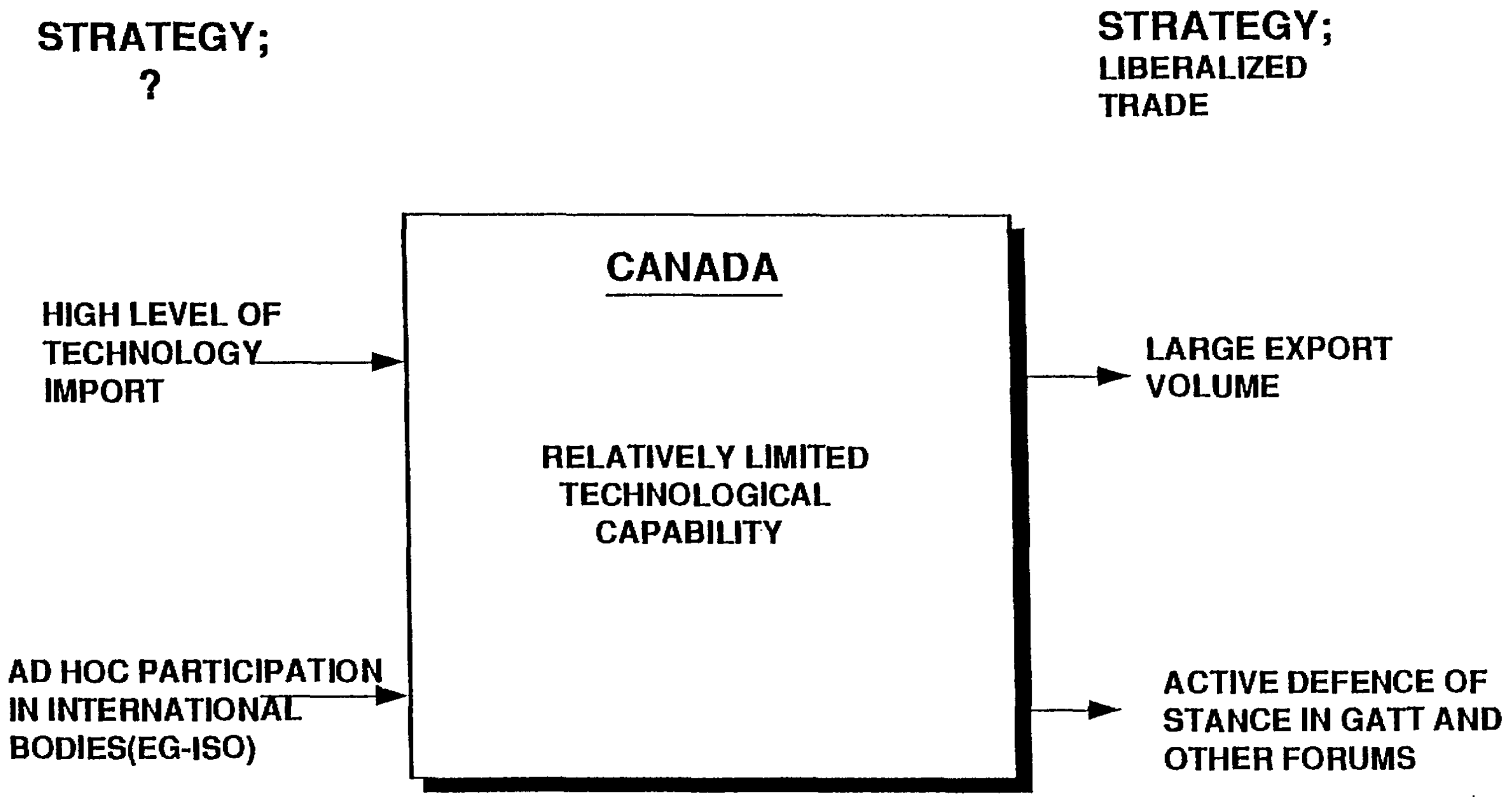
THE NEED FOR A STANDARDS STRATEGY:



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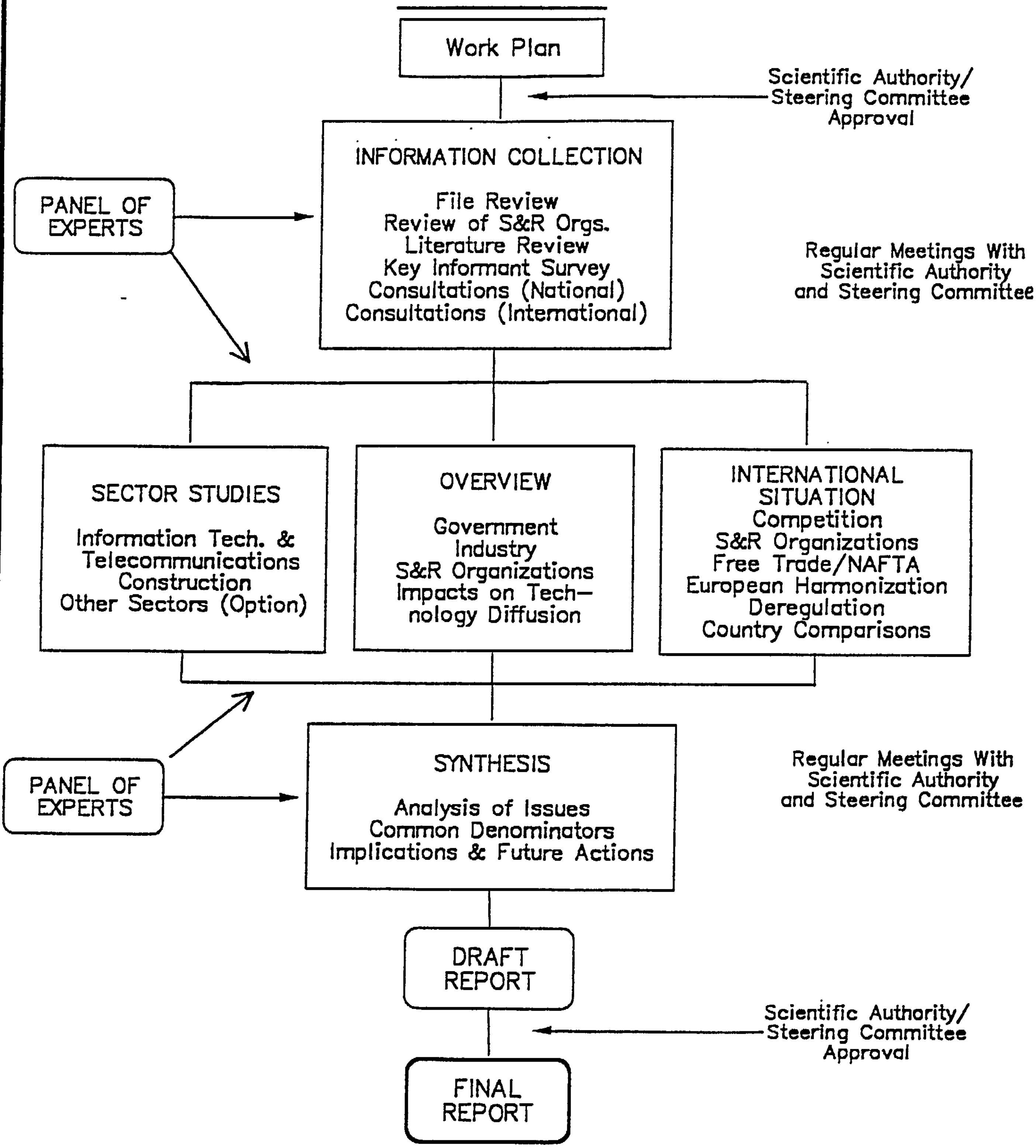
A MORE DETAILED LOOK:

Study Approach



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OVERALL STUDY METHODOLOGY (ELEMENTS) :

- Situation analysis
- Interdepartmental steering committee
- Panel of experts
- Interviews
- Literature
- Analysis (4 reports and synthesis)
- Comparisons with other countries
- Case studies
- Adjunct studies

CASE STUDIES -- RATIONALE FOR THE CHOICE OF INDUSTRY SECTORS:

CRITERIA	COMMUNICATIONS AND INFORMATION TECHNOLOGY	BUILDING CONSTRUCTION
1. Sufficient Scope	- a major advanced sector	- a pervasive traditional sector
2. Large Economic Impact	- dynamic sector with high multiplier effects	- a sector considered as a leading edge economic indicator (over $60 billion in annual business)
3. Important Cross-over Effects	- impacts on all other economic sectors	- has significant links to other sectors
4. Spread of Government Policy Process	- federal dominance	- fragmented responsibilities with major provincial and municipal influences
5. Advanced/Traditional Sectoral Contrast	- advanced technology driven sector	- traditional sector, but with high-tech systems
6. Industrial versus Social Concerns	- international competitiveness is a key issue	- socially relevant standardization significance (e.g., health, safety)
7. Jurisdictional Spread	- international/federal focus	- principally federal/provincial/municipal focus

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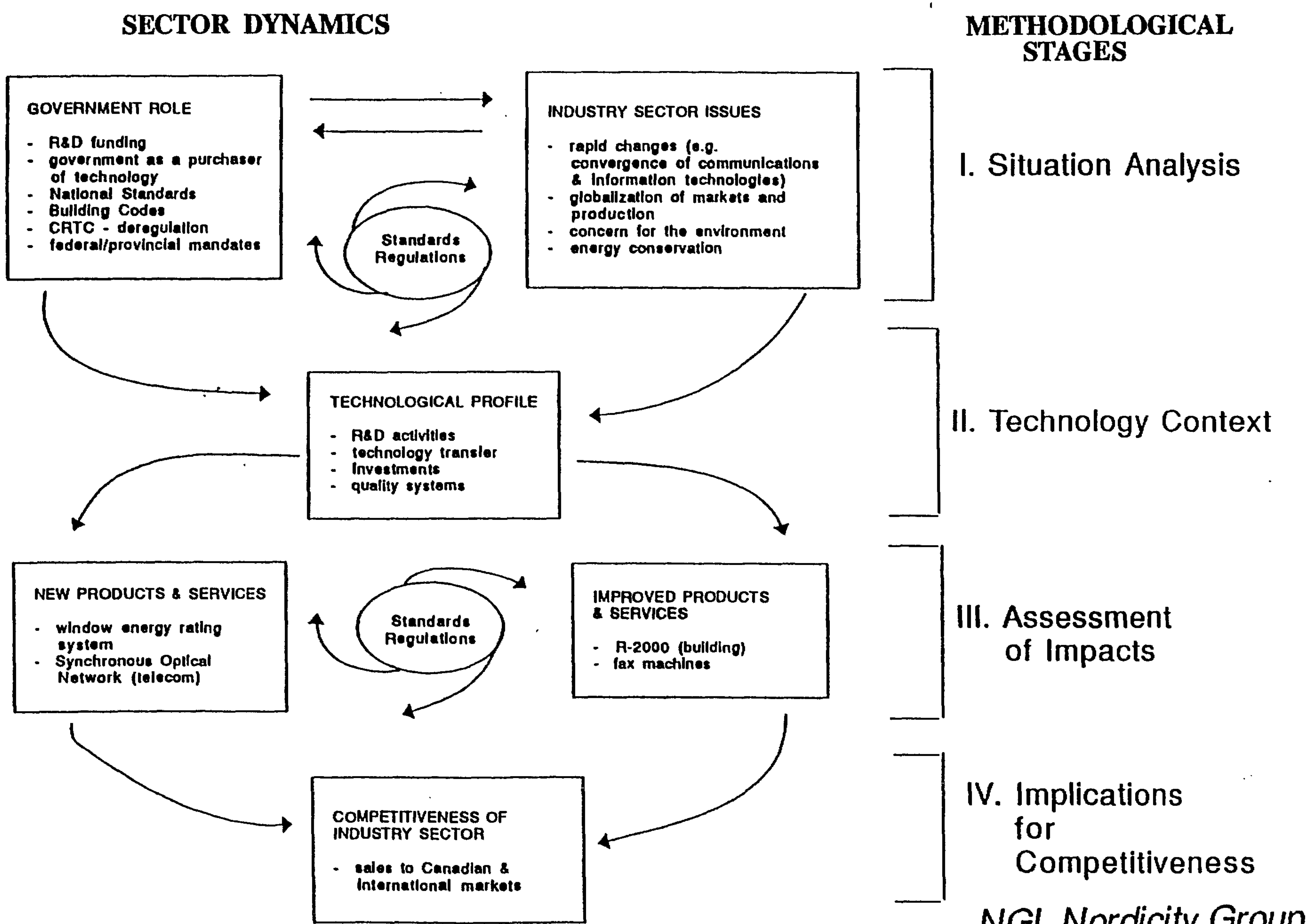
FINDINGS OF CASE STUDIES :

The two case studies confirm the general findings of the overall study :

- standards and regulations have a major impact on technology diffusion;
- there is a need to improve the dissemination of standards information;
- the federal government should promote awareness of standards and the standardization process, particularly as to how it impacts on competitiveness of Canadian industries;
- private and public sector participation in the standardization process should be increased, particularly at the international level.

METHODOLOGY FOR SECTOR ANALYSIS OF STANDARDS AND REGULATIONS:



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BUILDING CONSTRUCTION CASE STUDY:

- **Industry sector situation**
  - increasing competitive environment
  - diversity of interpretations of regulations and standards
  - growing base of innovative technology (products and materials)
  - concern for environment and for energy conservation
  - increasing interaction of international industrial base

- **Technology context**
  - leading-edge building technologies are accessible globally
  - competitiveness depends on capability to select, add value and accelerate diffusion of technology within national context
  - activities of government institutions have been a major factor for introduction of advanced technologies in the building industry.

- **Assessment of impacts/issues**
  - change is slow but is speeding up
  - multiplicity of public orgs. involved in S&R: hindrance to tech diff.
  - industry is active in S&R development, SMEs not able to participate
  - need to link R&D activities to standards development environment

- **Implications for competitiveness**
  - effective mechanisms for tech diffusions are increasingly important because of growing international competition (e.g., impacts of FTA, NAFTA)
  - compatibility of Canadian standards with other countries, especially U.S.A., is increasingly becoming an issue

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COMMUNICATIONS AND INFORMATION TECHNOLOGIES (C&IT) :

- **Industry sector situation**
  - Fast growing, hybrid industry
  - Strategically important industry
  - Worldwide trend towards more open, or liberalized regulatory environment
- **Technology context**
  - Telecommunications has become crucial part of the business infrastructure
  - Convergence of information and communications technologies
- **Assessment of impacts/issues**
  - Standards framework crucial to technological development
  - Standardization playing a major role in growth of industry
- **Implications for competitiveness**
  - Sector is a building block for the economy's competitiveness
  - Collaboration in the early establishment of standards, by C&IT manufacturers and service providers, is crucial to ensure inter-operability and competitiveness.

ISO 9000 FEASIBILITY STUDY FOR ELECTRONIC CHARTING IN CHS :

- **Recommendation:**

  Implement ISO 9001 for CHS electronic charting production, with a functional and institutional scope that covers electronic charting production processes across the board (i.e., covers HQ, Regional Offices, Nautical Data International and suppliers).

- **Implementation plan proposed involves:**

  - 412 to 442 person days of CHS staff time
  - Implementation period: 18 months
  - Costs: approximately $75,000 (not including staff time and travel costs).

- **Purpose: to provide quality assurance needed to achieve**

  - accuracy, consistency and timeliness in production of electronic charts
  - defence against litigation in cases associated with marine incidents
  - market advantages
  - after-sales servicing requirements

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PARTICIPANTS IN THE ELECTRONIC CHARTING PRODUCTION PROCESS:

SUPPLIERS (private firms)	REGIONAL OFFICES (across Canada)	HEADQUARTERS (Ottawa)	NAUTICAL DATA INTERNATIONAL (St. John's)
ELECTRONIC CHARTING PRODUCTION			
data digitizers software providers systems developers ECDIS manufacturer quality control data capture	data capture data conversion digital files software quality control support & advice	data capture content analysis file conversion software quality control support & advice	marketing distribution data capture quality control
--	--	--	--
PAPER CHARTING PRODUCTION			
--	--	--	--
OTHER FUNCTIONS AND ACTIVITIES			
--	--	--	--
Other activities	Other activities	Other activities	Other activities
--	--	--	--
--	--	--	--

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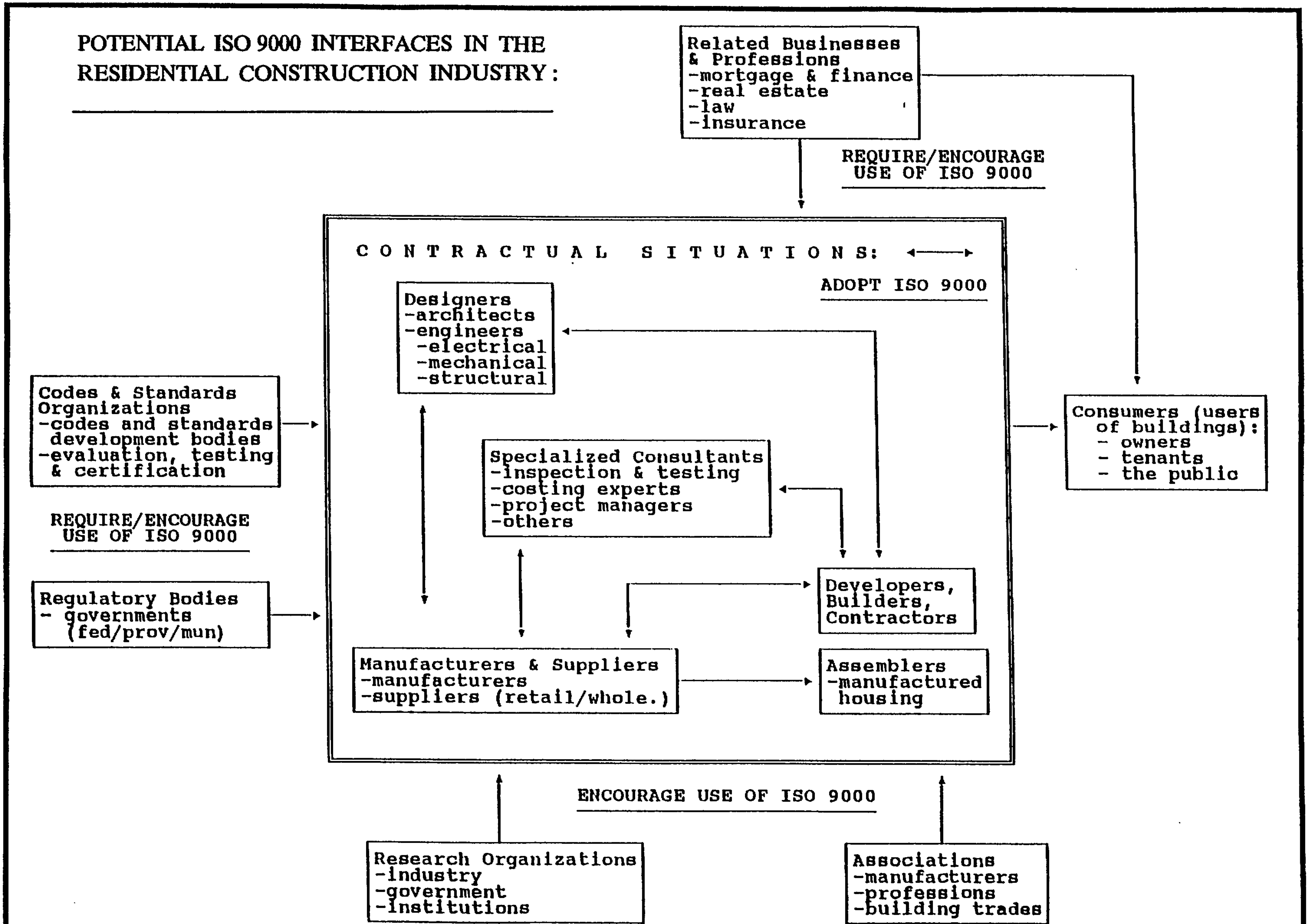
ISO 9000 AND THE RESIDENTIAL CONSTRUCTION INDUSTRY:

- Specific areas of application:
  - to reduce regulatory requirements
  - as a complementary factor in house warranty programs
  - as a means to reduce multiple inspection and testing prerequisites
  - as a procurement tool in CMHC (and others) contractual situations
  - as a quality assurance system for situations with high liabilities and risk
  - as a means of streamlining supplier-contractor relationships

- CMHC and ISO 9000:
  - promoting quality in the housing industry
  - warranty programs
  - reduced costs
  - reduction of regulatory requirements
  - training and information dissemination
  - procurement tool -- contractual requirements

- The opportunity is ripe, over the next 2-3 years, for a vanguard of companies in the residential construction industry (manufacturers/builders) to gain a competitive advantage.

POTENTIAL ISO 9000 INTERFACES IN THE RESIDENTIAL CONSTRUCTION INDUSTRY :



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OTHER ISO 9000 ADJUNCT STUDIES :

- **Use of ISO 9000 in government procurement: policies, support mechanisms and directions.**
  - **Demonstrates that ISO 9000 standards are being phased in by governments worldwide for procurement purposes**
  - **Shows that most of our industrial partners have a variety of support mechanisms to assist SME's to adopt ISO 9000.**

- **Federal microcomputer procurement study**

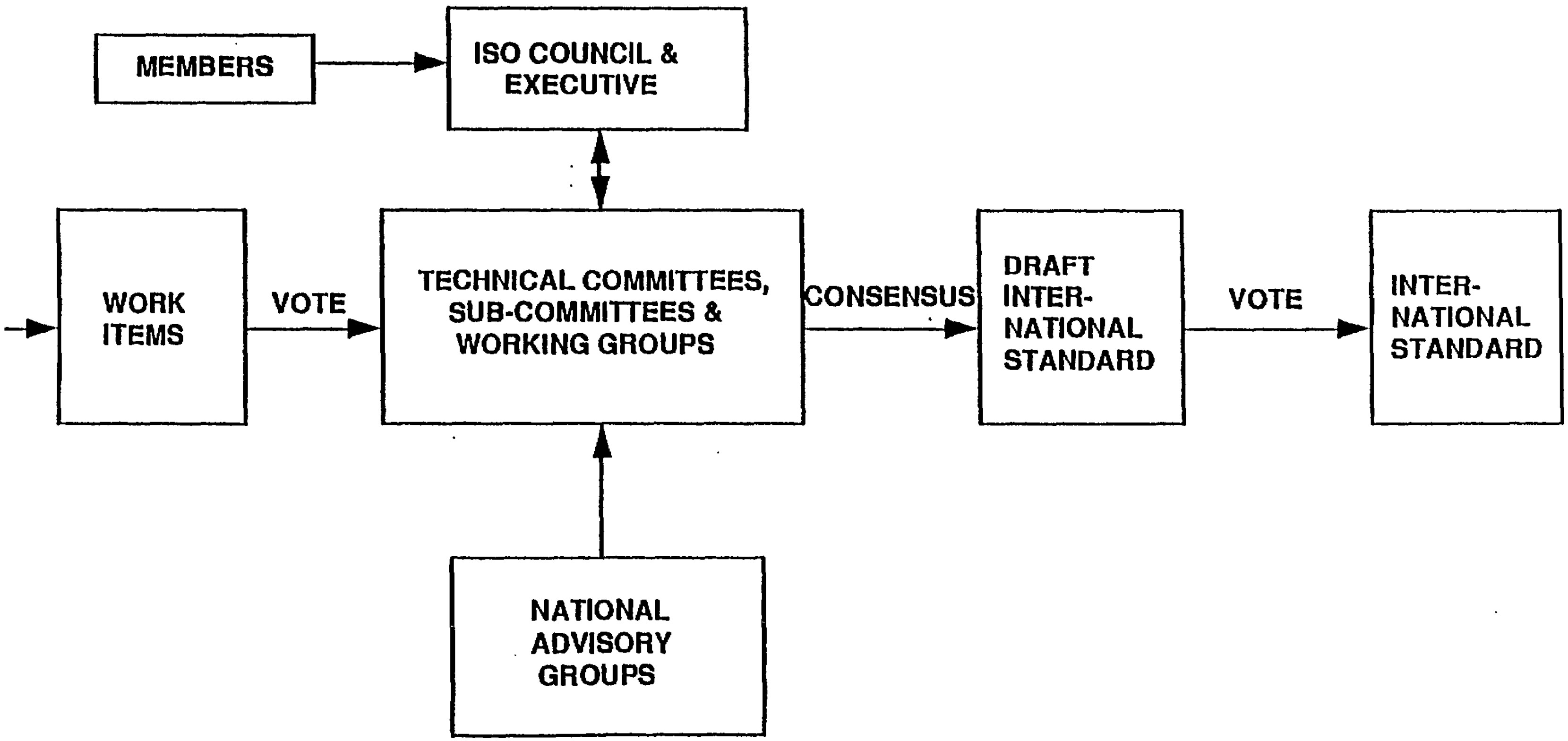
  ISO 9000 is a necessary but not sufficient condition for developing the technological capability/competitiveness of the Canadian micro computer industry.

  - **Reasons for adopting ISO 9000 as identified by 10 micro computer firms interviewed:**
    - **cost reductions**
    - **export market potential**
    - **customers insisting on it**
    - **psychological effects /image**
  - **Impacts of ISO 9000 on product innovation: some constraints on flexibility**

MARKET TECHNOLOGY INTELLIGENCE AND STANDARDISATION :

The consensual process of standards development provides a valuable source of market and technology intelligence.

THE INTERNATIONAL ORGANIZATION FOR STANDARDISATION(ISO) PROCESS



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ISO/IEC JOINT TECHNICAL COMMITTEE (JTC1) :

- **Mandate:** standardization in information technology
- **Structure:** 18 sub-committees and 78 working groups
- **Canadian Advisory Committee (CAC):** 437 Persons (68% industry)

Areas of Activity :

- VOCABULARY
- SOFTWARE ENGINEERING
- REP. OF DATA ELEMENTS
- LANGUAGES
- FLEXIBLE MAGNETIC MEDIA FOR DIGITAL DATA INTERCHANGE
- LABELLING AND FILE STRUCTURE
- IDENTIFICATION AND CREDIT CARDS
- OPTICAL DIGITAL DATA DISKS
- OFFICE EQUIPMENT
- CHARACTER SETS AND INFORMATION CODING
- COMPUTER GRAPHICS AND IMAGE PROCESSING
- INTERCONNECTION OF INFO TECHNOLOGY EQUIPMENT
- SECURITY TECHNOLOGIES
- EXCHANGE BET. SYSTEMS
- DOCUMENT PROCESSING
- INFO RETRIEVAL TRANSFER
- MICROPROCESSOR SYSTEMS

SC 29/WG 11: CODING OF MOVING PICTURES AND ASSOCIATED AUDIO

NWI FOR VERY-LOW BITRATE AUDIO-VISUAL CODING

A solution is needed to provide audio-visual quality that is better than what is available using existing standards. The project will provide the following benefits:

- enable new and improved audio-visual services;
  Potential applications include videophones, multimedia electronic mail, remote sensing, electronic newspapers, interactive multimedia databases, multimedia videotex, games, interactive computer imagery, multimedia annotation, and sign language captioning;
- more efficient use of bandwidth by utilizing narrow-bandwidth transmission channels on PSTN, LAN, and mobile networks;
- more efficient use of storage media, especially in storage-limited systems, such as Smart cards and memory cards;
- generic coding will provide commonality of electronics between applications, facilitating lower costs;
- generic coding will enable easy interchange of audio-visual information between application domains;
- robustness of digital media, e.g. relative permanence of digital storage media;

RECOMMENDATIONS OF THE US TRADE PROMOTION COORDINATING COMMITTEE (SEPT 93)

- Improve the timeliness and completeness of the information that the federal government makes available on the formation of working groups and drafting of standards in international and regional standards-setting bodies.

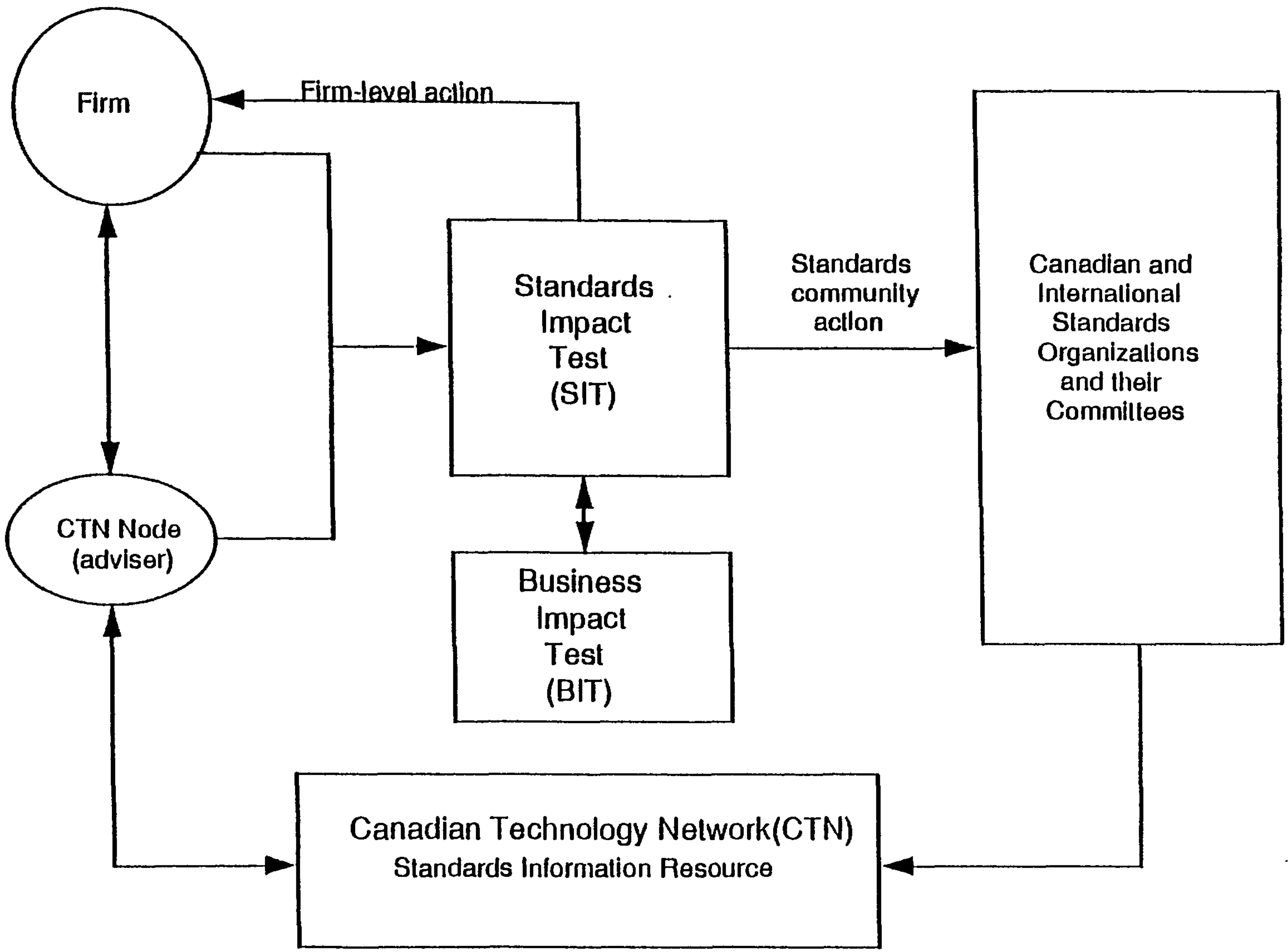
- Seek funds (estimated at about $1 million annually) for NIST to implement a modern and more comprehensive standards information system.

- Improve dissemination of information to US firms and standards developers and assistance to such firms in advocating the adoption of US standards in international standards bodies.

THE COMPLEMENTARITY OF BIT AND SIT:

- **BIT has been designed to identify the direct costs/benefits to a firm of regulations. As such it is an efficiency tool.**
- **BIT can also be used to identify the direct costs/benefits to a firm of standards (with minor modifications).**
- **SIT (Standards Impact Test) would indicate how a firm's market/technology position is affected by a standard. As such it would be a complementary tool to BIT. It would be an awareness and advocacy tool.**

LINKING THE SIT TO THE CTN :



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SOME DIRECTIONS -- STANDARDS AS A GOVERNMENT INSTRUMENT:

- Working towards an overall strategic approach to standards
- Focussing on the interface of regulatory process with voluntary standards system
- Ensuring the health of the voluntary standardization system
- Building on the transferability of methodology/approach to other sectors
    - for standards studies
    - for other "horizontal" studies

EXAMPLES OF OTHER AREAS FOR "HORIZONTAL" REVIEWS :

- environmental management
- international S&T programs
- international trade support programs
- support for NGOs
- international agreements
- federal-provincial agreements
- regional operations of federal activities
- quality management systems for government

3

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Le Groupe Nordicité ltée

THE EFFECTS OF STANDARDS ON TECHNOLOGY DIFFUSION

SYNTHESIS REPORT

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EXHIBITS

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EXECUTIVE SUMMARY

This report provides a synthesis of the findings of the study and presents recommendations that address the major issues identified.

The mission statement which guided the study was the following:

> *"To carry out a study of standardization and regulatory processes which will make recommendations to give Canadian firms the capacity to promptly develop or acquire new and current technologies, to maximize their industrial competitiveness. This statement implies a need for Canada to maintain an efficient, productive and well-informed national technological and standards development infrastructure, as a base for effective participation in international and regional standardization."*

Product, process and performance standards originate from three sources; the marketplace which establishes de facto standards through market forces; standards development organizations (SDOs) which develop standards based on consensus; and governments which set regulatory standards. The globalization of the world economy and the associated international technology flows are increasingly shifting the focus for standards setting from the national to the regional and international levels.

The Europeans are leading in developing European Community wide regional standards. The Canada-U.S. Free Trade Agreement (FTA) and the North American Free Trade Agreement (NAFTA) are driving the harmonization of standards in North America. In the Far East there are nascent attempts at forming regional standards groups such as within the Association of South East Asian Nations (ASEAN).

In parallel, there has been increasing acceptance of international standards. It has been estimated, for example, that some 85% of CEN and CENELEC (two major European standardization organizations) standards are now identical to international standards. As well, the number of international standards set by the International Organization for Standardization (ISO), the principal world standardization organization, nearly doubled between 1982 and 1992.

The growth in international sourcing of technology and components, the need to ensure the inter-operability of communications systems world-wide, not to mention the increasing number of global environmental problems are some of the major driving forces leading to the growing need for international standards. To anticipate areas requiring standardization attention, the ISO, along with a sister agency, the International Electrotechnical Commission (IEC), have reviewed 149 technological areas to establish priorities for the 1990s. It is not surprising that several environmental, health and information technology areas were identified as needing urgent standardization attention. Moreover, with rapid technological change, the ISO/IEC have recognized that standardization concerns are increasingly being incorporated into research and *development (R&D) programs so that acceptable terminology and measurement techniques can be developed to set the stage for standards-setting downstream.*

This dynamic was well illustrated in the two case studies undertaken. In the communications and information technology sector, standards-setting is now leading technology introduction and diffusion, rather than following it, as it was a decade ago. Even in the more traditional, slower moving, building construction industry, the focus of the second case study, there is a growing realization that technology and globalization are becoming more and more tightly linked to standards-setting. A methodology was developed, based on these two cases, to facilitate the investigation of the impact of standards on other sectors.

Through these cases and other work, a number of key issues were identified. Many of these issues related to Canada's involvement in the international standards setting process, because in a small open economy, which imports a large amount of technology and exports large volumes of primary and manufactured goods, Canadian firms need to have intelligence about, and be able to influence, emerging standards to create a business environment that leads to improved competitiveness. The issues identified are related to the lack of a strategic approach to standards, the lack of awareness of the strategic importance of standards, the impact of budgetary constraints on international standards activities and the limited involvement of small and medium-sized enterprises (SMEs) in the standardization process.

To address these issues it is recommended that:

- *A Policy Development Committee, in collaboration with the Standards Council of Canada, provincial governments, industry and universities, undertake an issue identification and strategic positioning exercise to develop an agenda of priorities to enhance industrial technological competitiveness through domestic and international standards development activities.*

- *A Policy Implementation Working Group be established to develop implementation plans for priorities and issues as identified by the Policy Development Committee, and to promote and co-ordinate standards policy development initiatives in consultation with other organizations.*

- *A full time dedicated Secretariat, comprised of secondments from participating government departments, be established to assist the Policy Development Committee and Policy Implementation Working Group to carry out their respective responsibilities.*

- *A comprehensive awareness/education program be developed and implemented to enhance the awareness of the importance of standards and their relationship to technology development and diffusion.*

- *Much greater emphasis be placed on encouraging and supporting proactive participation in the international standard-setting activities, including the dissemination of information acquired through participation in these activities.*

- *Mechanisms to acquire, evaluate and disseminate sectoral and firm level standards intelligence be identified and established in collaboration with various government departments and agencies.*

The Panel of Experts set in place for this study concurs with the above recommendations.

The 14,000 Canadians involved in national and international standards-setting activities are a major resource to be used to support the implementation of these recommendations.

At a time when most industrialized countries are increasing their commitment to the international standardization process, Canada appears to be lagging. By acting on these recommendations the federal government would bring a strategic perspective to bear on the relationship between technology development/diffusion and standardization, which in turn would improve Canada's competitiveness.

1.0 INTRODUCTION

1.1 Study Mandate

A consortium of federal government departments and agencies commissioned this study in order to investigate the role that standards and regulations play in the technological innovation process and how they impact the international competitiveness of Canadian firms.

1.2 Context

The world economy is increasingly being driven by rapid technological change and globalization of industrial markets and production. In this context, there is a greater need for understanding the effects of standards on technology diffusion and vice versa.

Setting and following standards are important keys to industrial success. If Canadian firms are to be competitive internationally, it is essential for Canada to participate actively in the development of, and to effectively adapt to, changes in international and regional (e.g., North American, European) standards. The ability to influence and participate in standards development activities will, to a significant extent, determine how and whether Canadian companies can compete abroad and, in many situations, at home as well. Active participation in standardization activities is, in itself, a form of technology diffusion.

In addition to concerns about the impacts of standardization on technology diffusion, government regulations are increasingly undergoing scrutiny, to determine how best to address concerns regarding overburdening effects of inappropriate and non-essential regulations.

1.3 Approach

Methodology

This study includes five components, as proposed,[1] which deal with issues related to the effects of standards and regulation on technology diffusion:

[1] During the course of this study other adjunct studies were undertaken on specific issues. They were; (i) a study of the leverage of government procurement on the adoption of quality standards (ISO 9000); (ii) a case study of the Versailles Project on Advanced Materials and Standards (VAMAS); (iii) a study of the complementarity between the activities of the International Organization for Standardization and those of the Sector Branches of Industry and Science Canada; (iv) a study of the market/technology intelligence potential of the ISO/IEC Joint Technical Committee #1 on information technology; (v) an assessment of the application of ISO 9000 standards to the Canadian Hydrographic Services.

- an overview of Canadian and international standards structures and processes;
- an industry case study of the communications and information technology sector;
- an industry case study of the building construction sector;
- a review of the international context for standards development and the impacts on technology diffusion; and finally
- a synthesis report on findings and recommendations for action (this report provides the synthesis).

Process

The study process entailed a series of interviews with key public and private sector experts and stakeholders in the standards development environment. A literature review of Canadian and international documents and reports on the roles of standards and regulation, trends in technology development and diffusion, and government industrial strategies and competitiveness was undertaken.

In addition, a Panel of Experts was convened to advise the study team on issues and directions for the study, and to review the draft reports. The panel of experts met four times with the study team during the course of the project. As well, advice was sought on an individual basis. The individuals who participated in the Panel were the following: Graham Cameron (metrology expert -- ex-DND official); John Gilbert (telecommunications expert -- ex-DOC official); Roy Phillips (immediate past Chairman of ISO); Philip Preston (standards consultant); Grant Wilson (building construction expert -- ex-DPW official); John Woods (past Executive Director of SCC).

Finally, an inter-departmental Steering Committee, led by Industry, Science and Technology Canada (ISTC), oversaw the entire study, meeting with the study team periodically to review progress, to discuss issues, and to evaluate the draft reports. The Steering Committee included representatives from ISTC, Consumer and Corporate Affairs, Department of Communications, External Affairs and International Trade Canada, National Research Council, Standards Council of Canada, and Department of Supply and Services.

1.4 Mission

To give a more precise orientation to the study mandate, the Panel of Experts suggested that it would be useful at the outset to formulate a "mission statement" as a guide for the study. The Steering Committee agreed to this idea and the following statement was endorsed:

> *"To carry out a study of standardization and regulatory processes which will make recommendations to give Canadian firms the capacity to promptly develop or acquire new and current technologies, to maximize their industrial competitiveness. This statement implies a need for Canada to maintain an efficient, productive and well-informed national technological and standards development infrastructure, as a base for effective participation in international and regional standardization."*

2.0 TECHNOLOGY DIFFUSION AND STANDARDS

2.1 Definition of Standards

What is meant by "standard"? The French language makes an important distinction between two groups of standards, a distinction lost in English. The first group is called *étalon* and refers to a standard as a unit or physical constant such as a metre, mile, kilogram or gallon. The second group is called *norme* and refers to a technical specifications document. The first group is the oldest and serves as the building blocks of the second. The second group - standards as written specifications - is a relatively recent development. The second group is the principal focus of this study.

According to the terminology accepted by the International Organization for Standardization (ISO) and by the Standards Council of Canada (SCC), a technical standard is a: "Document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context".[2]

Some standards are designed to act as preventive measures against injury or death, such as those for medical gas, playground equipment and hockey helmets; some are concerned with the physical or performance characteristics of products like plywood, paints and lifting machinery.

Standards can be written (normative) or they can be standards of physical measurement. This study is concerned mainly with written standards as defined by ISO (above). The National Research Council (NRC) provides nationally and internationally recognized measurement and calibration capabilities necessary to support the development of normative standards and the testing, certification and validation of products and services to those standards. Base units such as the kilogram, metre or second represent the physical standards of mass, length and time, respectively. They are calibrated and certified by the Institute for National Measurement Standards (INMS) of NRC.

Normative standards can be typified on the basis of their purpose, by the development process through which they are achieved, and by the way they are applied. All three of these dimensions interplay in the definition of standards. The matrix shown in Exhibit 2-1 provides a summary of how the standards universe may be conceptualized along the lines of purpose, development process and application. This matrix also provides some examples

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[2] See ISO-IEC *Guide 2: General terms and their definitions concerning standardization and related activities*, ISO-IEC, Sixth edition, 1991.

of standards within each category. The particular process by which a standard is established and evolves is often the result of historical circumstances and/or political and cultural choices.

Purpose: Standards can be classified on the basis of what they define and for what purpose. In the matrix shown in Exhibit 2-1, three generic types of standards are shown. The first is the *product design standard* which specifies the characteristics of a product or a group of products in order to ensure their fitness for purpose (e.g., baby walkers, traffic lights).

The second generic type of standard shown in Exhibit 2-1 is the *performance standard* which is a product standard specifying requirements for one or more performance characteristics. They deal with operating or testing and evaluating characteristics of a product.

Exhibit 2-1
Matrix of the Standards Universe

PROCESS: DEVELOPMENT OF THE STANDARD--BY WHOM AND HOW	APPLICATION*	PURPOSE/TYPE OF STANDARD: PRODUCT DESIGN STANDARD	PERFORMANCE STANDARD	PROCESS STANDARD
INDUSTRY/ MARKETPLACE (DE FACTO)	M	traffic lights	professional qualifications (doctors, etc.)	driving on the right
	V	VCRs	software/computer compatibility	ABM shared networks (telecom)
STANDARDS-WRITING ORGANIZATIONS (CONSENSUS)	M	electrical sockets	hockey helmets	test methods for flammability of textiles
	V	paper sizes	garment sizing	ISO 9000 series
GOVERNMENTS (REGULATIONS)	M	lawn darts	children's nightwear flammability	fish packing
	V	baby walkers	R2000 housing	advertisement approvals

Note: * Application: M = Mandatory V = Voluntary

A performance standard stipulates that the characteristics with which a product must comply are based on tests that simulate as nearly as possible the performance that a product is required to give under actual service conditions. An example of a performance standard would be a certain mechanical strength specifying a minimum value of load on a physical structure which must be resisted. Another example is R2000 housing specifying minimum energy conservation requirements.

Thirdly, a *process standard* defines socioeconomic roles and relationships and establishes rules for interpreting behaviour. It facilitates interactions between people. Examples of this type of standard include driving on public streets on the right side of the road, or management practices as defined by the ISO 9000 series. This type of standard is a functional, "how to" standard.

Development: Standards may also be classified on the basis of how or by which organizations they are developed. For example, a standard can be developed through a "de facto" process. This means the standard was developed by industry within the context of market forces. They evolve from the marketplace and are subject to supply and demand mechanisms of competition.

A standard could also be developed through an accredited standards development organization (SDO).[3] SDOs are accredited by the Standards Council of Canada. SDO standards are prepared on a consensus basis and are in the form of published documents which contain requirements, procedures or definitions which apply to specific products or activities. "Consensus" means that the standard was obtained by agreement of those concerned, at the best and highest level of thought. Consensus standards are negotiated by a representative group of stakeholders (in North American standardization, "consensus" means substantial but not necessarily unanimous agreement).

In addition, all three levels of government in Canada write and/or use standards for regulation. Regulatory standards arise from political choices and are man-dated by government authorities. These types of standards are usually driven by public concerns (for example, to deal with environmental, safety or other social issues). They are also introduced to regulate market structures which may be uncompetitive or economically inefficient.

All federal government departments and regulatory agencies are responsible for administering regulations. The Treasury Board Secretariat is responsible for ensuring that departments and agencies follow the government's regulatory policy. It is commonplace for Parliament to delegate to Cabinet its power to make certain laws within the framework of the Statutes of Canada. These laws are often referred to as delegated legislation or

[3] "Standards Development Organizations" until recently were referred to as "Standards-Writing Organizations". The Standards Council of Canada has changed the reference to more accurately reflect all of what these organizations do.

regulations. Like legislation, regulations confer legally enforceable rights and impose legally enforceable obligations on Canadians.

Application: The application of any standard may be either voluntary or mandatory. The manner in which a standard is applied is not bound in any particular way to its source or to the method by which it is developed. Some standards established by a government body may be put in place as voluntary guidelines and those developed by an individual company can sometimes achieve widespread voluntary acceptance. On the other hand, many consensus standards are mandatory standards. Even though sometimes confusingly called "voluntary consensus standards", their application (and, in many cases, their certification procedure) is often compulsory with legally prescribed penalties for failure to comply.

A "voluntary" standard is one which is based on a consensus of experts. Sometimes these are referred to as "voluntary consensus" standards. The word "voluntary" applies to both the preparation of the standard and its use. In the preparation it means that "those concerned, freely and without coercion, gave of their time, money, and effort to achieve a given objective". In use, it means that the standard is either applied or not applied at the discretion of those individuals or organizations involved.

2.2 The National Standards System

The National Standards System of Canada is a federation of accredited standards development, certification, testing and quality systems registration organizations. The Standards Council of Canada (SCC) is responsible for the overall coordination of this federation. Through the System, the Standards Council works to ensure that Canadian needs for standards and related services are met.

The SCC is a Crown corporation created by an act of Parliament of Canada in 1970. The SCC now reports[4] to Parliament through the Minister of Industry and Science Canada. Previously, the SCC reported through the Minister of Consumer and Corporate Affairs Canada (CCAC). The SCC consists of 57 members, 41 from the private sector, 6 from the federal government and 10 from provincial governments. The objectives of the SCC, as set out in the *Standards Council of Canada Act*, are: to foster and promote voluntary standardization in Canada; to assist and protect consumers; to facilitate domestic and international trade; and to further international cooperation in the field of standards. During the 1992-1993 period, 109 standards were approved as National Standards of Canada (NSCs), bringing the total number of NSCs to 1,844. Several additional standards have since been approved. Some 14,000 people across Canada are involved on a voluntary basis in the development of standards through participation in various committees.

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[4] As of June 1993.

Although the level of funding has been reduced dramatically in the past few years, the Council continues to be 66 percent funded by government. Other income comes from the sale of foreign and international standards and accreditation fees from certification, testing and registration organizations. The organizations accredited to the National Standards System, as of 1992, had together published over 7,600 Canadian standards.

There are seven main elements of the National Standards System which define its activities. These are: (1) approval of the National Standards of Canada; (2) standards development; (3) certification; (4) product testing; (5) quality system registration; (6) participation in international standardization; and (7) accreditation.

A **National Standard of Canada (NSC)** is a standard submitted by an accredited Canadian standards development organization for NSC approval by the Standards Council, which must satisfy itself that specified criteria have been met (for example, that the standard is not written to act as a restraint on trade, that there is only one National Standard of Canada for a specific subject, and that the standard is written in accordance with good standards writing practice).

There are five accredited standards development organizations under the National Standards System. These SDOs are: Canadian General Standards Board (CGSB), Canadian Standards Association (CSA), Underwriters' Laboratories of Canada (ULC), Bureau de normalisation du Québec, and the Canadian Gas Association (CGA). These organizations coordinate the work of standards committees whose members represent a balanced cross-section of interests -- including producers and users. Standards prepared by these committees can be submitted for SCC approval as National Standards of Canada.

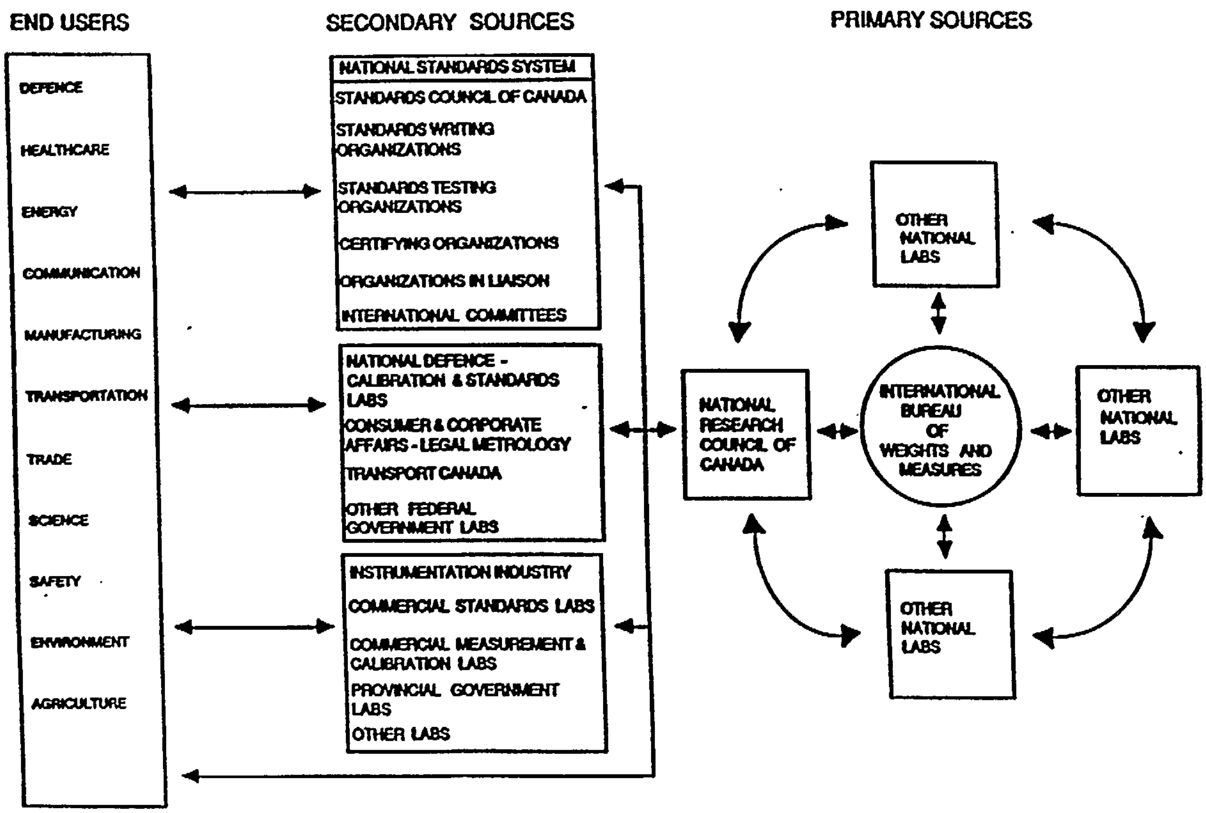
2.3 National Measurement System

One of the major components of Canada's standards activities involves metrology. Metrology is the science of measurement. It is the means by which base and derived units are given a basis of operation in the fields of science. Base units such as the kilogram, metre, or second, in addition to their derived and supplementary units, are component parts of the International System of Units, adopted by the Conférence des Poids et Mesures (CGPM). These units represent the physical standards of mass, length, and time. They are calibrated and certified by the Institute for National Measurement Standards (INMS) of the National Research Council (NRC).

The INMS of NRC serves as Canada's national measurement laboratory and as such is the focal point for Canada's activities in developing, maintaining, and improving physical standards of measurement so that they remain internationally compatible. In the terminology of metrology, the INMS provides "traceability" for Canada's national measurement system. Traceability can be defined as a documented chain of measurements connecting the accuracy of a means of measurement to one of a higher accuracy which in turn is ultimately connected to a primary measurement standard.

As noted earlier, physical standards function as the foundation upon which normative standards are built and maintained (Exhibit 2-2). NRC provides nationally and internationally recognized measurement and calibration capabilities necessary to support the development of normative standards and the testing and certification of products and services to those standards. NRC provides the interface between Canada's national measurement system and those of other countries as well as with the International Bureau of Weights and Measures.

Exhibit 2-2
The Canadian and International Physical Standards and Measurement System



2.4 Definition of Technology Diffusion

"Technology diffusion" can be defined as "the spread of a technology already put to use by at least one firm or public institution, either in Canada or elsewhere in the world."[5] This definition serves to distinguish technology diffusion from technology transfer, which is seen as the transfer from the idea stage to initial use, either for commercial or public purposes.

In Canada, technology diffusion occurs within a broad context of government-industry interrelationships involving consultation and collaboration, and public financing and investment in R&D activities. The factors contributing to the success or failure of technology diffusion are varied, including legal and cultural practices, economic forces, competitive resource allocation and development of know-how. The ultimate purpose of technology diffusion, to a large measure, is increased economic benefits through sales of products and services to domestic and international markets.

Since Canada, with a relatively small population base, can only develop a small proportion of the world's technological innovations, the acquisition of foreign technologies and their diffusion throughout Canadian industry is critical to maintaining the competitiveness of the country. There are a number of routes to technology acquisition, including participating in standards development activities, adoption of international and regional standards, licensing, parent-subsidiary transfers, direct investment by foreign firms, the import of capital goods, and the exchange of technologies through joint technology development ventures.

During the past two decades, there has developed a much better understanding of the technological development process. This process, once viewed as a linear sequence of events, from scientific discovery to applied research and development, then production and marketing, is now seen as a series of concurrent interactive processes with increasing dependence on basic science and scientific engineering at every step.

2.5 Interface of Standards With Technology Diffusion

One of the general purposes of standardization and related activities is to *facilitate* technology diffusion and hence the exchange of goods and services, at the national, regional and international levels, and to promote cooperation in the sphere of intellectual, scientific, technological, and economic activities,[6] and <u>not</u>, at least in theory, to act as an obstruction for any purpose (e.g., as a protectionist trade barrier). In practice, however, standards do often act as impediments, either through overburdensome bureaucratic processes or due to necessary requirements for technical details and rigour.

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[5] *Technology Diffusion in Canada: Myths and Realities*, A. Millington and Y. Van Ruskenveld, MOSST, Sept. 1986.

[6] Albert L. Batik, *A Guide to Standards*, Serendal Research Institute, Inc., Parker Colorado, 1989, p. 33.

As the given body of scientific knowledge grows, the process of discovery and technological change progresses more rapidly. This has had a profound impact on industries in several ways:

- *dramatic progress in material and process characterization;*
- *increasing power of analytical instrumentation, and its transformation into tools for process control in production;*
- *global computer communication allowing codified engineering practice for design, production and control to be accurately disciplined, and at the same time geographically dispersed;*
- *intelligent production tools permitting greatly enhanced product diversity (personalization) without loss of scale economies;*
- *wide-scale use of information systems controlling distribution and providing end-user support to integrate products with the services required for their beneficial use.*[7]

Together these factors are changing the pace of technology diffusion and the role of standardization. Emerging global industrial sectors characterized by more rapid technological development and diffusion have created an intensified need for global standardization so that technologies and components can be more easily integrated.

Standards impact on all the different stages of the technology development process shown in Exhibit 2-3 -- i.e., research, production, distribution, and use. All players in this process are involved in or are affected by standardization. Therefore, for the purpose of this study, technology diffusion has been defined broadly, because the techno-economic contexts in which it takes place, including the preconditions related to technology development, influence and are also influenced by the setting of standards.

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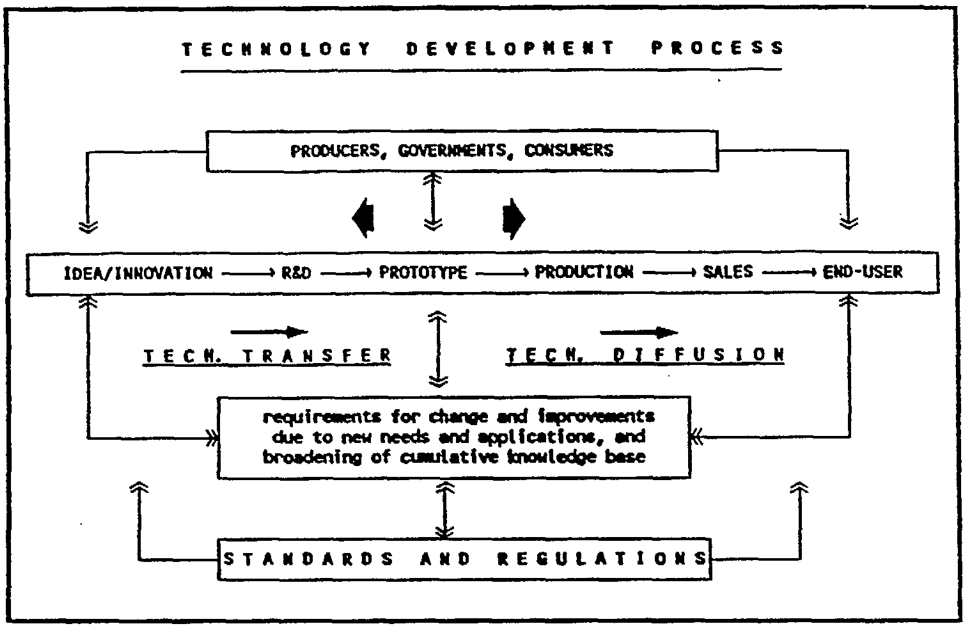
[7] See discussion on fundamental changes in the process of technological innovation in *A Vision for the Future*, joint publication of ISO and IEC, printed in Switzerland, 1990.

Exhibit 2-3
Diffusion as Part of the Technology Development Process



3.0 INTERNATIONAL CONTEXT

3.1 Harmonization of Standards

The internationalization of the world economy is characterized by the increased diffusion of technology internationally. The technology is either embedded in products or circulates as "know-how". Technology from various countries comes into play to produce products ranging from personal computers to automobiles. These international technology flows put increased pressure on countries to harmonize standards to facilitate technology diffusion.

The regional level is the first level at which there is pressure to harmonize national standards and to eliminate barriers to trade and to technology flows. Europe is in the lead regionally and has set in place its own standards-setting bodies (e.g. CEN/CENELEC, ETSI) to harmonize national standards. Moreover, Europe adapts international standards whenever possible. It has been estimated that 85 per cent of CEN and CENELEC standards are identical to international standards. To anticipate up-coming standards, European research and development (R&D) programs increasingly focus on the standards implications of the R&D undertaken.

The Canada-U.S. Free-Trade Agreement (FTA) and more recently the North American Free Trade Agreement (NAFTA) which includes Mexico, are driving the emergence of a North American economic region. The FTA, for example, includes certain provisions in Chapter 6 requiring the elimination or reduction of non-tariff barriers and the harmonization of standards. However, it is expected that it will take some time for a fully harmonized North American region to emerge which means that many issues will have to be resolved at the international level (e.g. GATT; ISO/IEC).

In the Far East there are nascent attempts at forming regional groups such as the Association of South East Asian Nations (ASEAN). However, major political and economic differences among Pacific Rim countries in the region, are expected to slow down the formation of a region wide economic zone. This means that, like North America, issues will have to be settled at the international level.

At the international level, there is increased pressure to deal with issues ranging from climate change to the inter-operability of communications systems. International standards-setting forums are increasingly the locus for the establishment and harmonization of standards. For example, the number of international standards set by the International Organization for Standardization (ISO), the principal world standardization organization, nearly doubled between 1982 and 1992 (see Section 5.3).

To anticipate areas that require standardization attention in a rapidly changing technological environment, ISO/IEC have reviewed 149 technological areas and established priority areas for the 1990s. It is not surprising that environmental, health and information technology standards have been identified as areas requiring urgent attention, as shown in Exhibit 3-1.

Exhibit 3-1
ISO/IEC Survey Results Regarding the 10 Technologies Requiring Immediate International Standards Attention

- Storage, management and disposal of highly radioactive solid waste
- Communications between heterogeneous computer systems
- Elimination of air pollutants
- Erasable and rewritable large-capacity optical disk
- Treatment, disposal and reuse of low-level radioactive waste
- Reduction of NO_x emission from automobiles
- Safety assessment of pharmaceuticals/foods
- Prevent metastasis of cancer
- Environmental water purification technology
- Serological testing in cancer screening

Source: A Vision for the Future: Standards needs for emerging technologies, joint study by International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC), 1990.

Because of rapid technological change, attention is increasingly being given to standards related issues during the R&D phase of product development. It is at this stage that terminology and measurement issues are addressed to facilitate standards-setting downstream. The international comparability of research results is an essential underpinning to standards setting. Therefore, the research and measurement infrastructures that support the development of standards are becoming increasingly linked internationally.

3.2 Canadian Participation

For Canada, a small country, with an open economy which imports a large amount of technology and exports large volumes of primary and manufactured goods, it is imperative to participate actively in international standards-setting activities:

- to obtain intelligence and influence emerging standards related to new technologies; and

- to ensure that product standards and international trade rules do not act as barriers to the export of Canadian goods.

The former relates more to the early stages of the innovation cycle (e.g. R&D; demonstration) while the latter relates more to the commercialization end (e.g. health; product safety).

The dynamics of the international standards-setting environment raise a number of key issues for Canada including the following:

- strategic positioning: Canada does not have a strategic approach to international standards-setting which defines priorities in light of our economic interests and rapid technological change. It is becoming increasingly important to anticipate current and emerging technological developments in order to be able to influence international standards-setting in areas of economic importance to Canada;

- participation in international standards-setting activities: The growing requirement for Canada to participate in international standards-setting activities is adversely affected by on-going restraint measures of related government activities. An adequate level of resources is needed to be maintained to ensure effective Canadian participation in international standards-setting activities; and

- information flows: It is essential that the information and intelligence obtained be disseminated to Canadian industry, especially to smaller firms which usually can only react to the impact of the standards that they meet in the marketplace. While there is much information flowing through the Canadian National Standards System much of it is not sufficiently targeted to be of strategic value. Therefore mechanisms need to be set in place to ensure that international standardization information is disseminated to Canadian industry in the most effective manner.

3.3 Standards as a Competitiveness Strategy

If the federal government intends to assist Canadian firms to develop, test, and adopt/adapt modern and advanced technologies, it cannot ignore the importance of standards and their role in competitive strategies that are evolving in the major industrialized countries. This is especially important vis-à-vis the U.S.A., our major trading partner.

For example, recently, on February 4, 1993, a Bill was introduced in the U.S. Congress to amend the Stevenson-Wydler Technology Innovation Act of 1980.[8] The 1993 Bill (which has passed the House of Representatives and is currently before the Senate) recognizes that "the creation, development, and adoption of advanced technologies are significant determinants of economic growth, productivity improvement, and competitive standing ...."[9] More specifically, however, this Bill also underscores the importance of standards as having "a significant role to play in competitiveness."[10]

Section 402 of the Bill is focused solely on international standardization. This section stipulates that Congress finds that "private sector consensus standards are essential to the timely development of competitive products." Other highlights of the Bill include:

- The National Institute of Standards and Technology (NIST) is mandated to promote and support the dissemination of United States technical standards to additional foreign countries, in cooperation with governmental bodies, private organizations including standards setting organizations and industry, and multinational institutions that promote economic development.

- The Bill also commissions a study to determine how the United States can meet the goals of --
  (1) increasing the international adoption of standards beneficial to United States industries; and
  (2) improving the coordination of United States representation to international standards setting bodies.

- $5 million (U.S.) for fiscal year 1994 and $5 million (U.S.) for fiscal year 1995 are authorized to NIST for a standards pilot program. The purpose of this program is to assist a country or countries that have requested assistance from the United States in "the development of comprehensive industrial standards by providing the continuous presence of United States personnel on-site for a period of 2 or more years to provide such assistance and by providing, as necessary, additional technical support from within [NIST]".

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8 "The National Competitiveness Act of 1993", H.R. 820, Congress of the United States, February 4, 1993.

9 Ibid., p.3.

10 Ibid., p.5.

Another example of the emerging importance of international standards in competitiveness strategies is the priority being given to the ISO 9000 standards for quality systems. Increasingly, these international standards are replacing corporate and national standards (particularly in Europe) as the benchmark for quality assurance. Early qualification for ISO 9000 gives a company a competitive edge over its rivals.

There are now approximately 35,000 firms around the world in 55 countries that have been certified for ISO 9000 series. Only about 700 in Canada have been registered/certified to date and a similar number in the United States. Canadian companies wishing to participate in international trade will increasingly have to rely upon this international standard as its badge of quality assurance.

In order to build a solid quality infrastructure in Canada, the Canadian Manufacturers Association has estimated that Canada needs to have a base of 7,500 manufacturing firms registered to ISO 9000 levels by 1998. There may also be potential for an equal number of service firms, as well as selected institutions and areas of government.

4.0 CASE STUDIES

4.1 Rationale for the Case Studies

The sectors that were examined for this study were the communications/ information technology sector and the building construction sector -- the former a rapidly changing technological sector, the latter a more traditional and well established, yet continuously changing, sector. With regard to standards and technology diffusion, these two sectors provide an opportunity to study a variety of issues, some of which are common to other sectors and some of which are unique. Exhibit 4-1 provides a summary of the rationale for the selection of these two sectors as noted.

4.2 Methodology for Sector Analysis

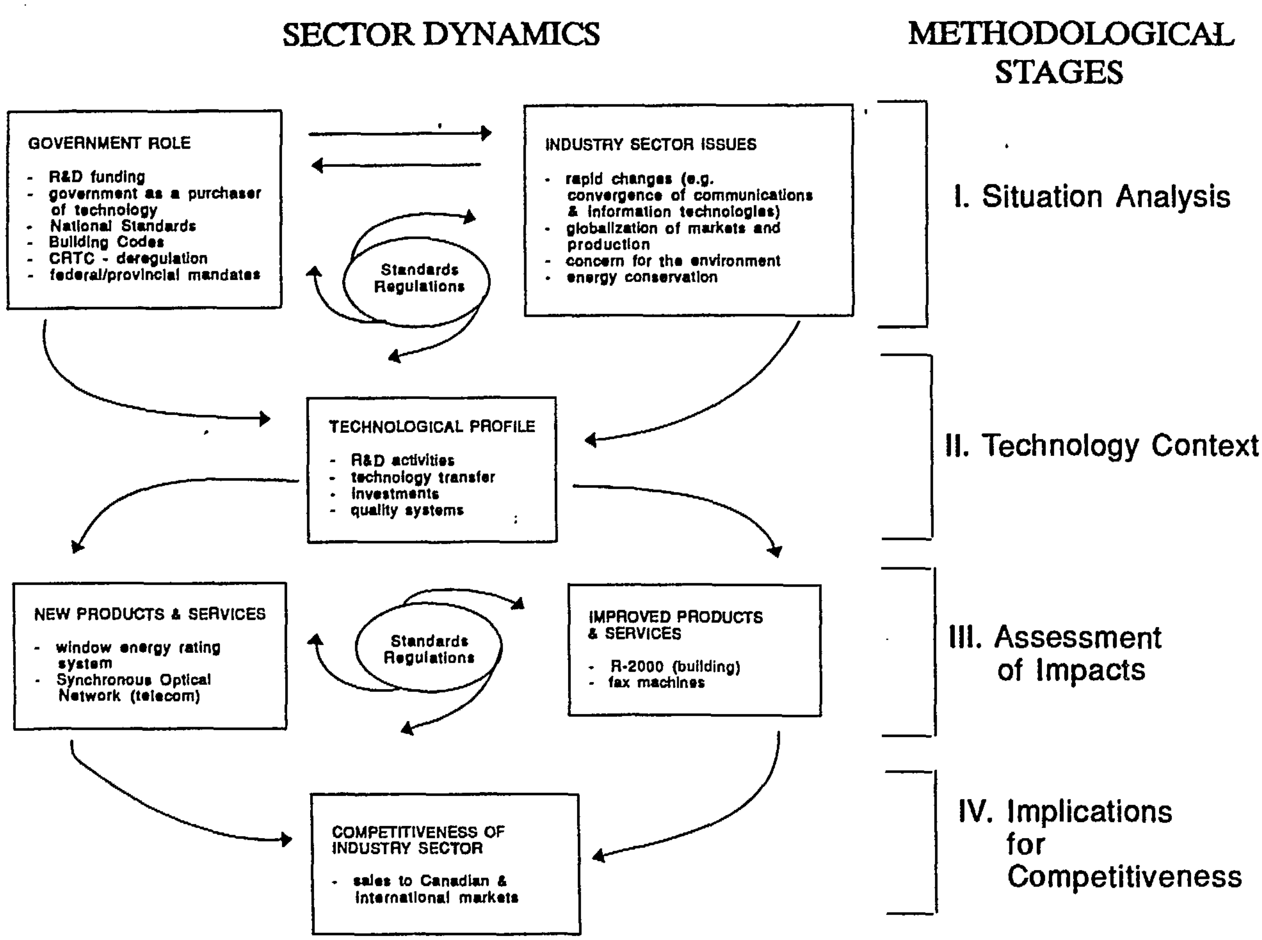
Technology diffusion is on the whole a sector-specific phenomenon. It is not sufficient to study standards and regulations only in generic terms. In the process of analyzing the two sectors identified above, a methodology for examining industrial sectors was developed.

Exhibit 4-1
Rationale for the Choice of Industry Sectors

CRITERIA	COMMUNICATIONS AND INFORMATION TECHNOLOGY	BUILDING CONSTRUCTION
1. Sufficient Scope	- a major advanced sector	- a pervasive traditional sector
2. Large Economic Impact	- dynamic sector with high multiplier effects	- a sector considered as a leading edge economic indicator (over $60 billion in annual business)
3. Important Cross-over Effects	- impacts on all other economic sectors	- has significant links to other sectors
4. Spread of Government Policy Process	- federal dominance	- fragmented responsibilities with major provincial and municipal influences
5. Advanced/Traditional Sectoral Contrast	- advanced technology driven sector	- traditional sector, but with high-tech systems
6. Industrial versus Social Concerns	- international competitiveness is a key issue	- socially relevant standardization significance (e.g., health, safety)
7. Jurisdictional Spread	- international/federal focus	- principally federal/ provincial/municipal focus

Exhibit 4-2 displays this methodology. Technology diffusion in an industrial sector occurs within a broad context of government-industry interrelationships involving consultation and collaboration, financing and investments and R&D activities which lead to technological development and innovation. The factors contributing to the success of technology diffusion are varied, including legal and cultural dimensions, economic considerations and competitive resource and know-how advantages. The ultimate purpose of technology diffusion is economic benefit through sales of products and services to Canadian and international markets.

Exhibit 4-2
Methodology for Sector Analysis of Standards and Regulations



The methodology developed for the sector studies, as shown in Exhibit 4-2, comprised four stages of analysis, each designed to focus on separate components of the technology development process. A **situation analysis** identifies the main events and elements of the complex web of government-industry interrelationships. Discussion of how standards interface with industry and government activities is necessary at this stage. From the first stage flows a profile of the **technological context** which provides details about the relevance and application of technology and standards within the sector. Next, an **assessment of impacts** of standards provides a basis for identifying issues of a strategic nature and for determining the **implications for competitiveness** of the industry, domestically and in the international arena.

4.3 Communications and Information Technologies (C&IT)

4.3.1 Industry Sector Situation

The information technology sector constitutes one of the world's fastest growing and strategically most important hybrid industries. Today, this is one of the few high-tech sectors in which Canada is a strong world player. In Canada, the sector consists of about 12,000 firms with nearly 300,000 employees who generate products and services worth more than $40 billion annually.

The Canadian telecommunications sector is also very important to our economy, contributing almost $12 billion to Canada's GDP in 1987. It continues to be one of the fastest growing sectors, contributing as much to the economy as the forestry, textiles, aviation and chemical industries combined.

Telecommunications has become a crucial part of the business infrastructure, and as such is a building block for the economy's competitiveness. In fact, if you eliminate telecommunications from most businesses, you remove the business as well.

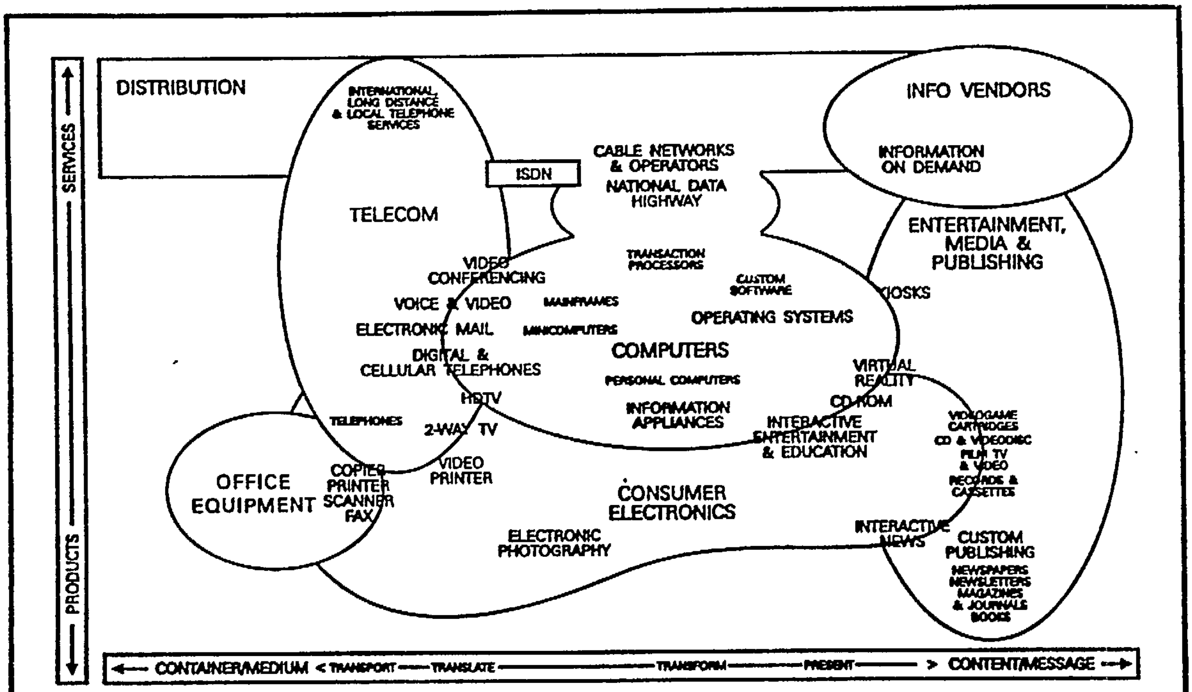
Until recently, the communications and information technology industries have been quite separate, having different communities of individuals, different styles of operation and distinct processes for standard setting. The information technology field was characterized as having many suppliers, limited regulation by government, and many products, systems and approaches to data transmission, and a great number of *de facto* standards with a lack of compatibility between them. The communications industry was characterized as having telephone companies which have either been government agencies or regulated monopolies, limited to competition and equipment that was based on proprietary standards.

4.3.2 Technology Context

Information and communications technologies are converging to the point where it has become very difficult to tell where the communications system ends and the terminal or computer begins. This convergence of technologies, as shown in Exhibit 4-3, constitutes one of the world's fastest growing and strategically most important hybrid industries. Today, this is one of the few high-tech sectors in which Canada is a strong world player.

Ten to twenty years ago technology was diffused in the C&IT areas before standards were in place. In other words, in the past, proprietary implementation of technologies was abundant. However, the environment has changed significantly over the past ten years,

Exhibit 4-3
The C&IT Information Industry in 2001



Source: The Economist, February 27, 1993 particularly with respect to the telecommunications industry. Because of the international focus of many of today's telecommunications vendors, it has become essential to have a sufficient standards framework in place before new products are diffused. The standards-setting process, both within formal international groups and within industry forums, has become increasingly important.

C&IT manufacturers and service providers realize that it is to their advantage to collaborate in the early establishment of standards, to ensure inter-operability. Without standards, product sales will be stalled if, for example, network interface interconnection issues are not first addressed.

4.3.3 Assessment of Impacts/Issues

Even though products will still continue to be developed and diffused where standards have not been formalized, it is becoming more and more necessary for manufacturers, service providers and users to be familiar with standards, both existing and under development, in order to optimize their strategies and business decisions pertaining to the development, introduction and use of C&IT.

As illustrated in the following examples, standards and regulations significantly influence the diffusion of C&IT technologies.

- Australia's absence at important standards meetings left that country with an electronic banking network that is incompatible with the rest of the world.

- Having failed to participate in international standardization efforts at a key time, Japanese banks had to spend millions to recall 6 million credit cards, produced with the magnetic strip on the front instead of the back, and replace them with standardized ones.

- Canada's AIT Advanced Information Technologies Corp. has succeeded in dominating the world market for quality-assurance readers by being actively involved in the early stages of this developing technology. Participation in the international standards-setting process has been a strategic and integral factor in AIT's success.

- Northern Telecom's decision, in the late 1970s, to implement proprietary digital switching technology resulted in that organization becoming one of the leading manufacturers of switching technology in the world. However, Northern Telecom now recognizes that, in today's environment, its equipment must conform to international standards if it is to maintain its dominant position.

- Newbridge Networks, with its decision to deploy products that are in accordance with the international ATM standards, is now one of Canada's fastest growing companies, with revenues expected to exceed $1 billion in the near future.[11]

These examples illustrate not only the significance of C&IT standards themselves, but the importance of fully participating in the international standards- setting process. Absence from key meetings (or the intelligence from such) can result in manufacturers making poor decisions regarding the development, and eventual diffusion, of C&IT products.

Several issues are identified in the C&IT sector study, mostly of a process nature. These issues relate principally to increasing the role of the federal government as a strategic partner in the standards-setting process; rationalizing and streamlining the Canadian standards process; harmonizing the policy and regulatory environment in Canada; improving the efficiency and effectiveness of performance testing and certification; and addressing the requirements for improved communications and information disseminated on C&IT standards, particularly to the small and medium-sized enterprises across Canada.

There is clearly a need to raise the level of awareness of the importance of C&IT standards to Canada's overall development and prosperity. There is also a need to more adequately involve or represent the users and small businesses in the standards process.

Generally, the challenge for Canadian and international C&IT standards-makers is to ensure a standards development process which accounts for rapid technological change and user needs, and which produces internationally harmonized standards. In addition, standards developers must ensure the availability of accredited testing services which are mutually recognized among trading nations.

[11] Newbridge received its ISO 9000 certificate in June 1993.

4.3.4 Implications for Competitiveness

Globalized competition and renewed regionalism characterize the trade and financial regimes of the future. Technology and investment -- particularly in services and knowledge-based industries -- will continue to be a force behind growth in world trade and global integration. Communications and information technologies are providing the underlying revolutionary infrastructures for this future global society.

Three key forces drive the emergence of global competition in this hybrid industry: the worldwide trend toward a more open, or liberalized, regulatory environment; the growth in demand for telecommunications services; and rapid technological progress. Standardization is playing a major role in how these three driving forces are evolving.

In order to promote an internationally competitive industry in Canada, priority will have to be given to telecommunications deregulation, both domestic and international. The Canadian government can have an influence, through participation in international forums, as well as making representations to our major trading partners, to deregulate foreign telecommunications markets to the utmost, thereby increasing Canadian export opportunities.

4.4 Building Construction

4.4.1 Industry Sector Situation

The building industry is a mature sector comprised of a wide variety of players. Broadly defined, the industry includes not only firms directly involved in the construction and renovation of buildings, but also the manufacturers and the engineering and other professionals who provide the goods and services used in these activities.

The application of new technology in the building industry has long-term impacts on building construction. Any major new development has lasting effects because of the nature of the residential or non-residential building product. The erection of a home or an office building is a long-term investment.

The pressures for rapid change in building construction has increased considerably over the past decade. Owners and building practitioners in Canada, including designers, contractors and inspectors, face many challenges today. Among the key factors that are impacting on the building industry, and are driving technology development in this sector, are:

- the specialized nature of the sectors within the industry and the increasingly competitive environment;
- the diversity of government interpretative and enforcement processes;

- the growing base of innovative technology in products and materials;
- growing concern for the environment and for energy conservation;
- globalization of markets and production, and increasing interaction of the international industrial base.

4.4.2 Technology Context

Leading-edge building construction technologies are accessible globally, but developing competitive advantages depends on the capability to select, add value to and accelerate the diffusion of these technologies within the appropriate national context. The pace by which new technology is standardized, and the manner in which these standards become incorporated into the building and other regulatory codes, is thus an important issue for the diffusion of new products and processes in the building industry.

While the building industry in Canada has a strong domestic orientation, and while many innovations have been developed in Canada, still most of the building technology used is adopted or adapted from foreign sources. With increased globalization and international competition, amongst manufacturers in particular, Canada needs to be active in the international arena -- to monitor technological developments as they occur, particularly within our major industrial partners.

The introduction of advanced technology into the building construction industry has been helped significantly during the post-war years, through the activities of government organizations such as National Research Council, Canada Mortgage and Housing Corporation, and Energy Mines and Resources.

Public laboratories and research institutions such as the Institute for Research in Construction (NRC) and CANMET (EMR) are involved in building technology development and are active on standards development committees. The development and dissemination of standards is an important means of promoting the use of results of research carried out in these institutions.

4.4.3 Assessment of Impacts/Issues

The Canadian building construction standards institutions are well established, and Canadian procedures for standardization in this sector are the envy of many industrialized countries.

Yet change is slow. The multiplicity of public bodies (federal, provincial and municipal), regulating and inspecting building construction projects, could be a factor in delays, conflicts, uncertainties and unnecessary costs. In addition, there is a multitude of zoning, planning, environmental, and civic regulatory requirements that often take lengthy periods (sometimes years) to comply with before a construction project can proceed. These delays and associated additional costs in the building process could have detrimental impacts on technology diffusion.

On the positive side, industry participation on standards committees is a catalyst for the diffusion of technology. Manufacturers and consumers regularly adopt new technologies or products through standards. It is, therefore, very important to be closely associated with standards development committees, nationally and internationally. However, the building construction industry is made up of many small and medium firms, who may be unable to participate especially in times of recession. Many of those who do participate are typically representatives of larger enterprises with their own vested interests.

The requirements for standardization increasingly focus on the early stage of the research and development process. Including standardization concerns at an early stage of R&D can have an accelerating effect on the diffusion of new technologies. This case study has provided some examples of this approach (e.g., Institute for Research in Construction (IRC), NRC; and the Buildings Group, CANMET, EMR).

One way of influencing policy formation about new technologies is to link the R&D environment to the standards development process. In this way research organizations can promote and disseminate the results of their work through involvement in standards setting activities.

Through the IRC, the NRC contributes in many ways to building technology development, standardization and regulation. NRC has had a strong presence in the building regulations area ever since it developed the National Building Code in 1941.

With a staff of over 200 engineers, scientists, architects, technical experts and administrative staff, IRC operates construction program activities through its own research and technology development activities and through its strong affiliation with field advisors of NRC's Industrial Research Assistance Program (IRAP).

The strategic objectives of IRC are:

- to undertake research of significance to the Canadian construction industry and its users;

- to develop appropriate technology and information and promote their adoption by the industry;

- to support the national construction codes, standards and evaluation system.[12]

By combining these three strategic areas of activity into one organizational structure, the IRC contributes at the different stages of R&D and technology development to the standardization process and to technology diffusion.

In performing its mandate for research in new technology, the Buildings Group (CANMET) includes in its approach the investigation of requirements for new and revised building standards. This activity is embodied in all stages of the innovation/technology development cycle. The aim is to accelerate the diffusion of proven technologies and to increase support for emerging technologies. This energy efficient technology strategy is an integrated approach involving: research and technology development; lab testing and field trials; standards and guidelines; technology transfer; and quality assurance.

These complementary activities are depicted in Exhibit 4-4, which summarizes the Buildings Group approach.

4.4.4 Implications for Competitiveness

There is growing international pressure (particularly from our major trading partners) on the building construction industry to introduce new, more effective mechanisms for technology diffusion. For example, the harmonization of standards under the FTA and NAFTA is currently receiving considerable attention by the building industry. Many players, particularly those in the building products manufacturing industry, are concerned with the potential negative implications of competition with American firms. In the area of manufactured housing, for example, two years ago the Department of External Affairs and International Trade and the Canadian Manufactured Housing Institute (CMHI) compared the Canadian and U.S. standards on manufactured housing. It was concluded that the Canadian standards were superior and that those in the U.S.A. should be strengthened in any harmonization program, rather than vice versa.

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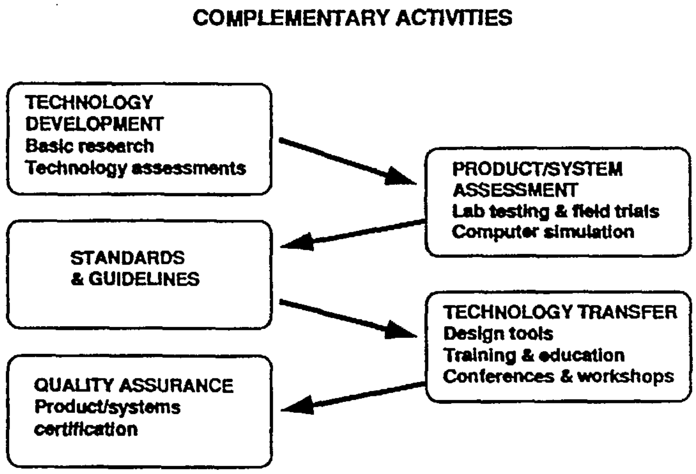
[12] *NRC - Working with the Construction Industry*, National Research Council, Institute for Research in Construction, Ottawa, 1992.

Exhibit 4-4
EMR Buildings Group Approach:
Integrated Program for Technology Development



Activities include:

- For "proven" technologies:
  - Technical information & advice
  - Product/services certification
- For "market-ready" technologies:
  - Training and education
  - Standards and guidelines
- For "emerging" technologies:
  - Lab testing, field trials, research
  - Technology assessments

Source: Buildings Group, CANMET, Energy Mines and Resources.

The creation, use and communication of information is now playing a central role in the development and diffusion of technology. In the building industry, there is an explosion of information provided by a complex network of organizations. Quick and effective access to building information is extremely important in constructing high quality buildings. It is also needed to minimize the risk of legal actions and unexpected delays and costs during construction. Adapting to the new technological realities of the 1990s will depend very much on the progress of the state of information and standards on many of the new building systems and technologies.

Faster response time will help the industry to introduce new mechanisms for technology diffusion. Following the CANMET model, where implications of standardization are built into the R&D stage of technology development, could also increase the competitive position of the Canadian building industry.

4.5 Summary of Sector Findings

The two case studies that have formed part of the empirical basis of this study, confirm the general findings of the overall analysis, namely:

- that standards and regulations have a major impact on technology diffusion;
- that there is a need to improve the dissemination of standards information;
- that the federal government should promote awareness of the standardization process, particularly as to how it impacts on the competitive position of Canadian industries;
- that it is vital that public and private sector participation in the standardization process be increased, particularly at the international level.

5.0 MAJOR ISSUES

5.1 The Lack of a Strategic Approach to Standards

A major issue identified in this study is the lack of a broadly-based Canadian strategic approach to the development and use of standards. It is not that we do not have an adequate National Standards System (NSS) and that Canada does not participate in international standardization. Quite the contrary. Canada has a unique NSS with the Standards Council of Canada (SCC) at its centre and is well respected for its involvement in international standards setting organizations such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). It's that Canada has an ad hoc posture which often lacks continuity. There have been many calls in recent years for a strategic approach that links standards more closely with our economic interests.

As shown in Exhibit 5-1, the standards organizations in other major countries have a strong economic vocation and interface closely with industry and the economic portfolios of their respective governments. Because Canada has a relatively small industrial base the role of government will continue to be important. Even in the U.S., government is beginning to play a more important role through NIST, an arm of the Department of Commerce (see section 3.3). The fact that the SCC now reports to Parliament through the Minister of Industry and Science Canada augers well for a closer link between standards and Canada's policy of enhancing international competitiveness. In fact, the mission statement of the SCC states specifically that it will provide leadership in "facilitating Canada's competitiveness and prosperity through standardization".[13]

[13] Standards Council of Canada; Strategic Plan, 1993/94 to 1998/99; p.5.

Exhibit 5-1
Selected ISO Member Bodies: Interface With Governmental

Country	Name of National Standards Organization	Legal Status
Canada	Standards Council of Canada	A Crown corporation incorporated by public law. Reports to Parliament through Minister of Consumer and Corporate Affairs
Denmark	Dansk Standardiseringsread	Organization incorporated by private law but granted official recognition through the Ministry of Commerce
France	Association francaise de normalisation	Organization incorporated by private law but recognized through the Ministry of Industry and Research
Germany	DIN Deutsches Institut fur Normung	Private organization geared to technological development and matched to economic conditions, regulated by contracts with Federal government
Italy	Ente Naxionale Italiano di Unificasione	Private organization but entrusted by the National Research Council with the development of standards
Japan	Japanese Industrial Standards Committee	Government organization affiliated to the Ministry of International Trade and Industry
Mexico	Direccion General de Normas	Government department of the Ministry of Trade and Industrial Development
Netherlands	Nederlands Normalisatie-institut	Private organization affiliated with Nederlands Society for Industry and Trade
Norway	Norges Standardiseringsforbund	Private organization integrated with the Norwegian Federation of Industries
Sweden	Standardiseringskommissionen i Sverige	Private and independent organization supported by all sectors of Swedish industry, trade and business and recognized by the Government and formed by the Federation of Swedish Industries
United Kingdom	British Standards Institute	Organization incorporated by Royal Charter and recognized by Government through a Memorandum of Understanding between the President of BSI and the Secretary of State for Trade
United States	American National Standards Institute	Private organization incorporated by New York State public law

Source: ISO Member bodies, Seventh edition, 1991, Geneva.

In an international environment where firms are increasingly "footloose" and undertake various operations (e.g. production, R&D) in jurisdictions that provide them with a competitive advantage, decisions on standards become very important because they have a direct effect on the flows of technology and hence on the productivity and competitiveness of firms and by extension the well-being of national economies.

A strategic approach to standards becomes essential so that Canada's economic interests, as an open economy, are best served.

5.2 Lack of Awareness of the Strategic Importance of Standards

In Europe and Japan, the role that standards play in trade and industrial strategy has been recognized for some time. The U.S. is now catching on. As noted in a recent report by the Office of Technology Assessment:

> *"There is a clear need in the United States for greater attention to standards. In an information-based global economy, where standards are not only employed strategically as marketing tools but also serve to interconnect economic activities, inadequate support for the standards setting process will have detrimental effects."*[14]

However, there is not a similar level of awareness in Canada, except within the standards community. There is no lack of information regarding standards generated largely within the standards community but somehow the issues do not appear to receive the broader policy attention that they deserve.

We are not the only ones to have identified this problem. A comprehensive study of standards in Canada remarked that Canada's long term interests could be compromised by inattention, a continued incrementalism and the lack of a broadly informed, strategic view of Canada's standards interests and priorities as a context for standards activities.[15]

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[14] U.S. Congress, Office of Technology Assessment, *Global Standards: Building Blocks for the Future,* TCT-512, Washington D.C.: U.S. Government Printing Office, March 1992.

[15] Office of Privatization and Regulatory Affairs (OPRA), Treasury Board Canada, *Towards a Standards Policy for the 1990's: A Discussion Paper,* December, 1989 (Revised).

5.3 The Impact of Resource Priorities on International Standards Activities

Canada, as a small open export-oriented economy, has to have timely information on standards being set in other countries and internationally to ensure that its economic activities are not adversely affected. This means that Canada has to participate actively in international bodies such as the GATT, ISO, ITU and so on to obtain intelligence on and influence where appropriate, emerging standards. Much of the effort of Canadians has focused on the GATT. Less well known are other bodies such as ISO and ITU where Canada has a significant level of influence and an excellent reputation which are the result of a long term investment in participation in such international standardization bodies.

With the globalization of the world economy, participation in international organizations becomes more important because international standards are increasingly being developed and accepted. For example, in the period from 1946, when ISO was founded, to 1982, ISO published 4,914 standards. By 1992, 8,651 standards had been published; that is 3,737 in the 1982-1992 period alone.[16] However, budgetary constraints in recent years, as shown in Exhibit 5-2, are eroding Canada's ability to continue to participate effectively in international forums. Involvement of Canadians in standards development activities peaked in 1987. This situation makes the development of a strategic approach to standards even more urgent.

Standards-setting activities are supported by a technical infrastructure that develops measurement techniques to ensure that standards are developed. Increasingly, this technical infrastructure becomes involved in R&D projects to ensure that adequate terminology and measurement techniques are developed to pave the way for the setting of standards. It is essential that this pillar of the standards system has the financial and human resources needed to develop the tools needed to support standards development.

5.4 The Limited Involvement of SMEs

Large firms participate actively in standardization activities. Many have staff dedicated to this function. However, such is not the case with small and medium-sized enterprises (SMEs). They usually meet standards in the marketplace which puts them in a reactive posture. If a supplier has a close relationship with the user of his products, there could be more awareness of standards and their implications.

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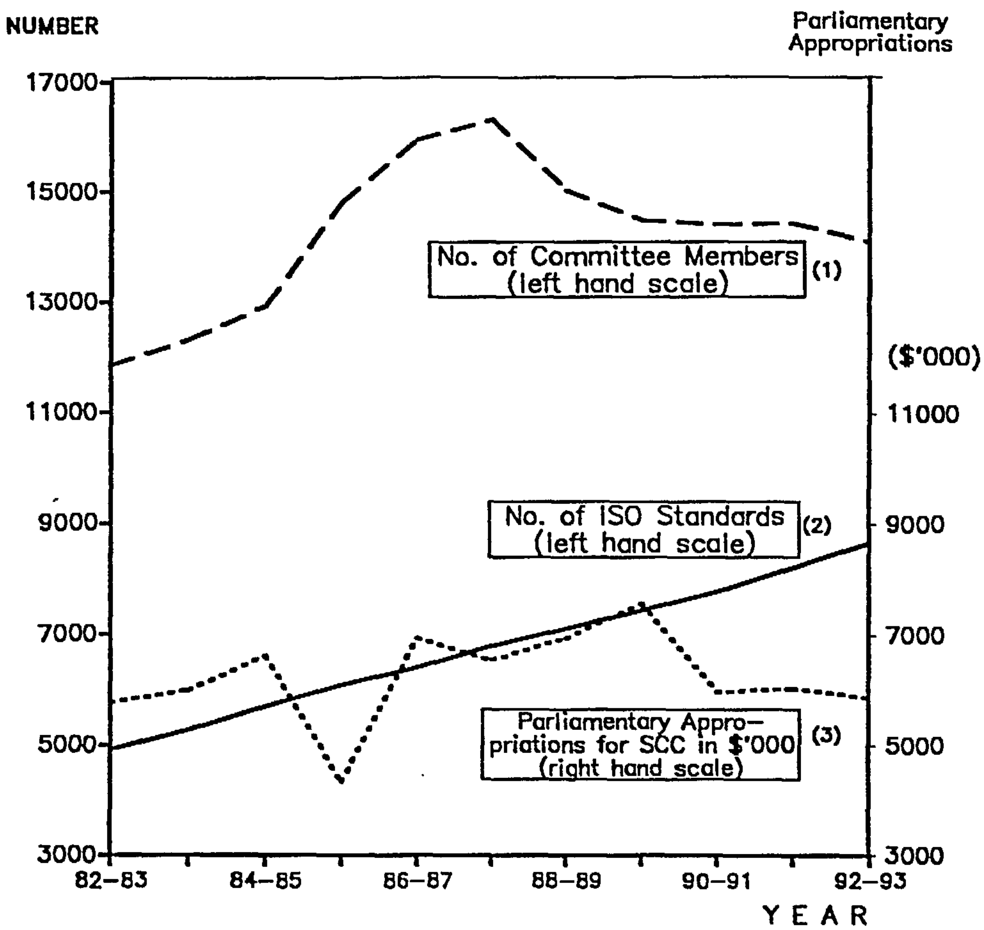
[16] The average rate of publication of international standards was about 137/year in the 1946-1982 period, and 374/year in the 1982-1992 period; i.e., almost three times faster int he last ten years.

There are repositories of information on standards (e.g. SCC). However, SMEs do not have the time and resources to undertake the research needed to extract the relevant information. Moreover, SMEs need intelligence on emerging standards. This means that they should participate in standards-setting activities both nationally and internationally. Again, SMEs have difficulty in participating effectively in such activities because of limited time and resources. Alternatives to direct involvement need to be found.

Exhibit 5-2
Comparison of Canadian Standards Participation and Funding With International Standardization Activity



SOURCES: (1) "Statistical Data on Standards Activity, SCC 1004–20, 15/93; (2) ISO in Figures, published by ISO, January 1993; (3) SCC Annual Reports.

6.0 RECOMMENDATIONS

Based on the analysis and synthesis of the issues identified in the course of this study, it is recommended that, to improve Canada's competitiveness:

- A Policy Development Committee in collaboration with the Standards Council of Canada, provincial governments, industry and universities, undertake an issue identification and strategic positioning exercise to develop an agenda of priorities to enhance industrial technological competitiveness through domestic and international standards development activities.

- A Policy Implementation Working Group be established to develop implementation plans for priorities and issues as identified by the Policy Development Committee, and to promote and co-ordinate standards policy development initiatives in consultation with other organizations.

- A full time dedicated Secretariat, comprised of secondments from participating government departments, be established to assist the Policy Development Committee and Policy Implementation Working Group to carry out their respective responsibilities.

- A comprehensive awareness/education program be developed and implemented to enhance the awareness of the importance of standards and their relationship to technology development and diffusion.

- Much greater emphasis be placed on encouraging and supporting proactive participation in the international standard-setting activities, including the dissemination of information acquired through participation in these activities.

- Mechanisms to acquire, evaluate and disseminate sectoral and firm level standards intelligence be identified and established in collaboration with various government departments and agencies.

The above recommendations are discussed below under four major headings.

6.1 Strategic Positioning and Priorities

The growing importance of international standards to international competitiveness, and dramatically increasing activity in international standard-setting, means that strategic choices have to be made. Broadly based coverage of standards activities will become increasingly difficult if not impossible.

It is therefore recommended that the federal government create a Policy Development Committee in collaboration with SCC, the provinces, industry and universities, to undertake an issue identification and strategic positioning exercise to develop an agenda of priorities to enhance industrial technological competitiveness through domestic and international participation in standards development activities. The Policy Development Committee would look at the overall situation in Canada and other countries and develop a strategic perspective on priorities and possibly develop a framework for addressing identified priorities. It would also deal with major horizontal issues which have been identified as having the potential to impact broader national interests.[17]

To assist and complement the role of the Policy Development Committee, it is recommended that a Policy Implementation Working Group be established to develop and implement plans and priorities as identified by the Committee and to promote and coordinate national and international standards policy development initiatives in consultation with other organizations within the National Standards System.

To provide working level support, it is recommended that a full time, dedicated Secretariat, comprised of secondments from participating government departments, be established to assist the Policy Development Committee and the Policy Implementation Working Group carry out their respective responsibilities. Members of the secretariat would have direct links with their respective organizations and would be able to transmit information and provide their organizations' views to the various investigative research projects being undertaken by the Secretariat.

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[17] A successful example from past experience with such a Task Force approach is that of the Ministry of State for Science and Technology Task Force on Federal Policies and Programs for Technology Development (1983). This Task Force, chaired by Dr. Douglas Wright, focused on examining the effectiveness of the federal government's efforts to promote technological development in Canada. A broad cross-section of industrial, scientific and professional bodies, and nine federal government departments contributed extensively to this work.

The above activity should take into account the priorities of the SCC as laid out in its five year plan.[18] Moreover, since standards-setting activities have to increasingly relate to international competitiveness, the fact that the SCC now reports to Parliament through the Minister of Industry and Science Canada should facilitate the participation of the SCC in the strategic positioning exercise referred to above. Much closer linkages between the SCC and government departments involved with supporting Canada's international competitiveness must be developed to enhance coordination and strengthen the National Standards System.

The involvement of industry will also be needed in this strategic positioning exercise. The larger firms have people dedicated to standards issues. Such is not the case for SMEs; they usually meet standards in the marketplace. With rapid technological change, standards issues are increasingly being addressed at the R&D stage in anticipation of the standards that will eventually be set. Therefore, to increase the participation of SMEs in standards-setting activities, it is recommended that consideration be given to extending the current R&D tax credit policy to include expenses related to participation in standards activities.[19]

As strategic directions are identified, publicly funded activities such as sector campaigns, the Industrial Research Assistance Program, R&D consortia and centres of excellence, which have a bearing on these directions should incorporate a standards dimension into their programs. In fact, where standards are identified as key to certain areas, specific R&D consortia and centres of excellence should be established (e.g. personal communications networks).

Moreover, if Canada's standards-setting activities are to align themselves with concerns related to international competitiveness, there will have to be improved harmonization of national and provincial standards.

To be able to act effectively on the strategic directions identified requires the support of a well-developed metrology, testing and registration/certification, and accreditation infrastructure. It is recommended that the financial support for this infrastructure be reviewed and augmented if required.

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18 Standards Council of Canada; op cit.

19 France recently extended its R&D tax credit to cover participation in standardization activities.

NCL

6.2 Awareness

Standards activities are largely restricted to the standards community. To improve the awareness of the importance of standards and their relationship to technology development and diffusion within the broader policy-making community in Canada as well as the public, it is recommended that a multifaceted awareness/ education program be set in place.

Elements of this program should include the following:

- The preparation of materials based on the reports prepared for this study, as well as from other sources, for dissemination to the public and private policy-making communities in an "easy-to-read" or "primer" format. The materials also could be used for presentations at seminars/workshops within government and the private sector. The former could be organized by interested government departments, the Canadian Centre for Management Development, and Training and Development Canada. The latter could possibly be organized through industry associations.

- The Standards Council of Canada (SCC) should develop its own awareness program to support its strategic thrust of increasing the profile of standards and standardization within Canada.[20]

- The introduction of courses on standards and technology at the university level, especially in engineering and MBA programs. A focal point for the development of such courses could be a Chair on Standards and Technology at a Canadian university under the NSERC/SSHRC Management of Technology Program.

- ISC could include a standards component to its science promotion activities, with a focus on the link between R&D and standards-setting.

- There should be secondment of personnel between government departments and the SCC so that each obtains a better understanding of the responsibilities of the other.

The 14,000 people involved in standards development activities in Canada are a major resource to tap into to support this awareness program.

[20] Standards Council of Canada; op cit., p.15.

6.3 Participation in International Standards Development Activities

It is one thing to develop a strategic position vis-a-vis standards that aligns itself with Canada's thrust to maintain its international competitiveness and it is another to implement such a strategy.

Key to the implementation is the active Canadian participation in international standards-setting activities in areas of importance to Canada. Such participation ensures that we get timely intelligence related to emerging standards and influence specific standards-setting activities where appropriate. The former is particularly important given the explicit (SCC) and implicit Canadian policy of adopting international standards whenever possible, and the fact that Canada is a major importer of technology.

It is recommended that the resources needed to ensure adequate Canadian representation in priority areas be identified and dedicated. This means maintaining, possibly increasing, the international budgets of the agencies involved, be they government departments or the standards development organizations within the National Standards System. Both public and private sector funding sources will be required. It is recommended that new approaches be made to business groups interested in international standards development.

In return for this assured budgetary allocation, the agencies involved would ensure that representatives sent to various international meetings would prepare trip reports and make themselves available for "debriefing" by interested parties. The trip reports should be made publicly available.

To complement the maintenance of a viable Canadian participation in international standards development activities, it is recommended that a "standards counsellor" position or function be established in Geneva, since that is where the ISO, IEC and the ITU are located, as well as the GATT. The person who would report on international standards development activities in ISO, IEC, ITU and GATT could be located within the permanent Canadian Delegation in Geneva. This function would parallel the one in place within the Canadian Mission to the European Community in Brussels where the evolution of European standards-setting activities is followed. Direct links should be established with the science-based government departments.

6.4 Information and Intelligence for Industry

Industry, particularly SMEs, has a need for intelligence on standards-setting activities, especially in areas where technology is changing rapidly, such as information and environmental technologies. Both sectoral and highly-targeted firm-level information is needed; the former to sensitize industry to the importance of standards in its particular sector and the latter to indicate how specific products could be affected. It is recommended that mechanisms to disseminate sectoral and firm-level information be established. These mechanisms would link to the international standardization activities referred to in the previous section.

The dissemination of sectoral level information falls within the orbit of government. ISC, for example, is organized along sectoral lines, and through its regional offices and other networks could disseminate appropriate information that is obtained through Canada's international network in different countries and internationally (e.g. EC, GATT, etc.). DOC could fulfil a similar role for the communications sector. In fact, the SCC is currently involved in defining such a service with interested government departments, agencies, and firms. The aim is to offer a service, on a fee basis, that would provide "tombstone" data on international and Canadian standards, meeting reports of standards development committees and the names of Canadian representatives to these committees. The Telecommunications Standards Advisory Council of Canada (TSACC) is also involved in defining a similar service for the C&IT sector.

However when it comes to highly targeted firm-level information, this type of intelligence is likely best interpreted and disseminated by the private sector; that is, by industry associations and/or service firms that have an in-depth understanding of firms and product-lines in their areas of expertise. Given the technological trends identified by the ISO and in this study, it is recommended that three private sector international standards intelligence mechanisms, one in the area of information technology, another in the area of health care technology, and the third in the area of environmental technology, be established. These specialized services could be offered in conjunction with the ones that are either planned or could be offered by government.

7.0 CONCLUSION

This study has demonstrated that standards and standardization are a vital component of the technology development process. Standards can both help or hinder technology diffusion. At a time when most industrialized countries are increasing their commitment to the international standardization process, Canada appears to be lagging. It is imperative that the federal government implement the actions recommended in this report, to develop a strategic perspective on the relationship between technology development/diffusion and standardization.

4

Nordicity Group Ltd.
Le Groupe Nordicité ltée

THE EFFECTS OF STANDARDS ON TECHNOLOGY DIFFUSION

OVERVIEW REPORT

FINAL

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SUMMARY

This is the first of a series of five reports which comprise a comprehensive study of the impacts of standards on technology diffusion in Canada. This report provides a review of the standards process in Canada and discusses issues regarding the role and effectiveness of the Canadian standardization infrastructure.

This report is an overview which should be read as a "Discussion Paper" to stimulate debate of the issues that have been identified. Both substantive and process issues are identified. Substantive issues center mainly around the lack of a strategic approach to the use of standards to meet the challenges of international competitiveness. Process issues relate principally to maintaining Canada's ability to participate effectively in international standards activities and the national infrastructure needed to support that participation.

The globalization of the world economy is increasingly shifting the focus for standards setting from the national to the regional and international levels. Compared to many of its main trading partners, Canada has a relatively small open economy which imports much of its technology to support its industrial development and exports. To maintain this activity will require more involvement in international standards activities. Canada will also have to maintain a viable national standards infrastructure to support its international activities.

Overall, there is a need to raise the level of awareness in Canada, both inside government and in the private sector, of the importance of standards in the emerging international economic arena.

1.0 INTRODUCTION

1.1 Context of the Study

The rapid pace of technological change is driving economic growth and globalization of industrial markets. In this context, there is a greater need for understanding of the effects of standards on technology diffusion. For example, the setting of standards is accelerating the development of technology (and vice-versa). Product life-cycles are getting shorter and shorter which means that firms increasingly buy technology rather than make it. This accelerates technology diffusion. A joint ISO/IEC study of areas requiring the attention of the international standards community identifies the ten technological domains, shown in Exhibit 1-1, as deserving immediate attention, so that technology development and diffusion can proceed in an acceptable manner.

Exhibit 1-1
ISO/IEC Survey Results
Regarding the 10 Technologies Requiring Immediate International Standards Attention

Storage, management and disposal of highly radioactive solid waste
Communications between heterogeneous computer systems
Elimination of air pollutants
Erasable and rewritable large-capacity optical disk
Treatment, disposal and reuse of low-level radioactive waste
Reduction of NO_x emission from automobiles
Safety assessment of pharmaceuticals/foods
Prevent metastasis of cancer
Environmental water purification technology
Serological testing in cancer screening

Source: *A Vision for the Future: Standards needs for emerging technologies*, joint study by International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC), 1990.

The proliferation of Total Quality Management and the ISO 9000 series of standards, which is now underway in Europe and North America, is an important development that will likely change the way technology is acquired and utilized by industries worldwide. Alongside new applications of benchmarking, standards such as ISO 9000 are becoming an element of economic strategy, with governments playing an increasingly important role in their development.

The risks and the costs associated with the advancement of technology and its diffusion lead to the need for establishing internationally accepted standards, to reduce the uncertainties associated with a changing technological environment, and to create a relatively stable framework for investment. Technology development and diffusion also give rise to unintended health, safety and environmental problems which lead governments to pass legislation as a framework for setting regulations to limit or to alleviate such problems.

With the setting up of free trade regions and economic harmonization between countries in Europe, the Americas, and the Asian Pacific Rim, respectively, barriers to the exchange of goods and services between nations will continue to come down. In North America, the two largest trading partners in the world have set in place a Free Trade Agreement. An arrangement regarding a wider North American Free Trade Agreement (NAFTA) between Canada, the United States and Mexico, is expected to lead to a more generalized North American open market, pending legislative approval in these three countries.

The technological preeminence of American firms in the post-war period permitted the United States to play a competitive, often dominant, role in international trade. Although participation in international standardization was important to both the government and private sectors in the U.S., there was no major effort by government to link standards with industrial or trade policies. Other industrialized countries, in Europe particularly, were more active than the U.S. in this respect, leading into the 1980s. In recent years, however, most technologically advanced countries have begun to see standards as an integral part of their industrial and trade strategies. The European Community (EC) sees the harmonization of standards among its member countries as key to establishing a *de facto* unified single market -- a market that is roughly the size of the United States. Hundreds of national laws have been amended to accommodate the new European order, and so have thousands of standards and regulations. With globalization of industry, and the much more competitive world economic environment, the United States has now become very active in international standardization. The United States is now more concerned also because of what has happened in Europe as a result of the European Community and its harmonization of standards.

While regional harmonization of standards is a priority for Europe,[1] the challenge for Canada is to ensure that the new European market remains fully open to Canadian industries, and that our country can take full advantage of trade opportunities that the new Europe provides. To this end, one of the

[1] European harmonization of standards is based on adopting international standards to the extent possible -- the aim being to have unified European standards that are consistent with those standards set by international organizations.

initiatives involves negotiating a mutual recognition agreement (MRA) with the Economic Community, regarding conformity assessment, which means in this context, certification.

The impact of Japan and the increasing competition from Korea, Taiwan, Singapore and Hong Kong is intensifying, particularly as these countries have now acquired the abilities to produce and trade under modern technological conditions all over the globe. The immense markets at these countries' doorsteps in China, India and South-East Asia also enhance their competitive technological and industrial edge.

The Japanese Five-Year-Plan for Industrial Standards calls for assistance to developing countries to establish standards programs as an initial step to engage in technology transfer and trade. The Philippines, for example, is a target country for Japan. The EC along with some of its member countries has given similar support to target India, Mexico, China and the Association of South East Asian Nations (ASEAN).

It is quite clear that all the industrial markets across the world are now increasingly being driven by many new technologies. Setting and following standards are important keys to success in this expanding technological world. If Canadian firms are to be competitive in the new economic order, it is essential to actively participate in the development of, and to adapt to changes in, international, regional and national standards. The ability to understand and actively participate in standards-setting activities will determine how and whether Canadian companies will be able to compete abroad and, in many situations, at home as well. It can be argued that the development or acquisition, adoption and adaptation of new technologies is impossible without a complete appreciation of the changing context of standards and related national, regional and international issues.

The strategic importance of standards to international competitiveness as well as to the well-being of society should become more fully appreciated in Canada. The interplay of standards with technology development and diffusion, at the level of the firm as well as at the level of the nation, is becoming part and parcel of corporate strategies and national industrial policies, respectively in other countries.

Key questions to address in this context are: **How can Canada gain the most through participation in international standardization bodies? How should our own Canadian standards system evolve to adapt to the increasing pace technological change? To what extent is the Canadian standards infrastructure hindering or helping technological diffusion in this country?**

In addition to concerns about the impacts of standardization on technology diffusion, government regulations are increasingly undergoing scrutiny, to determine how best to address concerns regarding overburdening effects of too much regulation. A recent study by the Sub-Committee on Regulations and Competitiveness of the Standing Committee on Finance, House of Commons, investigated alternatives to government regulations, such as industry self-regulation, and examined how our regulatory programs may be impeding this country's ability to compete internationally. The report of this Committee is now being studied by federal regulatory officials and its impact is yet to be determined.[1] This matter is discussed further in Section 2.3.

1.2 Objectives

This study has been initiated by Industry Science and Technology Canada "... to investigate the role that standards and regulations play in the technological innovation process and how they impact the international competitiveness of Canadian firms."[2]

Specifically, the following are the objectives of the study:

1. *to prepare an* ***Overview*** *of the standards process in Canada, which includes government regulations and industry standards, and to review the issues regarding the role and effectiveness of Canadian standards structures;*

2. *to develop a framework for sector-specific analysis of standards and their impacts on technology diffusion;*

3. *to carry out at least two* ***sector-specific studies*** *of the impacts of standards on technology diffusion;*

4. *to identify and analyze the factors which need to be taken into consideration to determine how standards* ***hinder or stimulate*** *technology diffusion and international competitiveness;*

5. *to review the* ***international context*** *of standards and how this impacts on technology diffusion in Canada and on this country's competitiveness in world markets, both on a specific sector basis and in general terms;*

6. *to compare Canada to* ***other industrialized countries*** *with respect to standards and the stimulation of technology diffusion;*

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1 *Regulations and Competitiveness*, Seventeenth Report of the Standing Committee on Finance, House of Commons, January 1993.

2 Request For Proposals, *Impact Study on the Analysis of Effects of Standards and Regulations on Technology Diffusions*, DSS File, 1992, Appendix A, p.2.

7. *to establish **priorities** for future action; and*

8. *to determine how **actions** should be initiated and the scope of these actions.*

This Overview report addresses the first objectives. Four other subsequent reports that are part of this project address the other objectives. These other reports are: a sector report on the communications and information technologies industries; a sector report on building construction; a report on the international standards-setting situation and Canada's role in it; and, finally, a synthesis report which summarizes the findings and conclusions of the overall study and provides recommendations for the future.

The Overview is intended to provide a description of the current infrastructure of standards-development in Canada. Basically, it describes the national standards system and the regulatory infrastructure that is in place in this country. It also reviews the role of the Canadian standards institutions and identifies issues related to standards and their impacts on technology diffusion and competitiveness. The report should be viewed as a Discussion Paper to stimulate discussion of the issues identified.

1.3 Summary of Study Approach

The study approach for the Overview involved, first, a **literature review** of Canadian and international documents and reports on the roles of standards and regulations, trends in technology development and diffusion, and government industrial strategies and competitiveness (see list of references, Appendix E). Second, a series of **face-to-face and telephone interviews** carried out to get the opinions of experts and key stakeholders in the standards-setting environment (see list of interviewees, Appendix B). Finally, a **Panel of Experts** to advise the study team on issues and directions for the study (see names of experts, Appendix C), and to review and approve the draft reports.

In addition, the study team reported to a **Steering Committee** made up of representatives from Industry, Science and Technology, Consumer and Corporate Affairs, Department of Communications, External Affairs Canada, National Research Council, Standards Council of Canada, and Department of Supply and Services (see Appendix D). The Steering Committee met with the study team periodically to review progress, to discuss issues, and to evaluate the draft reports.

1.4 Mission Statement

In addition to the study objectives, the Panel of Experts suggested that it would be useful to formulate a "mission statement", as a guide for the study. The

Steering Committee agreed that such a statement should be developed. This mission statement is as follows:

> *"To carry out a study of standardization and regulatory processes which will make recommendations to give Canadian firms the capacity to promptly develop or acquire new and current technologies, to maximize their industrial competitiveness. This statement implies a need for Canada to maintain an efficient, productive and well-informed national technological and standards development infrastructure, as a base for effective participation in international and regional standardization."*

1.5 Definition of Standards[1]

Standards are omnipresent and have been so over the millennia. They are part of our daily activities, at work, at home and at play. Our houses are built to standard, and our cars, our food, our furniture and utensils are all standardized. The technology which creates the products and services consumed by our society conforms to standards.

What is meant by "standard"? The French language makes an important distinction between two groups of standards, a distinction lost in English. The first group is called *étalon* and refers to a standard as a unit or physical constant such as a metre, mile, kilogram or gallon. The second group is called *norme* and refers to a technical requirements document. The first group is the oldest and serves as the building blocks for the second. The second group -- standards as written requirements -- is the principal focus of this study.

There are many types of standards with many names, such as "industry standards", "codes of practice", "regulations", "technical standards", "consensus standards", and so on. A joint publication of ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) provides definitions of what are now generally accepted standardization terms.[2] This *Guide* covers terms in the official languages of ISO and IEC (English, French and Russian), and equivalent terms provided by the relevant member bodies in German, Spanish, Italian, Dutch and Swedish.

The Standards Council of Canada has also published a glossary of standardi-

1 For the rest of this report, a "regulation" will be defined as a sub-category of standards (see Exhibit 1-3).

2 *ISO-IEC Guide 2: General terms and their definitions concerning standardization and related activities*, ISO-IEC, Sixth edition, 1991.

zation terms.[1] The terms contained in this glossary are by and large accepted by Canadians involved in standardization. The discussion in the following segments of this report is consistent with the ISO-IEC publication and the SCC glossary, and some of the definitions provided below are derived from these documents.

According to the terminology accepted by ISO-IEC and the SCC, a standard is a: "Document, established by *consensus* and approved by a recognized *body*, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context".[2]

Some standards are designed to act as preventive measures against injury or death, such as those for medical gas, structural design and hockey helmets; some are concerned with the physical or performance characteristics of products, like plywood, paints and lifting machinery.

Many of Canada's standards are prepared by committees composed of specialists, consumers and users of technology. In the absence of uniform standards, these specialists would have to be hired by industries and countries as consultants, at an enormous cost, to advise on technology development and implementation. However, the work of these specialists when codified into standards makes the technology available for a few cents a page. In effect, standards are a low cost way of acquiring technology.

<u>Measurement Standards</u>:
Standards can be written (normative) or they can be standards of physical measurement. This report is concerned mainly with written standards as defined by ISO-IEC (above). However, one of the major components of Canada's standards activities involves metrology. Metrology is the science of measurement. It is the means by which base and derived units are given a basis of operation in the fields of science. Base units such as the kilogram, metre, or second, in addition to their derived and supplementary units, are component parts of the International System of Units, adopted by the Conférence des Poids et Mesures (CGPM). These units represent the physical standards of mass, length, and time. They are calibrated and certified by the Institute for National Measurement Standards (INMS) of the National Research Council (NRC).

The INMS of NRC serves as Canada's national measurement laboratory and as

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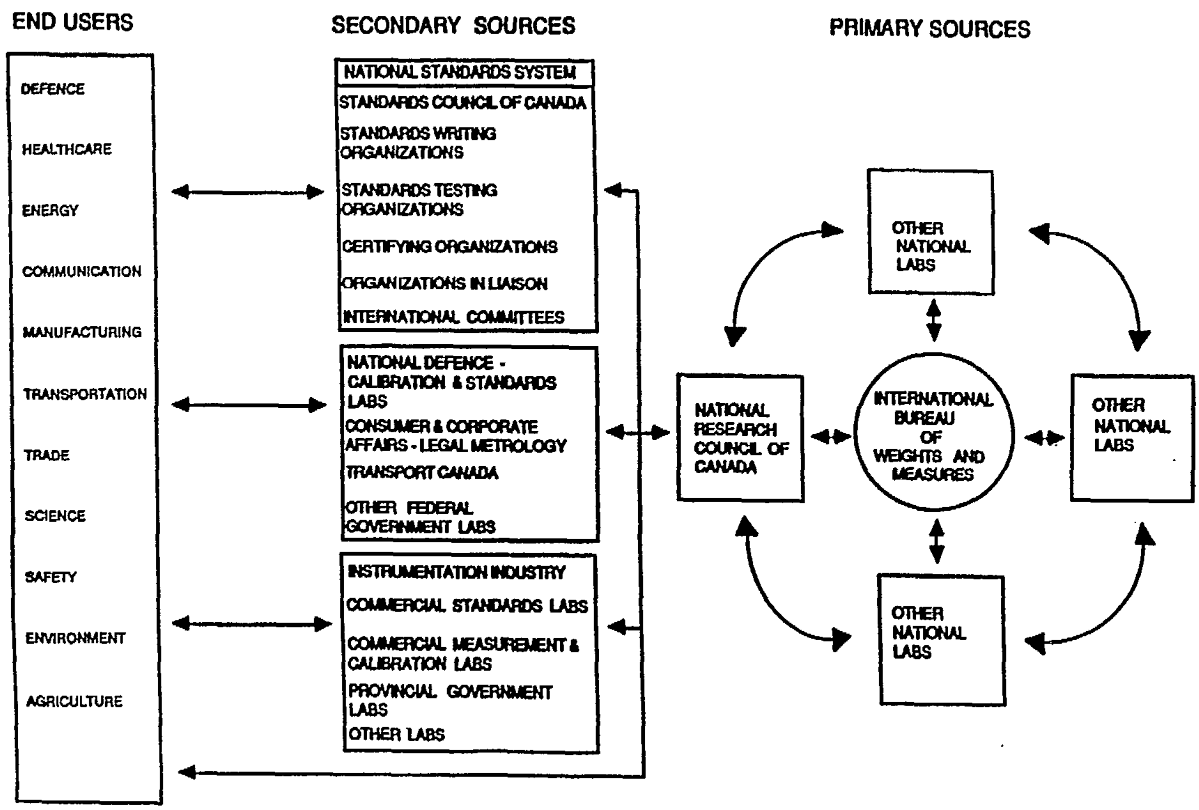
1 *National Standards System: A Glossary of Common Administrative Terms Used in Standardization Activities*, Standards Council of Canada, CAN-P-1012A, June 1985.

2 See *ISO-IEC Guide* ... and *National Standards System: A Glossary of Common Administrative Terms* ..., op.cit.

such is the focal point for Canada's activities in developing, maintaining, and improving physical standards of measurement so that they remain internationally compatible. In the terminology of metrology, the INMS provides 'traceability' for Canada's national measurement system. Traceability can be defined as a documented chain of measurements connecting the accuracy of a means of measurement to one of a higher accuracy which in turn is ultimately connected to a primary measurement standard.

Physical standards function as the foundation upon which normative standards are built and maintained (Exhibit 1-2). NRC provides nationally and internationally recognized measurement and calibration capabilities necessary to support the development of normative standards and the testing and certification of products and services to those standards.

Exhibit 1-2
The Canadian and International
Physical Standards and Measurement System



Normative Standards:

Normative standards can be typified on the basis of their purpose, by the development process through which they are achieved, and by the way they are applied. All three of these dimensions interplay in the definition of standards. The matrix shown in Exhibit 1-3 provides a summary of how the standards universe may be conceptualized along the lines of purpose, development process and application. This matrix also provides some examples of standards within each category. The particular process by which a standard is established and evolves is often the result of historical circumstances and/or political and cultural choices.

Purpose: Standards can be classified on the basis of what they define and for what purpose. In the matrix shown in Exhibit 1-3, three generic types of standards are shown. The first is the *product design standard* which specifies the characteristics of a product or a group of products in order to ensure their fitness for purpose (e.g., baby walkers, traffic lights).

The second generic type of standard shown in Exhibit 1-3 is the *performance standard* which is a product standard specifying requirements for one or more performance characteristics. They deal with operating or testing and evaluating characteristics of a product. A performance standard stipulates that the characteristics with which a product must comply are based on tests that simulate as nearly as possible the performance that a product is required to give under actual service conditions. An example of a performance standard would be a certain mechanical strength specifying a minimum value of load on a physical structure which must be resisted. Another example is R2000 housing specifying minimum energy conservation requirements.

Thirdly, a *process standard* defines socioeconomic roles and relationships and establishes rules for interpreting behaviour. It facilitates interactions between people. Examples of this type of standard include driving on public streets on the right of the road, or management practices as defined by the ISO 9000 series. This type of standard is a functional, "how to" standard.

Development: Standards may also be classified on the basis of how or by which organizations they are developed. For example, a standard can be developed through a "de facto" process. This means the standard was developed by industry within the context of market forces. They evolve from the marketplace and are subject to supply and demand mechanisms of competition.

Exhibit 1-3
Matrix of the Standards Universe

PROCESS: DEVELOPMENT OF THE STANDARD--BY WHOM AND HOW	APPLICATION*	PURPOSE/TYPE OF STANDARD		
		PRODUCT DESIGN STANDARD	PERFORMANCE STANDARD	PROCESS STANDARD
INDUSTRY/ MARKETPLACE (DE FACTO)	M	traffic lights	professional qualifications (doctors, etc.)	driving on the right
	V	VCRs	software/computer compatibility	ABM shared networks (telecom)
STANDARDS DEVELOPMENT ORGANIZATIONS (CONSENSUS)	M	electrical sockets	hockey helmets	test methods for flammability of textiles
	V	paper sizes	garment sizing	ISO 9000 series
GOVERNMENTS (REGULATIONS)	M	lawn darts	children's nightwear flammability	fish packing
	V	baby walkers	R2000 housing	advertisement approvals

Note: * Application: M = Mandatory V = Voluntary

A standard could also be developed through an accredited standards-development organization (SDO). SDOs are accredited by the Standards Council of Canada.[1] SDO standards are prepared on a consensus basis and are in the form of published documents which contain requirements, procedures or definitions which apply to specific products or activities. "Consensus" means that the

[1] SDOs and their role as part of the Canadian National Standards System are described in Section 2.0. "Standards Development Organizations" until recently were referred to as "Standards-Writing Organizations". The Standards Council of Canada has changed the reference to more accurately reflect all of what these organizations do.

standard was obtained by agreement of those concerned, at the best and highest level of thought. Consensus standards are negotiated by a representative group of stakeholders (in North American standardization, "consensus" means substantial but not necessarily unanimous agreement).

In addition, all three levels of government in Canada write and/or use standards for regulation and procurement. Regulatory standards arise from political choices and are mandated by government authorities from the top down. These types of standards are usually driven by public concerns (for example, to deal with environmental, safety or other social issues). They are also introduced to regulate market structures which may be uncompetitive or economically inefficient.

Application: Finally, the way a standard is applied can be used to describe a standard. Basically, this means that a standard can be "mandatory" or "voluntary". A "mandatory" standard is one for which the application has been made mandatory by a regulation. A "regulation" is a binding document which contains legislative, regulatory or administrative rules and which is adopted and published by an authority legally vested with the necessary power. A standard which has been legislated is often referred to as a "de jure" standard.

A "voluntary" standard is one which is based on a consensus of experts. Sometimes these are referred to as "voluntary consensus" standards. The word "voluntary" applies to both the preparation of the standard and its use. In the preparation it means that "those concerned, freely and without coercion, gave of their time, money, and effort to achieve a given objective". In use, it means that the standard is either applied or not applied at the discretion of those individuals or organizations involved.

Other Terms: Another term that is sometimes used in association with standards is "code". A code has the meaning of a compilation of technical or other provisions relating to the same topic, e.g., a plumbing code, fire code, electrical code, or, more generally, building code. Codes have another attribute in that they are adopted by government entities, in whole or in part, and enforcement of the provisions of the code lies with the government, thus effectively turning them into regulatory documents. For example, the National Building Code of Canada, which is a model set of building provisions prepared by the National Research Council, becomes mandatory when adopted by a province. Such documents are comprehensive and use a method of regulating known as "reference to standards".[1] This is a method of drafting a regulation, standard, or other

[1] See R.P. Preston and P.R. Webb, *Report on Reference-to-Standards Research Project*, for discussion of this method and its applications.

document in such a way that one or more detailed statements of technical specifications is replaced in the text by reference to one or more standards. The ISO-IEC *Guide* defines "reference to standards (in regulations)" as "reference to one or more standards in place of detailed provisions within a regulation".[1]

There are a number of other additional key terms applied to standards that sometimes lack precision. For example, "international standard" may mean used world-wide, or it may mean issued by an international standards body. "Protocol" may be the standard of a treaty organization, such as the International Telecommunication Union, or it may apply to accepted procedures used in computer standards. Hierarchical references to standards such as "proposed", "amended", "supplement", "addendum", "withdrawn", etc., all have nuances which may vary with the organization using the term.

1.6 Definition of Technology Diffusion

"Technology diffusion" can be defined as "the spread of a technology already put to use by at least one firm or public institution, either in Canada or elsewhere in the world."[2] This definition serves to distinguish technology diffusion from technology transfer, which is seen as the transfer from the idea stage to initial use, either for commercial or public purposes.

In Canada, technology diffusion occurs within a broad context of government-industry interrelationships involving consultation and collaboration, and public financing and investment in R&D activities. The factors contributing to the success or failure of technology diffusion are varied, including legal and cultural practices, economic forces, competitive resource allocation and development of know-how. The ultimate purpose of technology diffusion, to a large measure, is increased economic benefits through sales of products and services to domestic and international markets.

Since Canada develops only a very small proportion of all technological innovations, the acquisition of foreign technologies and their diffusion throughout Canadian industry is critical to maintaining the competitiveness of the industry. There are a number of routes to technology acquisition, including adopting standards, licensing, parent-subsidiary transfers, direct investment by foreign firms, the import of capital goods, and the exchange of technologies through joint technology development ventures.

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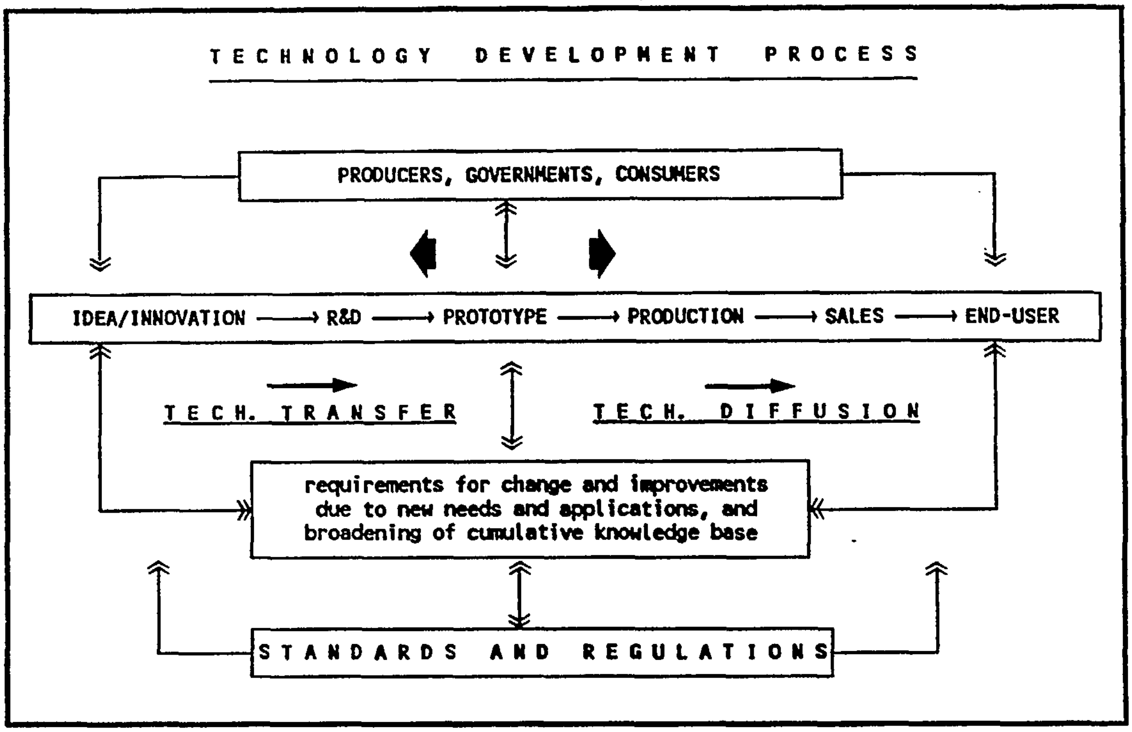
[1] See *ISO-IEC Guide 2*, op.cit.

[2] *Technology Diffusion in Canada: Myths and Realities*, A. Millington and Y.Van Ruskenveld, MOSST, Sept. 1986.

During the past 25 years, there have been unprecedented changes in the nature of the technological development process. This process, once viewed as a linear sequence of events, from scientific discovery to applied research and development, then production and marketing (see Exhibit 1-4), must now be seen as a series of concurrent interactive processes with heavy dependence on basic science and scientific engineering at every step.

Exhibit 1-4
Diffusion as Part of the
Technology Development Process



1.7 Interface of Standards With Technology Diffusion

One of the general purposes of standardization and related activities is to *facilitate* technology diffusion and the exchange of goods and services, at the national, regional and international levels, and to promote cooperation in the sphere of intellectual, scientific, technological, and economic activities[1], and not, at least in theory, to act as an obstruction for any purpose (e.g., as a protectionist trade barrier). In practice, however, standards do often act as impediments, either through overburdensome bureaucratic processes or due to necessary requirements for technical details and rigour.

[1] Albert L. Batik, *A Guide to Standards*, Serendal Research Institute, Inc., Parker Colorado, 1989, p.33.

As the given body of scientific knowledge grows and forms a perpetually higher base, the process of discovery and technological change progresses exponentially. This has had a profound impact on industries in several ways:

- *dramatic progress in material and process characterization;*
- *increasing power of analytical instrumentation, and its transformation into tools for process control in production;*
- *global computer communication allowing codified engineering practice for design, production and control to be accurately disciplined, and at the same time geographically dispersed;*
- *intelligent production tools permitting greatly enhanced product diversity (personalization) without loss of scale economies;*
- *wide-scale use of information systems controlling distribution and providing end-user support to integrate products with the services required for their beneficial use.*[1]

Together these factors are changing the pace of diffusion and the role of standardization. Emerging global industrial sectors characterized by more rapid technological development and diffusion have created an intensified need for global standardization.

Standards impact on all the different stages of the technology development process shown in Exhibit 1-4 -- i.e., innovation, production, distribution, and use. All players in this process are involved in or are affected by standardization. Therefore, for the purpose of this study, technology diffusion will be defined broadly, because the techno-economic contexts in which it takes place, including the preconditions related to technology development, influence and are also influenced by the setting of standards.

In his book *Technology Infrastructure and Competitive Position*, Gregory Tassey has put forth the notion that all phases of R&D, plus production and market development, are supported by a set of *infratechnologies*. These constitute an element of technology infrastructure which becomes "embodied in or supports generic technology and its applications. It also provides the technical basis for standards, which directly affect process and quality control at the production stage and the efficiency of market transactions through risk reduction."[2]

According to Tassey, "infratechnologies" fall into three categories:

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[1] See discussion on fundamental changes in the process of technological innovation in *A Vision for the Future*, joint publication of ISO and IEC, printed in Switzerland, 1990.

[2] Gregory Tassey, *Technology Infrastructure and Competitive Position*, Kluwer Academic Publishers, 1992, p.60.

- *scientific and engineering data that are used for conducting R&D and controlling production, especially in continuous process technologies (such as chemical production and petroleum refining);*

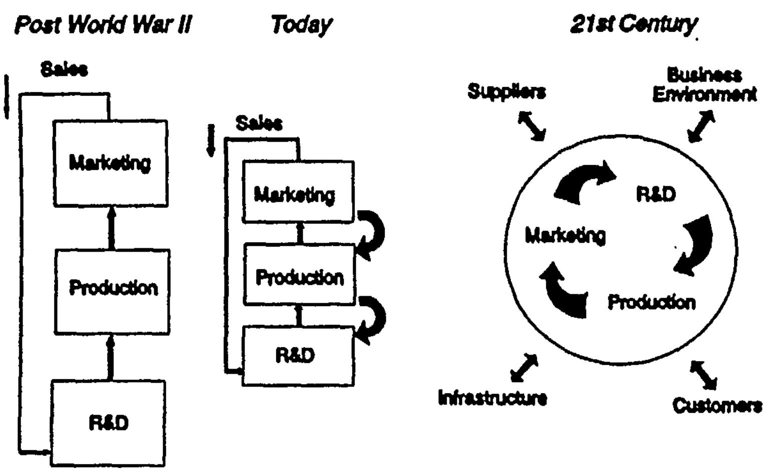
- *measurement and test methods that are essential to conduct state-of-the-art R&D, monitor and control production, and execute market transactions (product acceptance testing); and*

- *practices and techniques, such as process control models, that allow various elements of the typical industrial technology to be organized and utilized efficiently.*

Today, industries and governments need to realize that global competitiveness of a country's industrial base requires these supporting infratechnologies (including standards), to remove market imperfections in all the major stages of technology development (Exhibit 1-4).

Tassey characterizes the evolving technological competitive environment as shown in Exhibit 1-5.

Exhibit 1-5
Evolution of Technology-Based Competition



Source: Gregory Tassey, *Technology Infrastructure and Competitive Position*, Kluwer Academic Publishers, 1992, p.60.

In the post-World War II period, technology and related product life cycles are seen as quite linear and stretched out sequentially in time. The right hand diagram, on the other hand, suggests a more dynamic paradigm, with more or less complete integration of the basic stages of technology development. Such an integration demands flexibility of industry and government in responding to the requirements for economic competitiveness. The traditional sequential process of adding value to products is being replaced by a much more simultaneous construct in which the stages of technology-based economic activity overlap in time.

The results that could be expected from this simultaneous process are as follows:

- *The efficiency of early-phase R&D is increased so that technology life cycles are shortened without significantly raising costs.*

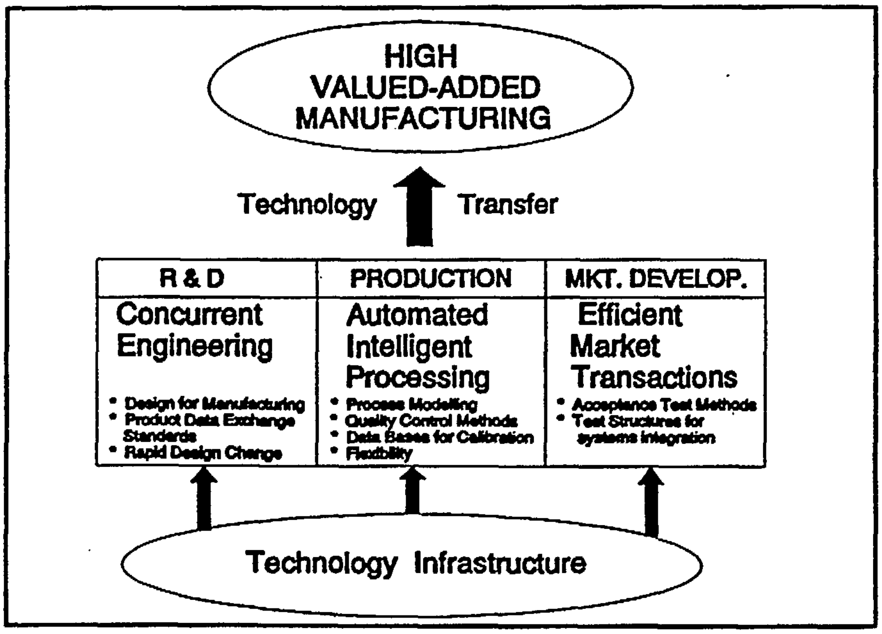
- *Commercialization is facilitated by more efficient technology transfer.*

- *Market development is accelerated by productivity and quality programs, and by other infrastructure such as standards.*[1]

It is necessary to incorporate simultaneity (the time element) into strategic planning, for effective technology-based growth. "The dynamics of technology-based competition are such that relatively small amounts of resources, applied at the right points in the technology life cycle, can have substantial leverage."[2]

Exhibit 1-6 shows the collective action of the technology infrastructure, and its supporting infratechnologies, across the stages of technology-based economic activity.

Exhibit 1-6
Infrastructure Impacts on Competitive Position



Source: Gregory Tassey, *Technology Infrastructure and Competitive Position*, Kluwer Academic Publishers, 1992, p.60.

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[1] Tassey, pages 92-93.

[2] Ibid., p. 271.

If long-term competitiveness is to be developed and maintained, industry-government interactions in terms of joint planning, cooperative research, standards development, technology transfer, etc., needs to take place to varying degrees over the entire technology life cycle, not just in early-phase technology research.

2.0 STANDARDS ORGANIZATIONS AND THE STANDARDS DEVELOPMENT PROCESS

2.1 The National Standards System (NSS)

In Canada, the National Standards System is a federation of accredited standard development, certification and testing organizations. The Standards Council of Canada (SCC) is responsible for the overall coordination of this federation. Through the System, the Standards Council works to ensure that Canadian needs for standards and related services are met.

The SCC is a Crown corporation created by an act of Parliament of Canada in 1970. The SCC reports to Parliament through the Minister of Consumer and Corporate Affairs Canada (CCAC). The SCC consists of 57 members, 41 from the private sector, 6 from the federal government and 10 from provincial governments. The objectives of the SCC, as set out in the *Standards Council of Canada Act*, are: to foster and promote voluntary standardization in Canada; to assist and protect consumers; to facilitate domestic and international trade; and to further international cooperation in the field of standards. During the 1991-1992 period, 192 standards were approved as National Standards of Canada (NSCs), bringing the total number of NSCs to 1,749. Several additional standards have since been approved.

Although the level of funding has been reduced dramatically in the past few years, the Council continues to be funded primarily by government. Other income comes from the sale of standards of the SCC accredited organizations or international standards development bodies. The organizations accredited to the National Standards System, as of 1992, had together published over 7,600 Canadian standards.

There are seven main elements of the National Standards System which define its activities. These are: (1) approval of the National Standards of Canada; (2) standards development; (3) certification; (4) product testing; (5) quality system registration; (6) participation in international standardization; and (7) accreditation.

A **National Standard of Canada (NSC)** is a standard submitted by a Canadian standards development organization for NSC designation by the Standards Council, which must satisfy itself that specified criteria have been met (for example, that the standard is not written to act as a restraint on trade, that there is only one National Standard for Canada for the subject, and that the standard is written in accordance with good standards writing practice).

There are five accredited standards development organizations under the National Standards System. These SDOs are: Canadian General Standards Board (CGSB), Canadian Standards Association (CSA), Underwriters' Laboratories of Canada (ULC), Bureau de normalisation du Québec, and the Canadian Gas Association (CGA). These organizations coordinate the work of standards committees whose members represent a balanced cross-section of interests -- including producers and users. Standards prepared by these committees can be submitted for SCC approval as National Standards.

The Standards Council also operates programs for the accreditation of certification and product testing organizations under the NSS. The certification organizations (COs) have registered trademarks certifying that products or services meet a standard. Testing organizations (TOs), test products or services to determine whether they meet the standard for that product or service and report the results of their tests.

Although they are two distinct processes, certification and testing go hand in hand. The first is a process for displaying (certifying) conformity to standards of goods, services or procedures, the second for verifying (testing) that they indeed do conform to specific standards.

Canada's seven certification organizations include four of the standardsdevelopment organizations (CGSB, CSA, ULC, and CGA), together with the British Columbia Council of Forest Industries, Warnock Hersey Professional Services, and Canadian Welding Bureau (CWB).

The 1992 SCC Directory of Accredited Calibration and Testing Laboratories listed 100 registered testing organizations now operating under the National Standards System, including private research laboratories, government and industry facilities, and five of the six certification organizations (CGSB excluded).

Testing organizations are accredited under the National Standards System by the Standards Council of Canada, based on their ability to perform tests in accordance with recognized standards and procedures and to adequately document their findings.

In this era of internationalization, an increasingly important role of the SCC is the dissemination of information on national, international and foreign standards, standards-related documents and activities. In this respect, the SCC performs the following activities and services:

- *Responds to enquiries on standards, standards-related documents, and standardization activities from publics in Canada and other countries.*

- *Complies with the mandatory obligations of the GATT Agreement on Technical Barriers to Trade (Standards Code) and the Canada-United States Free Trade Agreement.*

- *Supports the activities of the Information Division and GATT TBT Enquiry Points by maintaining a comprehensive collection of national, regional and international standards, technical regulations, and certification information.*

- *Maintains an online interactive information system of standards, specifications, standards referenced in federal legislation and GATT TBT/Notifications to support the activities of the Information Division.*

- *Acts as the Canadian member of ISO's International Standards Information Network (ISONET).*

- *Acts as Canadian Information Centre on European and other regional standardization developments.*

Another main role of SCC is to ensure effective Canadian participation in the work of international organizations engaged in the formulation of voluntary standards . The Standards Council over the years has cultivated an important contribution by Canada in both the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). These two organizations are primarily responsible for voluntary standardization internationally. In all, Canada is involved in approximately 80 per cent of ISO and IEC committees.

In 1972 the Standards Council of Canada became the official Canadian member of ISO and IEC. As such, the SCC is responsible for the organization of relevant Canadian technical committees dealing with ISO and IEC subjects.

As mentioned above, the five accredited standards development organizations are the CSA, CGSB, ULC, BNQ and CGA. The CSA was chartered in 1919 to develop industrial standards, and is the largest standards development body in Canada. There are now well over 1,000 published CSA standards. These standards reflect a national consensus of producers, consumers and regulatory authorities, and cover some 35 major areas. In particular, the CSA has had a long history of involvement in electrical and telecommunications standards development. For example, it is responsible for the Canadian Electrical Code and its symbol is the mark of conformance to this Code. In addition, it is currently taking an active role in the development of interface standards for connection of customer equipment to the proposed ISDN (Integrated Services Digital Network).

The CGSB is a federal government service responsible to the Minister of Supply and Services, although, in practice, this organization is interdepartmental and writes standards which are applied in both the public and private sectors. CGSB was founded in 1936 to prepare procurement specifications outside the engineering field. Currently, CGSB is active in standards development activities over a broad range, including: quality assurance, cement and concrete products, glass, insulation, paints and pigments, roofing materials, petroleum products, solid fossil fuels, medical equipment, various home and household items (e.g., soaps and detergents), garment and shoe sizes, packaging materials and products, and personal flotation devices.

From 1920 to 1949 ULC operated as an affiliate of Underwriters' Laboratories, Inc., Chicago. In 1950 it became an independent, non-profit organization. ULC standards development and certification relates to life, fire and property hazards. ULC labels are found, for example, on equipment pertaining to motor vehicle systems or components with regard to fire hazard (such as fuel tanks); burglary protection equipment (alarms); fire protection products, systems and services (smoke detectors/alarms, fire extinguishers).

Founded in 1962, the BNQ is a Quebec provincial government organization which reports to the Quebec Centre for Industrial Research. Technically, the BNQ does not meet the criteria to be a part of the "National" Standards System, as it is not "national" in the scope of its activities. However, the need to prepare and apply national standards in both official languages makes the participation of the BNQ in the NSS both necessary and desirable. In particular, the BNQ prepares standards to meet the needs of Quebec industry and government in subject areas for which no standards exist or for which existing standards are not suitable. The standards development subjects in which BNQ is involved include areas such as: building and construction products and systems, electrical appliances, petroleum products, technology for the handicapped, furniture, automotive tires, packaging materials and products, paper and textiles.

The CGA organization is both a standards development and accredited certification body. CGA is a non-profit trade association founded in 1907 to represent the natural gas industry. It set up its standards development program in the mid-1950s. The areas of activity of CGA include primarily gas-fuelled products. The CGA certification mark is affixed to such items as gas barbecues, swimming pool heaters, gas furnaces, boilers, portable camping equipment (gas camp stoves, lights, heaters, and refrigerators), air conditioners, and liquid petroleum gas torches.

With the exception of the CGSB, which sells its National Standards through the Standards Council, standards are sold by the responsible standards development organization. Although not a major revenue generator compared to certification, the sale of standards can be an important part of a standard organization's revenue.

2.2 The Standards Development Process

Since its founding in 1970, the Standards Council of Canada has succeeded in consolidating standardization activities in Canada into the present National Standards System. The Council exercises a coordinating function, monitoring the distribution of subject areas among its accredited organizations, thereby minimizing duplication of effort and enhancing administrative effectiveness of national standards policy.

To guarantee the orderly development of standards activities in Canada, such a coordinated approach was necessary to utilize the available technical, administrative and financial resources to the maximum benefit of the Canadian economy. This cooperative effort resulted in an agreement between the accredited SDOs to accept an apportionment of their standards work based upon the recognition of a primary responsibility in the specific agreed subject areas.

The SCC does not actually write standards itself. The SCC approves standards for elevation to a National Standard of Canada (NSC). A request to consider a new or an existing standard for advancement as an NSC may originate from any source. However, it is preferred that requests originate from recognized associations or represent a coordinated group interest. The request should include evidence to substantiate that the standard is making or would make a significant contribution to the national interest.

The request should also define the problem or need, indicating who would be likely to benefit from the standard, who would financially support its development, and any known contact for committee members. Requests should be made directly to the accredited SDO, recognized as having primary responsibility in the particular subject area. Only in those instances where the accredited SDO is not known, or when there is no accredited SDO recognized in the particular subject area, the request should be made to the SCC.

When a request is received by the SCC, it is forwarded for evaluation to the accredited SDO recognized as having primary responsibility in the subject area. In those situations where there is no accredited SDO recognized, the

SCC will forward the request to all accredited SDOs to determine which is interested in evaluating the request. If more than one SDO shows an interest, the SCC advises that the choice of the SDO is the responsibility of the requester.

Once an accredited SDO has received a request, it advises the SCC, within 30 days of its receipt, and provides an estimate of the time required for evaluation. The request is then evaluated by the SDO to confirm that the proposed NSC is capable of making a significant and timely contribution to Canada.

When the request for an NSC is accepted by the SDO, as a result of the evaluation, the SDO will advise the requester and the SCC of its intention to proceed with the preparation of a new standard, or the advancement of an existing standard. If a request for an NSC is rejected, the SDO will advise the requester and the SCC in writing of the rejection and the reasons. If the requester is not satisfied with the evaluation of the request, the matter may be referred to the SCC who will determine what further action, if any, may be taken.

2.3 The Federal Regulatory Process

Regulations in Canada may be legally mandated through a statute enacted by Parliament, or through a statutory instrument issued pursuant to a statute. The *Statutory Instruments Act* of Canada provides the basic legal process that the federal government must follow to develop regulations. The Act requires that:

- *The Privy Council Section of the Department of Justice must examine proposed regulations to assess their legality.*
- *Regulations must be registered with the Registrar of Statutory Instruments within seven days of being approved.*
- *The government must publish its regulations in the* Canada Gazette, *Part II, within 23 days of registration.*
- *Regulations become law as soon as they have been registered. They can be enforced only after they have been published in the* Canada Gazette, *or, if they are exempted from publication, after the government has notified those whom the regulations will affect.*

The principles underlying the federal government's regulatory process are set out in the Citizen's Code of Regulatory Fairness and the Guiding Principles of Regulatory Policy.[1] Key requirements of these are:

- *Regulate only when government intervention is justified and regulation is the best instrument.*
- *Ensure that the regulatory method chosen maximizes net benefits.*
- *Establish a framework and allocate the resources necessary to implement regulatory programs.*
- *Provide for an open regulatory process, including opportunity for the public to participate in regulation making and clear communication of regulatory requirements.*
- *Establish clear accountability of officials for regulatory actions.*

All federal government departments and regulatory agencies are responsible for administering regulations. The Treasury Board Secretariat is responsible for ensuring that departments and agencies follow the government's regulatory policy. It is commonplace for Parliament to delegate to Cabinet its power to make certain laws within the framework of the Statutes of Canada. These laws are often referred to as delegated legislation or regulations. Like legislation, regulations confer legally enforceable rights and impose legally enforceable obligations on Canadians.

Over 2,800 regulations approved by Cabinet or by individual ministers are listed in the Consolidated Index of Statutory Instruments. Their objectives range from protecting Canadians from threats to health and safety and from unfair business practices, to implementing international agreements which affect Canada's economy and environment. The Montreal Protocol for reducing the use of ozone-depleting chemicals, and the Canada-United States Free Trade Agreement, are examples of international commitments that are implemented through regulation.

The Canadian federal regulatory process has been a subject of continuous debate all through the 1980s up until the present. Numerous studies have been undertaken concerning this country's regulatory programs and many changes have occurred over the years. In the past, public concern for fairness and equity prompted widespread government intervention through regulations, designed generally to :

- *achieve minimum standards of income, health and safety, and education;*

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1 See copies of the Citizen's Code and Regulatory Policy in *Federal Regulatory Plan, 1993*, Government of Canada, Treasury Board Secretariat, Canada, 1992.

- *reduce the degree of inequality in the distribution of income, wealth, power, and social and economic opportunities;*
- *ensure fair treatment before the law;*
- *prevent "exploitation" of the unknowing or economically disadvantaged;*
- *prevent economic transactions in what are regarded as personal, inalienable rights; and*
- *reduce the impact of arbitrary or chance factors on the positions of individuals or groups.*

While all these "reasons" for regulation continue to be valid and appropriate for the social and economic well-being of the country, many private and public sector representations have been made concerning the over-regulation of Canadian industry. In areas where technological products and processes are rapidly evolving, regulatory requirements could have serious effects on overall productive efficiency and international competitiveness. The distribution of benefits and costs over the industrial system does get affected by compliance requirements of regulations.

In the 1989 Report of the Auditor General of Canada to the House of Commons, regulations were referred to as " ... important and pervasive instruments of national and international policy." In 1985-86, regulatory programs involved some 34,500 persons and cost the government an estimated $2.7 billion and Canadians paid hidden costs estimated to be at least $30 billion. While recognizing that much progress had been made in regulatory policies and practices the Auditor General's report noted that:

> *"Major improvements are needed in the public reporting of key information on regulations such as significant commercial benefits to private sector firms and costs to the government."*[1]

From 1986 to 1991, management of the federal government's regulatory process had been the responsibility of the Office of Privatisation and Regulatory Affairs (OPRA). OPRA was described as a "gatekeeper" for regulatory initiatives in Canada, focusing on administering federal regulatory policy.[2]

In February 1991, the President of the Treasury Board was designated as

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[1] *The Report of the Auditor General of Canada*, March 31, 1989, p.341.

[2] "Overview of Regulatory Affairs", Regulatory Affairs Division, Treasury Board of Canada Secretariat, 1992.

Minister responsible for Regulatory Affairs. The Regulatory Affairs Division (RAD) was made responsible for ensuring that departments and agencies follow the government's regulatory policy. RAD is still responsible for the overall regulatory process, but more focus is placed on training, communication, inter-government consultation, and other system wide issues such as the impact of regulations on industry's competitiveness. Moreover, "there is an emerging concern regarding the resourcing of regulatory programs and the relationship to underlying legislation, regulations, and compliance policies."[1]

Current federal government policy on regulatory affairs stipulates that government departments and agencies:

- *justify the need for regulation;*
- *weigh the benefits of the regulations against their cost;*
- *establish the framework (compliance and enforcement policies, management systems and resources) needed to implement regulatory programs;*
- *determine the relevance, success and cost-effectiveness of existing regulatory programs; and*
- *provide for an open regulatory process.*[2]

Within this broad context of policy requirements, and for existing regulatory programs, and substantive new or amended regulations, departments must demonstrate, amongst other concerns, that:

> *"Steps have been taken: to minimize the regulatory burden on Canadians through such methods as cooperation with other governments; and to ensure regulatory programs impede as little as possible Canada's ability to compete internationally."*[3]

The February 1992 Budget tabled by the federal government, asked the Parliamentary Standing Committee on Finance to undertake a regulatory review which would:

- *determine how regulation affects Canadian competitiveness; and*
- *suggest ways to improve regulation, regulatory processes, and intergovernmental collaboration.*

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[1] Ibid., p.2.

[2] *Treasury Board of Canada: Regulatory Policy*, Regulatory Affairs Directorate, Treasury Board Secretariat, March 16, 1992.

[3] Ibid.

In a statement to Parliament regarding regulation and competitiveness,[1] the President of the Treasury Board and Minister responsible for Regulatory Affairs, identified some important concerns regarding regulations and their impact on Canadian competitiveness. The President suggested that the Committee seriously examine competitiveness and how we regulate compared to how our trading partners regulate. He suggested that the Committee "survey alternatives to regulation such as industry self-regulation", and he further recommended that amongst the issues to be addressed was whether "steps have been taken to ensure regulatory programs impede as little as possible Canada's ability to compete internationally...."

The report by the Sub-Committee on Regulations and Competitiveness of the Standing Committee on Finance was tabled in January 1993. This report, entitled *Regulations and Competitiveness*, is now being studied by federal regulatory officials and its impact is yet to be determined. Many briefs and representations from a cross-section of Canadian organizations and individuals were presented to this Committee during 1992.

Much of the thrust of the report is aimed at reducing the burden of government regulation. To this purpose, one of the key recommendations is:

> *"Government should be reticent about promulgating standards outside the health, safety and environmental area...." [Recommendation 6.2]*

Another important recommendation is:

> *"Where feasible, regulations should be expressed as functional outcome or performance objectives rather than detailed specification of the means of compliance." [Recommendation 3.2]*

Both these recommendations reflect what appears to be the Committee's view that Canada's exemplary standards-development system wherever possible should be applied in place of government-promulgated standards or regulation. This would stimulate innovation and technology diffusion. However, it is clear that the Committee recognized that government control is necessary if the standards developed are to become effectively binding, either by legislative reference or government threat of such.[2]

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1 "Notes for a Statement on Regulation and Competitiveness by the President of the Treasury Board and Minister responsible for Regulatory Affairs to the Sub-Committee on Regulation and Competitiveness of the Standing Committee on Finance, May 12, 1992," Treasury Board of Canada, 1992.

2 *Regulations and Competitiveness*, Seventeenth Report of the Standing Committee on Finance, House of Commons, January 1993, p.75.

2.4 International Standardization

At the international level, the principal world standards organization is ISO (the International Organization for Standardization), which was established at the same time as GATT and which covers all fields of standardization, with the exception of electrical and electronic engineering which by agreement are covered by IEC (the International Electrotechnical Commission), which was established in 1906.

In 1947, 25 countries including Canada founded the General Agreement on Tariffs and Trade, and at the same time decided that a separate international organ was needed to lead the process of international standardization: "to facilitate the international coordination and unification of industrial standards". As of January 1993, ISO comprised the national standards bodies of 92 countries (71 full members and 21 correspondent members)[1], representing more than 95 percent of the world's industrial production. There can only be one ISO representative standards organization from each country.

There are about 500,000 experts around the world who cooperate with ISO and IEC, which have together published over 11,400 International Standards. ISO and IEC work is carried out through 325 technical committees and approximately 3,000, sub-committees and working groups (as of January 1992), with representatives from member countries. These groups are made up of experts in their respective fields from industry, governments, academia, and consumers. Over the years, ISO and IEC have increasingly developed a closer working relationship.

ISO is active in the exchange of information between member organizations, the dissemination of standards documents, and the development or revision of standards. All ISO standards are reviewed at not more than five-yearly intervals. A primary objective of ISO is to replace the often divergent standards of its member countries with international standards. ISO standards are published as "international technical agreements". The purpose of ISO is to develop worldwide standards to improve international communication and collaboration, and to promote the smooth and equitable growth of international trade.

IEC, on the other hand, was founded much earlier in the Century to promote international cooperation on all questions of electrical and electronic

[1] A *correspondent member* is normally an organization in a developing country which does not yet have its own national standards body.

standards, including reliability, safety, interchangeability and mutual compatibility of equipment, and elimination of unnecessary diversity of components. IEC activities involve issuing standards expressing international consensus of to assist *national committees* in harmonizing national standards, in 45 member countries. Technical Committees liaise with intergovernmental and non-governmental organizations concerned in their specific fields and prepare technical reports pending the attainment of sufficient international agreement on a given subject. As of 1992, IEC had published over 3,200 international standards.

After it is determined by the ISO or the IEC, as appropriate, that a technical standard is required in a particular area, the international organization establishes a secretariat. Each secretariat is maintained in a member country. In Canada, ISO and IEC technical secretariats are maintained by one of five SDOs, with the approval of the SCC.[1] A secretariat will bring together the world's foremost experts in the field. The experts form a technical drafting committee and begin the process of articulating a standard, taking into consideration any available domestic standards. Individual countries may opt to establish national advisory committees that feed into the process, through their national standards systems. The standard is then tabled before the ISO or IEC and if it is accepted, it is given an international coding number. Member nations are then expected to promote the use of the international standard within their bodies.

One of the major international standards developments over the past decade has resulted from the trade liberalization developments emerging from the General Agreement on Tariffs and Trade. One of the specific agreements of the GATT is that dealing with Technical Barriers to Trade. The Standards Code, as it is commonly called, urges the use of international standards, wherever they exist, as the basis for technical regulations and standards. Canada has for many years played an important role in the ISO and the IEC. Canada shares with other industrialized countries an interest in the development and application of international standards through these organizations as a means of enhancing both bilateral and multilateral trade.

ISO has technical committees dealing with a range of subject areas such as microbeam analysis, technical energy systems, building construction machinery, hydrogen energy technologies, erasable and rewritable large-capacity optical disks, air and water quality, contraceptives, and so on. As the standards resulting from the work of these committees are of direct

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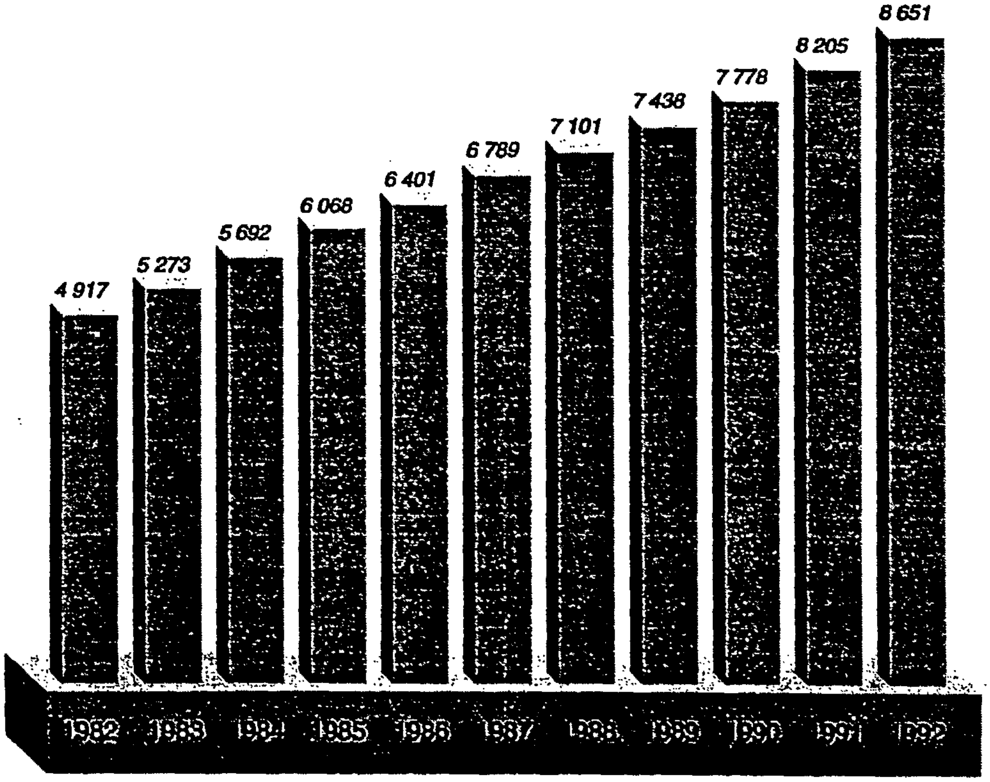
[1] For example, CSA was assigned responsibility for holding the secretariat and chairmanship of the international ISO/TC 176 committee, which is the committee responsible for the ISO 9000 series.

interest, not only to industry, but also to the general public, governments over the past two decades have taken an active interest in the work of ISO. For example, safety aspects have become more prominent: and thus, governments, in this respect, look to ISO -- and to IEC -- for preparing basic technical rules that could be referred to or used in national laws and regulations. The scope of international standardization has become much wider than ever before. Exhibit 2-1 provides an indication of the rapid, real growth of international standardization.

Exhibit 2-1
International Standards Published by ISO



Source: ***ISO in Figures*****, published by ISO, January 1993.**
Note: The data represented in this chart is cumulative (i.e., each year's figure is the total number of active standards published "to date").

An example of the standardization activities that take place under the auspices of ISO and IEC was recently described in the CIGOS News, fall issue, 1992. International experts from 18 countries met in Ottawa, from May 19 to June 3, 1992, as part of an ongoing effort to develop Open Systems Interconnection standards. The meeting of this committee, ISO/IEC JTC1/SC21 -- Information Retrieval, Transfer and Management for OSI, represented an international effort involving, in total, thousands of information technology experts. More than 350 delegates came to Ottawa, to represent their countries which included the United States, Japan, France, Germany and the United Kingdom. The Standards Council of Canada hosted the meeting with the support of both the SC21 Canadian Advisory Committee and various Canadian suppliers and users. The delegates managed to fill up the Government Conference Centre for almost two weeks. Canadian participation was strong, with more than 25 Canadian experts representing the needs of Canadian users and suppliers. Most of these experts provide their services on a volunteer basis with no or very little support from government.

ISO and IEC cooperate with many international, regional and national standardization bodies. Among these, one of the most important international bodies is the International Telecommunication Union (ITU). Telecommunications is a high-technology field which respects no borders. The importance of coordinating and facilitating cooperation between nations in this area is recognized by all countries. For this reason, ITU is charged with setting up international regulations of radio, telegraph, telephone and space radio-communications. It allocates radio frequencies and generally governs the area of international telecommunications standards.

ITU is set up as a "union" of member countries and is a specialized agency of the United Nations. There are over 160 ITU members. Unlike ISO and IEC, which are non-government organizations, the ITU is a mixed body comprising government and non-government representatives.

2.5 Standards Systems In Other Countries

2.5.1 The Standards System in the United States

In the United States, a comprehensive national standards policy is nonexistent. On a national level, responsibilities are shared by a select few organizations, with no formal link between them. The American National Standards Institute (ANSI) represents the U.S on international standards organizations. The anomalies of the American standards system are reflected in the fact that ANSI is one of the few non-government bodies holding membership on the two major international standards organizations, the ISO and the IEC, and one of only two member bodies not to receive any government funding.

ANSI coordinates the standards activities for U.S. participation in ISO and IEC. Many groups in the U.S. support ANSI as the central body responsible for the identification of and approval of voluntary standards. Standards developers and other participants contribute to the work of ANSI toward standards called American National Standards. ANSI approval of these standards is intended to ensure that a consensus of those directly and materially affected by the standards has been achieved, and that the needs of all parties concerned have been identified and met without conflict in their requirements and without unnecessary duplication.

Other non-government organizations involved in standards in the United States include the Institute for Electrical and Electronics Engineers (IEEE), and the American Society for Testing and Materials (ASTM). The IEEE was created in 1963 by merger of the Institute of Radio Engineers (IRE) and the American Institute of Electrical Engineers (AIEE). The IEEE is a private organization, including membership from a wide cross-section of engineering societies across the United States, Canada and Europe. Professional associations affiliated with the IEEE include the American Institute of Aeronautics and Astronautics, Association for Computing Machinery, American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Physics, etc. The Engineering Institute of Canada is also a member of the IEEE.

The American Society for Testing and Materials is also an active participant in the standards setting environment of the United States. About 80 percent of ASTM's income comes from sales of standards -- in comparison, sales of standards account for 28 percent of ANSI's income. Competition and turf battles among these and other standards setting bodies often revolve around these sales.[1] Such struggles are likely to become quite intense over the next few years, particularly with the growth of a world market for standards and the emergence of new global competitors.

In 1901, the American government established the National Bureau of Standards (NBS). The NBS was renamed the National Institute of Standards and Technology (NIST) in 1988, and given a fresh and refocused mandate. Neither NIST (nor ANSI, as the ISO representative body for the U.S.) can respond to all national demands or interests. Nor has either succeeded in coalescing the hundreds of federal, state, city or professional associations that write standards or administer certification programs into one national voice, responsive in all areas of standards policy. Exhibit 2-2 shows some of the major standards developers in the United States.

The reasons for the proliferation of standards developers in the U.S. are historical. Emerging intact from the Second World War, American manufacturers overtook international markets by default. Up to the 1960s, American influence over international technical standards was virtually complete. A national standards strategy, coordinated with developing trade

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[1] Office of Technology Assessment, *Global Standards: Building Blocks for the Future*, TCT-512, Washington D.C., U.S. Government Printing Office, March 1992, page 13.

initiatives, was not perceived as necessary because the standards of American manufacturers monopolized international registers. No apparent benefit existed to attract the support of elected officials for the creation of a standards umbrella organization in the United States.[1]

Exhibit 2-2
The Twenty Major Non-government Standards Developers in the U.S.A.

	Number of standards
Aerospace Information Association	3,000
American Association of Cereal Chemists	370
American Association of State Highway & Transportation Officials	1,100
American Conference of Governmental Industrial Hygienists	700
American National Standards Institute	1,400
American Oil Chemists Society	365
American Petroleum Institute	880
American Railway Engineers Association	300
American Society of Mechanical Engineers	745
American Society for Testing and Materials	8,500
Association of American Railroads	1,350
Association of Official Analytical Chemists	1,900
Cosmetic, Toiletry & Fragrance Association	800
Electronic Industries Association	600
Institute of Electrical & Electronics Engineers	575
National Fire Protection Association	275
Society of Automotive Engineers	5,100
Technical Association of the Pulp and Paper Industry	270
Underwriters Laboratories	630
U.S. Pharmacopeia	4,450

SOURCE: NIST Special Publication 806.

This situation is now gradually changing. The U.S. government is now pushing NIST to take on a greater role in the national standardization processes of the country. International developments brought about by the greater liberalization of trade in Europe and North America, and by the GATT developments over the past few years endorsing freer trade rules, are pressing hard upon American and Canadian voluntary standards infrastructures. "An influx of U.S.A. certification organizations will hallmark the Canada standardization scene throughout the 90s, whereas the U.S.A. will ultimately be required to consolidate national standards systems."[2]

A recent study in the United States by the Office of Technology Assessment demonstrates how the new international standardization order is being viewed increasingly by more stakeholders and policy makers in that country. The key

[1] Lloyd P. Duhaime, *The Impact of the Free Trade Agreement on Technical Standards*, Canada-U.S. Trade, Vol. 4, No.3, April 1991, pages 17-24.

[2] Ibid., p.20.

findings of that study are:

- *There is a growing national stake in standards issues.*
- *There is a clear need in the United States for greater attention to standards.*
- *The voluntary consensus process requires cooperation and trust rather than conflict to succeed.*
- *There is a need to strike an appropriate balance between the public and private sectors, and to work out their relationship with government.*
- *There is inadequate federal coordination and policymaking. While this is not a new problem, its consequences will be more serious in the future.*
- *There is a need for greater attention to how other governments use standards to create markets for their nations' industries.*[1]

Clearly, this study sees standards as increasingly taking a front row seat in the international trade negotiations and industrial competitiveness arena of the 1990s. The concern expressed in this study about the U.S. standards setting process and recommendations for greater government involvement are based on the notion that the existing U.S. approach no longer works as well as it should.

On the other hand, NIST, funded by government, has advanced considerably since 1988 and is progressively enhancing its capabilities to fulfill its mandate. NIST was established by the U.S. Congress with a view to assist industry in the development of technology necessary to improve product quality, to modernize manufacturing processes, to ensure product reliability and to facilitate rapid commercialization of products based on new scientific discoveries. The ultimate objectives of NIST are to strengthen U.S. industry's competitiveness, advance science, and improve public health, safety, and the environment.

NIST conducts basic and applied research in the physical sciences and engineering, including: electronics and electrical engineering; manufacturing engineering; chemical science and technology; physics; material sciences and engineering; building and fire research; computer systems; and computing and applied mathematics. The Institute also does generic and pre-competitive research and development work on new advanced technologies. It also develops measurement techniques, test methods, standards and related services.

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[1] Office of Technology Assessment, *Global Standards: Building Blocks for the Future*, TCT-512, Washington D.C., U.S. Government Printing Office, March 1992.

NIST also helps state and local governments ensure the equity of weights and measures in the marketplace. This is one of NIST's longest running and best known programs. It includes a certification program for state weights and measures laboratories in the areas of mass, length, and volume, as well as providing test protocols, certification training, and ongoing laboratory assistance.

NIST sponsors the Nationbal Conference on Weights and Measures, which involves over 3,000 industry and regulatory agency representatives, and program staff produce various manuals, handbooks, and other publications on matters related to physical standards and metrology.

NIST employs more than 3,000 scientists, engineers, technicians and administrative personnel, in addition to some 1,000 visiting researchers each year. Its annual budget is approximately $350 million. NIST acts as the GATT Enquiry Point for the United States.

It would appear that an infrastructure is in place in the U.S. which could address some of the issues brought up by the OTA report. However, it should be noted that American industry traditionally dislikes government involvement and centralization. The movement to create a federal government coordinating body on national voluntary standardization policy would not likely be received warmly.

2.5.2 European Community Standardization

Unlike the situation in the U.S., where several hundred organizations publish standards, each in its own domain, the European countries have centralized structures although, largely for historical reasons, the electrotechnical sector is an exception.

Because of this situation and because the national bodies all operate in a similar way, Europe has been able to play a key role in setting up an international standardization system patterned on national systems:

- *Sectoral technical committees bring together experts on topics in the work program for the preparation of draft standards. These unpaid experts come mainly from large industry organizations which look upon standardization as an essential investment for growth.*

- *A system of supporting structures, largely decentralized in national institutions, provides the logistic support needed and through the circulation of documents for public comment ensures that a consensus is attained.*

- *A system for the commercial publishing and distribution of the standards adopted.*

National variations around this basic pattern mainly concern the following aspects:

- *The percentage breakdown of the types of financial resources available to the standards institutions: voluntary contribution from industry, sale of standards and similar services (for example certification), public subsidies.*

- *The extent to which the structures basically responsible for preparing draft standards are centralized: they may either come under the auspices of trade associations (partially the case in France) or be integrated in the national institution itself (United Kingdom).*

- *The degree to which they are dependent on the public authorities, ranging from complete independence (Switzerland, for example) to the case of Portugal where the institution is a department of the Ministry of Industry; similarly the idea of "public service" generally associated with standardization may be defined either contractually between the State and the institution (as in Germany and the United Kingdom) or by regulation (France, Italy and Spain).*

- *Finally, the size of the institution which may range from a staff of approximately 100 (Italy, Denmark, Spain) to over 1000 (Britain -- BSI) when the institution has built up numerous services complementary to standardization proper.*

Since the emergence of the European Economic Community, with all the political and trade ramifications associated with it, Europe has generally placed a very high priority on its regional standards development process. The European countries have agreed to harmonize standards and standards development on their continent. One of the principles is to adopt ISO and IEC standards as CEN or CENELEC standards (see below for descriptions of these two European standardization bodies). The "Vienna Agreement" (1991) between ISO and CEN aims to minimize duplication of effort between CEN and ISO and maximize the use of standards by CEN. It calls for the use of methods such as parallel voting. A similar arrangement exists between IEC and CENELEC.

The following are descriptions of the main European regional bodies that are now actively shaping the future of standardization, not only for Europeans, but also for all countries doing business with Europe.

European Committee for Standardization (CEN)

The European Committee for Standardization (CEN) is the European organization responsible for the planning, drafting and adoption of European standards (with the exception of those pertaining to the two sectors of electrotechnology and telecommunications). The main purpose of CEN is to draw up European standards to promote the competitiveness of European industry throughout the world and to help establish the European internal market. Its procedures guarantee respect for the following principles:

- *openness and transparency: all interested parties take part in the work program;*
- *consensus: standards are developed on the basis of voluntary agreement between the interested parties;*
- *national commitment: formal adoption of European standards is decided by a majority vote of the CEN national members; and*
- *technical coherence at the European and national level: standards form a collection, which ensures its own continuity for the benefit of users.*

CEN is a non-profit-making international association of a scientific and technical nature registered in accordance with Belgian law. CEN shares its premises in Brussels with its sister organization, CENELEC (see description below). These two organizations together constitute what is commonly called the Joint European Standards Institution.

The size of CEN is steadily increasing as European standardization develops. It consists of 18 national standards institutions in the member countries of the European Economic Community and the European Free Trade Association (EFTA).

European Committee for Electrotechnical Standardization (CENELEC)

The European Committee for Electrotechnical Standardization (CENELEC) is a not-for-profit organization composed of National Electrotechnical Committees of approximately 20 countries in Western Europe. It was originated officially in 1959 by the National Electrotechnical Committees of the Common Market member countries at that time, and operated under the name of "The Group of Six". In 1963, this group changed its name to CENELCOM. Later, in 1973, in accordance with the growth of the Common Market, CENELCOM merged with CENEL, an organization of 13 National Electrotechnical Committees from the European Community and the European Free Trade Agreement countries, and changed its name to CENELEC.

The aim of the CENELEC is to prepare a single set of harmonized European electrotechnical standards in order to achieve the free market for goods and services inside Europe. Its objective is to remove any differences of technical nature, either between the national standards of the members of the CENELEC or between measures applied at the national level to certify conformity, that could give rise to technical barriers to trade.

Where necessary and appropriate, the CENELEC prepares European standards, related to new areas of technology, in collaboration with its sister organization CEN. Collaboration of other bodies may also be appropriate, such as CEPT, the European Conference of Posts and Telecommunications Administrations and ETSI, the European Telecommunications Standardization Institute, for subjects related to information technology including telecommunications. Problems related to the certification of products are also considered.

European Conference of Postal and Telecommunications Administrations (CEPT)

The European Conference of Postal and Telecommunications Administrations (CEPT) was founded in 1959 as a restricted Union, acknowledged by the deeds of the Universal Postal Convention. Since its inception, its objectives have been to establish closer relations between member administrations and, to harmonize and improve their administrative and technical services. Today, the CEPT's membership consists of postal and telecommunications administrations from more than 30 European countries.

In general, the activities of CEPT include: facilitating the settlement of accounts and rationalizing work among member administrations; organizing training courses, seminars and symposia; promoting standardization of tariffs, procedures and specifications for posts and telecommunications; and conducting studies. More specifically, CEPT Posts concentrates its efforts on improving and coordinating the structure and function of postal services, the simplification of procedure and the development of a range of products.

CEPT Telecom, on the other hand, is responsible for telecommunications policy within CEPT, with the goal to: achieve effective operation and interconnection of telecom services between member countries; promote development of new products and services; and coordinate, with a view to increase the development of international communications, especially within the ITU (International Telecommunication Union) framework.

European Telecommunications Standards Institute (ETSI)

The European Telecommunications Standards Institute (ETSI) was established in 1988 to create common technical standards in the field of telecommunications throughout Europe and to enhance the efficiency of communications across European industry. The members of ETSI consist of administrations, public network operators, manufacturers, users and private service providers, and research bodies from 21 European countries.

The ETSI operations include technical pre-standardization and standardization, at the European level, in the area of telecommunications. In areas common to telecommunications and information technology, ETSI operates subject to decisions made by the IT Steering Committee (ITSTC). Similarly, in areas common to telecommunications and, sound and TV broadcasting, the Institute cooperates with other concerned organizations such as the European Broadcasting Union (EBU).

The Project Teams of the ETSI are held responsible for preparing specifications and reports about terminal equipment, while the Technical Committees are accountable for work related to terminal equipment, switching protocols and signaling, network aspects, transmission and multiplexing. The Institute also conducts studies on open network provision interfaces, broadband ISDN networks, improved type approval test requirements and radio equipment.

European Free Trade Association (EFTA)

The European Free Trade Association (EFTA) was established in 1960, on signature of the Stockholm Convention, by government officials of Austria, Denmark, Norway, Portugal, Sweden, Switzerland and the U.K. Today, after various membership transformations, the EFTA member countries include Austria Finland, Iceland, Norway, Sweden and Switzerland.

The objectives of the EFTA are:

- *to promote, in the area of the Association and its member countries, a sustained expansion of economic activity, full employment, increased productivity and a balanced use of resources, financial stability and continuous improvement in living standards;*
- *to assure conditions of fair competition in trade between member countries;*
- *to avoid significant discrepancy between member countries in the conditions of supply of raw materials produced within the area of the EFTA; and*
- *to contribute to a unified development and expansion of world trade and to advance the removal of barriers to this.*

In cooperation with the European Community (EC), the EFTA established the European Economic Area (EEA) Treaty. The Treaty is primarily concerned with the free movement of goods, the free movement of services and capital, the free movement of persons, border and horizontal policies, and legal and institutional issues.

2.5.3 Germany

Deutsches Institut für Normung (DIN)

The Deutsches Institut für Normung (DIN) is a private, non-profit association which was founded in 1917. The DIN standards are recognized by industry, trade, labour unions, consumers and government as accepted rules of technology and are established according to the following principles:

- standards are voluntary in nature;
- standards projects and drafts are made available for public comment;
- all interested parties can participate;
- DIN standards form a unified and consistent whole;
- they keep to the technical matter in hand;
- they are geared to technological development;
- they are matched to economic conditions; and
- they are geared to the benefit of the community as a whole.

The DIN has published over 21,000 German standards to date.

To promote the implementation of standards, the DIN organizes training courses, regular exchange of experience among standards practitioners, and also participates in the field of certification and quality assurance. The organization's publishing house, Beuth Verlag, provides 56 per cent of its total budget through its sale of standards and associated technical literature in printed form, on microform and on electronic media.

DIN has an important presence in Germany. DIN employs over 900 people, and has offices in 40 locations nationwide. Many Germans are aware of the importance of standards, and knowledgeable about DIN's role in their development. Moreover, the Germans have an excellent reputation for standards development, so many other European countries look to Germany for standards.

2.5.4 France

Association française de normalisation (AFNOR)

The Association française de normalisation (AFNOR) was founded in 1926 to replace the Permanent Standardization Commission, which fell through due to lack of funds. Since its inception, the organization enjoyed the status of a private, non-profit association. By government decree, in 1943, it was subsequently recognized as a public service. By the decree of January 26 1984, the Ministry of Industry and Research became the national government department responsible for the status of standardization in France.

AFNOR is the main standardization body in France, incorporated by private law and recognized by government. It has no "test-house" responsibilities; but, for purposes of developing standards and within the context of certification, it is assisted by a great many specialized, officially recognized laboratories.

AFNOR has published approximately 17,000 French standards since its onset. Most of these standards are in the areas of mechanical engineering, ores and metals, chemical and allied industries, transport and distribution, and electrotechnology.

France ranks third, after Germany and the U.S., in its production of standards. AFNOR publishes or revises about 1,100 standards a year. AFNOR's annual budget is about $42 million, of which 40% is a government subsidy. The rest comes from sales of standards and publications, and membership fees (about 6,000 members, most of whom are corporate).

AFNOR has a staff of about 450 persons, 45% of which are involved in technical standards writing.

AFNOR is responsible for precision and consistency in developing the standards needed for the French economy. Essentially there are six major missions of AFNOR:

- evaluating needs for standardization;
- setting up standardization strategies;
- allocating resources;
- leading the standards system;
- taking part in European and international standardization;
- motivating AFNOR's partners which make up the French standards system.

2.5.5 United Kingdom

British Standards Institution (BSI)

The British Standards Institution (BSI) was the world's first national standards body to be established (1901). In 1929, the organization was incorporated by Royal Charter, including the following objectives:

- to coordinate the efforts of producers and users for the improvement, standardization and simplification of engineering and industrial materials;
- to establish standards of quality and dimension, and prepare and promote the general adoption of British standard specifications;
- to register, in the name of the Institution, marks of all descriptions; and
- to take such actions as may appear desirable or necessary to protect the objects or interests of the Institution.

The BSI is financed by industry, matching government grants, revenues generated from sales of standards, membership fees (from approximately 117,000 corporate members) and testing and certification fees. The annual budget of BSI runs at approximately £47 million (sterling), and as of 1990 had published 10,979 standards. BSI employs over 1,200 staff, of whom roughly 650 work directly on standards development and certification, 340 on quality control and testing and 50 on technical assistance to exporters. BSI represents the views of British industry at ISO and IEC.

2.5.6 Japan

Japanese Industrial Standards Committee (JISC)

The Japanese Standards System (JSS) is organized on very different principles than its North American or European counterparts. There are two components of the JSS: the national standards system, where government is the central actor, and the group standards system, which is developed and administered primarily by industry associations.

The Japanese national standards system is highly centralized, tightly controlled by government, and based on volunteer efforts and a consensus process. The group standards system is also primarily voluntary and centres around private industry associations which write and administer standards.

Unlike in Canada, where the SCC reports to Parliament through Consumer and Corporate Affairs, the Japanese Industrial Standards Committee (JISC) derives its legal status by affiliation with the Japanese Ministry of International Trade and Industry (MITI).

JISC was established under the Japanese Industrial Standardization Law of 1949 as an advisory organization to support Ministers in charge of the development of Japanese Industrial Standards (JIS) and the designation of the JIS mark to products.

As of 1992, over 8,400 JIS standards had been published covering all fields of industrial and mineral products, as developed by relevant Ministries under the provision of the Industrial Standardization Law. These JIS standards do not include standards developed for medicines and medical products, agricultural chemicals and chemical fertilizers, food, and other agricultural products, which are established under other laws.

The Industrial Standardization Law does not cover the "group standards" activities. These are standards established by industrial associations, academic societies, institutes, etc., on a voluntary basis, to promote the diffusion of their own group standards as a part of their business activities. These organizations number over 300 and between them have established over 5000 standards.

2.5.7 Australia

Standards Association of Australia (Standards Australia)

The Standards Association of Australia is an independent, not-for-profit organization. Established in 1922, it operates under a Royal Charter and brings together individuals and organizations committed to establishing standards as benchmarks for products and services. In 1988, a Memorandum of Understanding was signed with the Commonwealth Government which acknowledged the Standards Australia as the peak standards development organization in Australia as well as giving it responsibility for representing Australia in the international standardization arena.

Standards Australia consists of three main divisions: Standards Writing; Quality Assurance Services; and Australian Design Council. It has published more than 4,500 standards, many of which are in the areas of mechanical engineering and building and construction.

2.5.8 Republic of Korea

Bureau of Standards

The growth of industries since the 1950s in Korea has brought about a new social climate in which the need and benefit of mass production is strongly felt among manufacturers. The government of Korea felt the need to foster industrial standardization and to improve the quality of domestic industrial products for export and domestic consumption. In 1961 the Government promulgated the Industrial Standardization Law which regulates the nation-wide standardization activities in Korea. Simultaneously, the Bureau of Standards (KBS), responsible for the administration of industrial standardization, was set up under the Ministry of Commerce and Industry; it was then reorganized under the Industrial Advancement Administration in the structural reformation of the Government on January 16, 1973.

The business of KBS involves primarily the preparation of standards, certification/marking of goods, and metrology. The KBS is a government department.

2.5.9 Mexico

Dirección General de Normas

The Dirección General de Normas (DGN) of the Ministry of Trade and Industrial Development, created by decree in 1943, is the official body directly in charge of standardization activities in Mexico. Its objective is to promote the development of standards through several committees and sub-committees working in the main fields of industry. It also carries out metrological activities, especially dealing with secondary standards, and technical studies as an industrial support activity. It is also in charge of the official guarantee mark NOM (Norma Oficial Mexicana) and the compulsory standard official mark, which are government certification marks for products of certified quality.

The DGN is a founding member of ISO and is the representative of Mexico at the International Conference on Laboratory Accreditation (ILAC). It counts quality control promotion activities as one of its main duties.

2.6 Country Comparisons

As indicated in the previous section, all of the advanced trading partners of Canada have national standards bodies of one form or another. All have the following main functions in common:

- *to draw up and secure the approval of national standards;*
- *to promote the adoption and application of standards;*
- *to maintain the quality of products and certify that they comply with standards;*
- *to disseminate information on standards and other related technical matters at both national and international levels;*
- *to represent its country in international standardization work.*

Although all the 92 ISO member countries now have their own standards bodies, such bodies differ significantly in terms of the way in which they are organized, their size and the range of work they undertake.

The national standards body may in some cases be run directly by the government, or it may be completely out of the hands of the government, subsidized and managed primarily by private industry. Most arrangements clearly fall between these two extremes, and in fact the degree to which the government participates in the work of national standards organizations varies considerably throughout the world. See Exhibit 2-3 for a comparison of selected countries in terms of government involvement and sources of financing.

The United States is among the most decentralized systems: There are more than 400 independent standards-setting bodies. The ANSI acts as a clearing-house and central coordinating body. It has the authority to designate an industry standard as an American National Standard, subject to the standard and the formulating body adhering to certain principles of due process. ANSI primarily derives its importance from the fact that it is the official U.S. representative for international standardization activities. However, as mentioned earlier, traditionally in the U.S. industry has shunned national centralized bodies, and ANSI is involved to a certain extent in this capacity only "by default", since the ISO rules stipulate that only one national body can represent a country.

Government in Japan on the other hand is more involved in the standardization process. In fact, the Japanese Industrial Standards Committee (JISC) submits voluntary standards for approval by the relevant

Exhibit 2-3
Comparison of National Standards Systems

NATIONAL STANDARDS ORGANIZATION	FINANCING	GOVERNMENT INVOLVEMENT
Canada Standards Council of Canada (SCC)	- arm's length Crown Corporation - Parliamentary appropriation (90%)	- government members on SCC - government members (generally 1) on advisory committees - government participation in technical committees
United States American National Standards Association (ANSI)	- private, non-profit - funds from membership and sales	- technical committees may include federal and state government officials
France L'Association française de normalisation (AFNOR)	- 40% government funding - funds from membership and sales	- half of AFNOR Advisory Committee from government
United Kingdom British Standards Institute (BSI)	- 17% government funding - reports to Parliament - funds from sales, certification, and testing fees, membership	- BSI-government MOU on use of standards in regulation and procurement - government contributes to independent certification organization
Japan Japanese Standards Association(JSA)	- non-profit - funded by government and industry	- centralized government control, with extensive industry participation

Source: Standards in Canada: Federal Policy and Regulatory Practice Into the 1990s, Office of Privatization and Regulatory Affairs, Ottawa, September 1989.

Minister (usually the Minister of International Trade and Industry). Government procurement, both national and local, must conform to Japanese Industrial Standards thus approved. JISC is the representative of Japan to the ISO.

In France, Bureaux de Normalisation (Standards Offices), of which there are twenty-four, have been set up on a sectoral basis to draw up draft standards within committees in which the parties concerned are represented. These Bureaux are coordinated by the Association Française de Normalisation

(AFNOR) which, before approving the drafts that are submitted to it, checks that the requisite consensus has been reached.

The German standardization system makes no distinction between sectoral offices and a national agency and is therefore based on a single body, the Deutsches Institut für Normung (DIN). Its effectiveness relies upon the strength of collaboration between different economic actors, which results in strong participation by industry in the process of standardization.

In the United Kingdom, standardization also involves a single body, the British Standards Institution (BSI), which has a special committee for electrotechnical fields. Unlike their North American counterparts above, BSI, DIN, and AFNOR are also involved in certification, to varying degrees, which explains their larger budgets, shown in Exhibit 2-4.

Some of the difference shown in Exhibit 2-4 thus relate to variations in the basic functions of the bodies in question. BSI with the larger budget, due to its additional conformance-testing activities (it has its own test laboratories), produces fewer standards than its European counterparts shown in the Exhibit. After this is taken into account, the most active standards institute turns out to be DIN.

Exhibit 2-4
Scale of Selected National Standards Bodies, 1989

		1989 Budget	Standards Published Total as of 1989
France	(AFNOR)	$42,000,000	13,564
U.S.A.	(ANSI)	$ 8,800,800	8,500
U.K.	(BSI)	$60,000,000	10,420
Germany	(DIN)	$55,000,000	20,000
Canada	(SCC)	$ 8,460,000	1,389

Source: Audit report on the Association française de normalisation (AFNOR) made by A.Giscard d'Estaing, Inspector of Finances, Inspection Générale des Finances, No. 89-057.
Note: Figures reported may differ from those reported in text, due to year of reporting. In this table all data is for 1989.

In order to identify which countries play the most important roles in the international standardization process, a simple indicator shown in Exhibit 2-5, is provided by an analysis of the national distribution of secretariats of joint ISO and IEC working groups and technical committees. The following observations can be made on this basis:

- *Nine countries, all OECD members, assume the central responsibilities for standardization in the ISO. This has perhaps facilitated consensus approaches in the past.*

- *The four leading countries (Germany, United Kingdom, United States and France) account together for almost 65 per cent of the secretariats. The sum of EEC members secretariats (France, Germany, Netherlands, United Kingdom, etc.) forms a very strong majority block.*

- *Japan -- a late-starter in the international standardization effort but a leader in technology -- is very far behind, which underlines the difficulty of "catching up" institutionally.*

- *This table clearly indicates that Canada (sixth in rank overall) is a relatively active participant in international standardization, in comparison to some of its major trading partners.*

Exhibit 2-5
ISO/IEC Technical Committees, Sub-Committees and Working Groups -- Distribution of Secretariats

		Number of Secretariats	Percentages
DIN	Germany	495	19.2
BSI	U.K.	434	16.8
ANSI	U.S.A.	392	15.2
AFNOR	France	319	12.4
SIS	Sweden	108	4.2
NNI	Netherlands	82	3.2
SCC	Canada	77	3.0
UNI	Italy	65	2.5
JISC	Japan	61	2.4
GOST	Russian Fed.	52	2.0
SAA	Australia	40	1.6
	All Others(1)	455	17.6
	TOTAL	2580	100.0

Source: *ISO Memento*, 1993.

Note: (1) Includes 285 for all other countries plus 170 for technical committees, sub-committees and working groups which have no secretariat. Does not include JTC1, and does not include 25 ad hoc study groups.

2.7 The Interface With Technology Issues and Competitiveness

2.7.1 Globalization Promotes International Standards

With globalization of the world economy, participation in international standards organizations becomes a central concern of governments and industry because standards help to determine the competitiveness of firms, especially as the world economy becomes more reliant on technology.

Europeans have long recognized the relationship between standards and trade, not only to create a common market, but also as a marketing device to sell their products. The Japanese have also used standards effectively to improve productivity and add value to their products, not to mention their use as non-tariff barriers. The U.S.A., on the other hand, which until recently could impose itself on the world, is only now adjusting to a changing world economy and recognizing the link between standards and international competitiveness. As noted in the recent OTA report:

> *"... There is a clear need in the United States for greater attention to standards. In an information-based global economy, where standards are not only employed strategically as marketing tools but also serve to interconnect economic activities, inadequate support for the standards setting process will have detrimental effects."*[1]

Standards setting can reduce uncertainty in a rapidly changing technological environment. Participants in the process learn first hand about new technologies and transfer that information back to their firms or government agencies. This in itself is technology diffusion which can help firms to upgrade themselves to meet emerging standards. In the case of Japan, for example, many of the representatives that participate in the international standards-setting bodies are from private sector companies with divisions expressly set up to deal with standards and standardization. When these private sector representatives return to their companies they are in a good position to disseminate the knowledge throughout their corporate environment.

In a world economy where it is becoming increasingly difficult to determine the origin of a finished product, be it a car or PC (see Exhibit 2-6, for example), standards become the unifying concept that enable all the parts to

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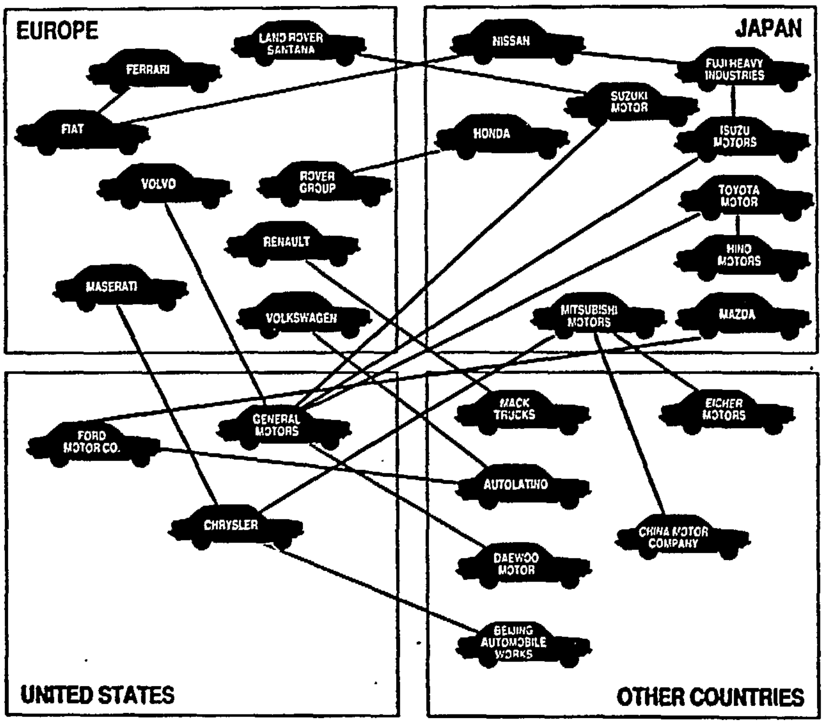
1 Office of Technology Assessment, *Global Standards: Building Blocks for the Future*, March 1992, p.9.

match and work together. In an information economy international and national communications networks have to interconnect or a country's economy will suffer, not to mention the risks to national security.

Given the high stakes of international competitiveness, governments increasingly support standards setting in the international arena.

Exhibit 2-6
Network of Product Origination and Alliances



Source: Delvin & Bleackley, *Strategic Alliances – Guidelines for Success*, October 1988.

2.7.2 Standards and Industrial Policy

While there is a push towards international standards, there is also the opposite pull to use standards to support national and regional industrial strategies.

At the national level, Japan, as is well known, has used standards as non-tariff barriers.[1] However, it has also used standards in more positive ways such as to control product quality and thereby promote trade. The Japanese have a rigorous procedure for testing and certifying standards which the U.S. said was another form of non-tariff barriers. In 1983, Japan agreed to accept the results of foreign testing organizations. The CSA has a reciprocal certification agreement with Japan.

European countries have also been known to use standards as non-tariff barriers. However, with the unification of the European market, the focus for standards setting is shifting to the Economic Community (EC) level and resources are being reallocated accordingly (see Exhibit 2-7, for example). This shift is associated with the harmonization of national standards within the EC. As well, EC level R&D programs are devoting significant financial resources towards research on standards.[2]

The products of non-European firms wishing to do business in Europe have to meet European standards as certified by accredited laboratories. The CSA has agreements with major European counterparts and Canada has entered into discussions with the EC regarding a Mutual Recognition Agreement (MRA) on conformity assessment.

However, Europeans are insisting that they are not creating a "Fortress Europe" by pointing out that 85 per cent of all CEN and CENELEC standards are based on international standards. On the other hand, they also point out that only 22 per cent of U.S. national standards are based on international standards.[3] This difference has implications for the possible emergence of regional standards in North America under NAFTA. Major mismatches could affect the flow of technology.

Standards are also marketing tools within an industrial policy context. The new sizeable markets are in the less developed countries. Therefore, as a prelude to technology transfer, diffusion and trade, industrialized countries focus on helping developing countries to set up national standards programs based on their own programs. For example, Canada has been active in providing expertise and hosting professionals from Malaysia for development in the standards field. The Standards Council of Canada in this respect has a close relationship with the Standards and Industrial Research Institute of

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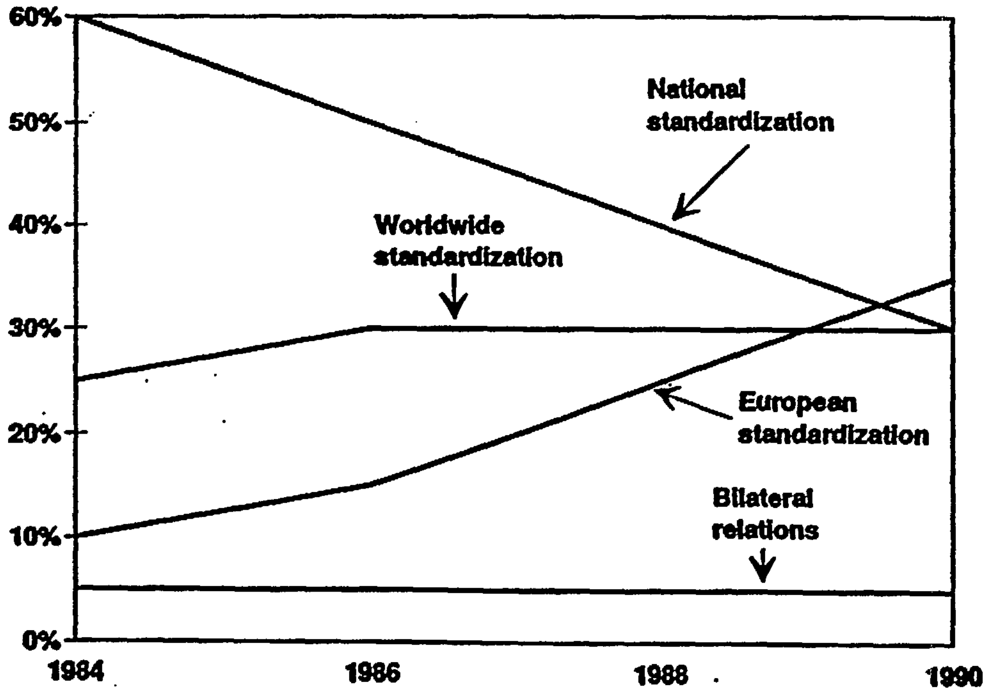
[1] A notorious case was that of the Japanese standard for baseball bats, which prevented the United States from exporting baseball bats to Japan. The case was eventually resolved at the GATT.

[2] The ESPRIT program (Phase 1) spent 12% on standards related R&D.

[3] OTA report, *Global Standards...*, op. cit.

Malaysia. Canada is also active in providing proffessional standards consulting in the Caribbean. The EC and Germany have provided $16 million to help establish an electronic component test laboratory in India. This aid includes training in standardization in Germany, U.K., Netherlands and Ireland. The EC has given Mexico $1.5 million in consultation and training in standardization, testing and quality system certification. The Japan International Cooperation Agency has conducted a major study of the Philippines national standardization system and provided a $23.1 million grant to establish three regional laboratories.

Exhibit 2-7
Resources Devoted by DIN to the Various Levels of Standardization in Percent of Total Budget



Source: Deutsche Institute für Normung, 1991.

2.7.3 Standards and Multinational Firms

Multinational firms (MNFs) have their own agenda which is not necessarily coincident with that of the home countries in which they operate. With their global reach, MNFs participate in a variety of international and regional standards bodies where they pursue their corporate goals. Increasingly these corporate goals are linked to seeking comparative advantage by integrating their activities on a worldwide basis which means keeping abreast of and influencing international standards. For example, IBM is also a European company which participates in ETSI through each of its six European subsidiaries. IBM gains from this participation but does the U.S.?

An example of a conflict between corporate and national policy was the 1991 ETSI decision on patented standards. This policy would have required patent holders to license the standard only to EC producers or to producers in countries that adopt the EC standards. Such a policy would have prevented U.S. firms from using the patent. However, the most active supporter of the policy was the British subsidiary of Motorola.

There is a view that MNFs are being superseded by the "relationship-enterprise", a network of strategic alliances among large firms, spanning different industries and countries, but held together by common goals which encourage them to act almost as a single firm.[1] These new arrangements have implications for the development of common standards to encourage technology diffusion. For example, Boeing and the three Japanese firms with which it is building the 777 airliner, have created a trans-Pacific telecommunications system to link their design operations.

2.7.4 Canada in the World

Canada is an export led open economy. To maintain its place in the world, Canada is a major importer of technology, much of it embedded in intermediate products that support our exports, as evidenced in a recent OECD study[2] (see Exhibit 2-8). Technology imports of intermediate inputs vary by sector, with some of the advanced technology sectors being the most active importers (see Exhibit 2-9). This means that Canada needs to participate actively in international standards organizations to obtain "intelligence" on, and influence where possible, upcoming standards and

+ suite.

[1] The Economist, February 6, 1993, p.69.

[2] OECD, *The International Sourcing of Manufactured Intermediate Inputs*, DSTI/ST11/IND/92(1) REV(1).

regulations being set in other countries or regions that can affect products developed abroad that will find their way into Canadian industry. This information, which is of value to Canadian firms is a form of technology diffusion. Advanced knowledge of upcoming standards creates a more stable environment which helps Canadian firms to develop product development strategies and governments and Canadian standards setting bodies to develop positions vis-à-vis the international standards setting environment.

While the multinational firms based in Canada can obtain information regarding emerging international standards from within the firm such is not the case with small and medium sized firms (SMEs) which usually meet standards in the marketplace. There are therefore several issues related to standards and technology diffusion in SMEs (see Section 3.3).

In the emerging global economic environment Canada, as a smaller export-oriented economy with a limited technology-intensive industrial base, will be very much a "taker" of international standards. This is bound to accelerate the diffusion of the technology needed to meet these standards so that products can be traded easily internationally. The situation will be particularly acute in technology intensive sectors with short product life cycles where technology will likely have to be purchased rather than be developed in order to meet the "time to market" requirements. In this context, purchasing could mean either buying a license, acquiring a firm or becoming involved in a strategic alliance to lower risks and accelerate development.

With the harmonization of standards worldwide supported by various formal agreements, Canada could possibly become a favoured site for product testing and certification because of our lower cost structure. For example, the CSA has stated that, "at the current time, our hard charges for certification run about 30% cheaper than the similar kind of service in the United States."[1]

Key issues related to Canada's participation in the international standards setting environment that affect technology diffusion are presented in the following sections.

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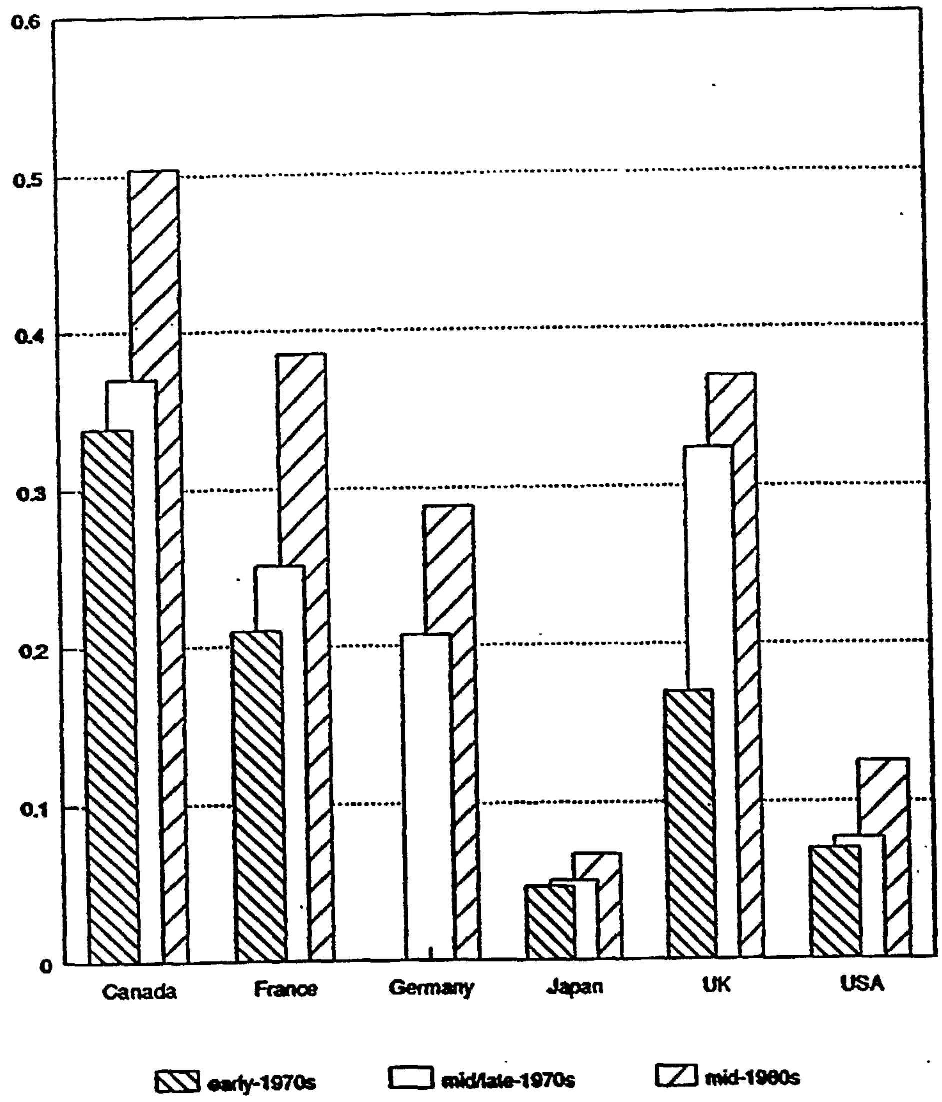
[1] Ridout, P.; Director, Government and Industry Relations, Canadian Standards Association; "Presentation to the Sub-committee on Regulations and Competitiveness", June 16, 1992.

Exhibit 2-8
Ratio of Imported to Domestic Sourcing of Inputs
Average of Manufacturing Goods



Source:

The International Sourcing of Manufactured Intermediate Inputs: by Canada, France, Germany, Japan, the United Kingdom and the United States, DSTI/STII/IND/92(1)/REV(1).

Exhibit 2-9
Ranking of Intermediate Inputs
by the Ratio of Imported to Domestic Sourcing

	Canada 1986	France 1985*	Germany 1986	Japan 1985	UK 1984	USA 1985
1	Motor Vehicles *4.8*	Instruments *1.7*	Computers *1.2*	Aerospace *0.6*	Aerospace *3.2*	Other Manufacturing+ *0.4*
2	Computers *3.2*	Non-ferrous Metals *1.0*	Non-ferrous Metals *0.9*	Non-ferrous Metals *0.4*	Non-ferrous Metals *1.3*	Computers *0.3*
3	Aerospace *2.1*	Chemicals *0.8*	Textiles, Apparel & Footwear *0.6*	Computers *0.2*	Chemicals *0.7*	Comm. & Semi. Equipment *0.3*
4	Comm. & Semi. Equipment *2.0*	Computers *0.8*	Aerospace *0.6*	Petroleum Refining *0.2*	Computers *0.6*	Motor Vehicles *0.3*
5	Instruments *1.4*	Comm. & Semi. Equipment *0.7*	Petroleum Refin-ing *0.6*	Food, Drink, & Tobacco *0.1*	Comm. & Semi. Equipment *0.6*	Instruments *0.2*
6	Non-elec. Machinery *1.3*	Non-elec. Machinery *0.5*	Electrical Machinery *0.4*	Wood, Cork & Furniture *0.1*	Wood, Cork & Furniture *0.6*	Shipbuilding *0.2*
7	Other Transport@ *0.9*	Petroleum Refining *0.4*	Chemicals *0.4*	Textiles, Apparel & Footwear *0.1*	Electrical Machinery *0.5*	Other Transport@ *0.2*
8	Textiles, Apparel & Footwear *0.6*	Other Manufacturing+ *0.4*	Instruments *0.3*	Pharmaceuticals *0.1*	Petroleum Refining *0.5*	Ferrous Metals *0.2*
9	Non-ferrous Metals *0.6*	Textiles, Apparel & Footwear *0.4*	Non-elec. Machinery *0.3*	Chemicals *0.1*	Motor Vehicles *0.5*	Non-elec. Machinery *0.1*
10	Electrical Machinery *0.5*	Ferrous Metals *0.3*	Motor Vehicles *0.2*	Instruments *0.1*	Textiles, Apparel & Footwear *0.5*	Electrical Machinery *0.1*

*** French data are in constant 1980 French Francs; all other countries are expressed in current domestic currencies.**
@ Other Transportation includes railroad equipment, motorcycles, bicycles, and travel trailers and campers and other transportation not elsewhere classified.
+ Other Manufacturing includes jewelry, musical instruments, toys, sporting goods, pens and pencils, and other manufacturing, not elsewhere classified.

Source:

The International Sourcing of Manufactured Intermediate Inputs: by Canada, France, Germany, Japan, the United Kingdom and the United States, DSTI/STII/IND/92(1)/REV(1).

3.0 ISSUES IDENTIFICATION

The following is a set of frequently mentioned issues that have been identified to this point in the study. In one way or another, these standards related issues which fall within the mission statement for this study touch on Canada's international competitiveness as well as on technology diffusion. Many of the issues relate to SMEs which represent the bulk of the firms making up Canada's industrial base. SMEs have more difficulty relating to Canada's standards system, than do the larger firms which participate more actively in the standards setting process.

3.1 Canada in the International Standards Setting Environment

As described in Section 2.7 there are major shifts taking place in the world economy which impact directly on standards activities. The compatibility of standards around the world is a critical issue that affects firms trading, developing technology and investing internationally. The representation of Canadian interests in various international standards setting bodies is becoming increasingly important. A number of issues related to Canada's involvement internationally are presented below.

3.1.1 The Lack of a Strategic Approach to the Use of Standards vis-à-vis International Competitiveness

In an international environment of "foot loose" firms that undertake various operations (e.g. production, R&D) in jurisdictions providing them with a competitive advantage, decisions on standards become very important. Decisions on standards and how they are applied will help to shape the productivity and competitive advantage of firms and by extension the well-being of national economies. Therefore, a strategic approach to the use of standards becomes essential. This approach should build on the stated policy of the Standards Council of Canada, that international standards should be adopted in Canada when they are available.

Canada does not have a strategic approach to standards at the international level. However, Canada is involved in a number of ways at the international level including:

1. Trying in GATT, NAFTA etc. to ensure that trading partners

    - use technical requirements only for legitimate objectives
    - restrict trade no more than needed to achieve objectives
    - regulate transparently

2. Canadian stakeholders (federal/provincial government departments, SCC, standards organizations, industry) keep informed about international standards developments and consult on development of appropriate Canadian strategy.

3. Canadian exporters obtain information on foreign requirements from GATT Enquiry Point (SCC), seminars

4. Encouraging development of international links (e.g. Canada-U.S.A.-Mexico private sector standards trilateral) and negotiation by industry and government of agreements on
   - mutual recognition of measurement and test results/certification in respect of selected goods and services
   - harmonization of standards

5. Discussing with EC negotiation of what would be Canada's first cross-sectoral mutual recognition agreement.

6. Participating in standardization activities of ISO and other international standards organizations for policy implications and coordinating activities where resources permit.

7. Working to improve coordination between national and international activities of Canadian standards development organizations and those of government.

8. Addressing access problems in export markets by appropriate use consultation and other mechanisms for resolution of differences in GATT and other agreements.

9. Assisting less developed countries in the implementation of standards.

Issue: Are such initiatives a de facto strategy?
Are they sufficient?

3.1.2 The Adequacy of Canada's Level of Participation in International Standards Setting Bodies

Canada has a significant level of influence and an excellent reputation in international standardization bodies such as ISO and IEC. This is the result of a long term investment in participation in these international standards-setting bodies.

With globalization of the world economy, the importance of international standards is increasingly dramatically. Countries and regions (e.g. EC) are putting more effort in international standards-setting and participation in relevant international bodies. New bodies are emerging in Asia, South America and Africa. On the other hand, because of budgetary restraints, Canada appears to be cutting back on its participation in international standards-setting bodies and in the support of the thousands of people involved (mostly on a volunteer basis) in the Canadian standards setting system.

Issue: Does Canada have an adequate level of participation in international standards-setting bodies? What level and type of participation is needed to maintain an effective presence?

3.1.3 The Effectiveness of Information Transfer Mechanisms related to International Standards Setting

Timely information on proposed and newly formulated international standards is of strategic importance to firms for their product development efforts.

Larger firms which participate actively in international standards-setting or have the resources to obtain this information use this information to advantage. However, small and medium sized entrepreneurs (SMEs) usually meet international standards in the marketplace because they are not closely involved with international standards-setting.

SMEs are increasingly thrust onto the international marketplace in a rapidly changing international environment. Also, because of a limited Canadian market, firms have to export early-on in their development. A large number of technology-intensive SMEs have to export more than 70% of their production to survive. Information on the international standards environment is essential. Smaller firms usually turn to their industry associations for assistance. However, most associations have limited resources and usually find themselves in a reactive posture regarding the impact of international standards on their membership.

The Standards Council of Canada does provide information, including a newsletter. Are there ways of streamlining this information for specific groups?

Issue: How can information on the development of international standards be passed on to firms, especially SMEs in the most effective manner possible?

3.1.4 The Lack of Communication Between the Technical and Strategic Level in Government and Industry

Often, international standards-setting is dealt with by technical people because of the technical nature of the standards themselves. But the standards will impact on business or government policy. It appears that in many instances, the technical people involved in standards discussions do not always have a sufficient appreciation of the business or policy implications of their decisions.

On the other hand, business and government policy people also do not always appreciate the full socioeconomic implications of the development of technical standards. There appears to be a "cultural gap" between the policy and technical levels.

Issue: How best can the interests of the technical and policy levels be integrated in a strategic sense vis-à-vis international standards setting.

3.2 Response of the National Standards Environment to the Globalization of the World Economy

In order to respond effectively to the globalization of the world economy Canada's standards structures need to work effectively together. The issues raised in 3.1 above also apply at the national level. For example, regarding a strategic perspective, a discussion paper of the Office of Privatisation and Regulatory Affairs has pointed to the policy vacuum in the federal government in relation to standards.[1] According to this report their are no coherent, system-wide perspectives on the relevance of standards.

It is now recognized that standards are going to play an increasingly important role in either stimulating or hindering technology diffusion and competitiveness. Therefore, should there be, at the national level, a central focus for discussing standards issues related to technology diffusion and competitiveness, especially to help in the development of a national standards strategy? Is the proposed Prosperity Council[2] the appropriate focus for such discussions?

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[1] Office of Privatization and Regulatory Affairs, *Towards a Standards Policy for the 1990s: A Discussion Paper*, December 1989, p.7.

[2] As part of the Prosperity initiatives of government, a Prosperity Council was recommended to oversee activities directed at the competitiveness challenges facing major industry sectors across Canada. At present such a Council is only at the proposed stage.

Standards are part of industrial policy development in other countries, particularly in Western European countries and in Japan. In Japan, the Japanese Industrial Standards Committee (JISC) reports to the Ministry of International Trade and Industry. Should Canada also link its National Standards System more closely to industrial policy considerations? For example, should the Standards Council of Canada report to ISTC rather than to CCAC?

A strategic approach to standards would need to address several issues including the following.

3.2.1 The Lack of Awareness of the Strategic Importance of Standards

As noted earlier, Europe and Japan have recognized for some time the strategic importance of standards and the U.S. is now catching on. The economic benefits of standards are now being better appreciated internationally.

However, there does not appear to be a similar level of awareness in Canada, except within the standards community. As can be appreciated from the list of references (Appendix E), there is no lack of information regarding standards but somehow the issues do not appear to receive the broader policy attention needed.

The comprehensive study of standards in Canada, referred to earlier, remarked about the risk that Canada's long term interests could be compromised by inattention, a continued incrementalism and the lack of a broadly informed, strategic view of Canada's standards interests and priorities as a context for standards activities.[1]

Issue: How can the level of awareness of the strategic importance of standards be improved?

3.2.2 Improving Collaboration Within the National Standards System

Canada has a unique standards setting system. However, it does not always appear to work as an integrated system. The organizations of the National Standards System are autonomous and compete among themselves. The coordination of standards development activities is overseen by the SCC, but

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[1] *Towards a Standards Policy for the 1990s ...*, op.cit.

the federal government does not have a consistent broader context for the NSS in terms of industrial or economic strategies.[1] While international competitiveness has received a high profile in government recently, the link of this to standardization has not. The relationship of the NSS to government remains weak, not only structurally but also seemingly by design.

With the increasing pressure on standards setting in a rapidly changing technology oriented world economy can Canada afford not to improve collaboration within the NSS?

Issue: What steps need to be taken to improve this collaboration?

3.2.3 Harmonization of Federal and Provincial Standards

Divided jurisdiction between the federal and provincial governments in Canada and the ensuing diversity of standards can increase compliance costs, create uncertainty and fragment the domestic market, all of which make it more difficult for firms to operate and develop.

The need to reduce interprovincial barriers and overlaps of standards between the federal and provincial governments was recognized by the Steering Group on Prosperity which recommended that First Ministers address these issues.[2]

The Subcommittee on Regulation and Competitiveness made the following recommendations regarding the federal-provincial harmonization of standards:[3]

- *identification of areas of overlap and incompatibility between federal and provincial regulations should be included among the main objectives of the departmental reviews of regulations that are currently underway.*

- *the online access to regulations and statutes system currently under development should be expanded to include information on regulations of all governments in Canada*

- *government departments and regulatory agencies should be required to notify provincial governments of proposed regulatory initiatives and provide them with adequate*

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1 Ibid.

2 Report of the Steering Group on Prosperity, pp. 16-17.

3 Report of the Sub-committee on Regulations and Competitiveness, op.cit., pp. 95-96.

opportunity for comment

- *the RIAS (Regulatory Assessment Impact Analysis Statement) should include a statement concerning how the proposed regulation relates to provincial government intervention in the same or closely-related areas.*

- *the federal and provincial governments should adopt mutual recognition of product standards as a general principle of interprovincial trade.*

Issue: Are there other approaches leading to the better harmonization of standards across Canada?

3.2.4 The Use of Government Procurement to Promote the Adoption of New Standards

Government procurement is a powerful tool of government policy and is being used, for example, at the federal level to promote the use of ISO 9000 standards in Canadian industry so that Canadian firms can improve their competitiveness.

However, the ability to sustain a policy that requires increasingly demanding standards of firms selling to government is being undermined by various pressures that government departments have to cope with (e.g., regional development). A current major pressure is budgetary restraint which puts pressure on procurement officers to purchase "off the shelf" at the lowest price. The effectiveness of using government procurement to promote the adoption of new standards is then adversely affected. The commitment of government is then questioned. How much leeway should be permitted in the interpretation of standards in government procurements?

Issue: How can government procurement be used in the most effective manner to promote new standards?

3.2.5 The Impact of Technological Change on Canada's Measurement Infrastructure and Demonstratable Traceability

The ability to measure is inextricably linked to standards. Rapid technological change is placing increasing pressure on the Canadian measurement system which was shown in Exhibit 1-2.

In the private sector, there are increased needs for standards calibration and precision measurement services and demonstratable measurement traceability -- to meet requirements of ISO 9000 quality systems, normative standards, and the requirements for the accreditation of calibration and testing laboratories. While in the public sector, measurement requirements related to environmental and other regulations are growing.

One estimate of the value of measurement related activities to the Canadian economy (value added to products and equipment) is $10 billion per year. Measurement technology helps firms to improve their competitiveness by showing that they are meeting various standards (e.g. quality) and helps governments to enforce regulations.

The Canadian measurement system is so basic to the support of standards activities that it has to have the resources needed to adapt to rapid technological change and deliver reliable and timely services.

Issue: Is the Canadian measurement infrastructure keeping pace with technological change, and are sufficient resources being assigned to deliver required and projected services?

3.2.6 Encouraging Closer Ties Between the Research and Standards Communities

There are three phases in the standardization process related to the development of a new technology;

Phase 1: in the very early stages of the development of a new technology, standardization is mainly concerned with the standardizing of the language and terminology of the new technology. This is not commercially or politically controversial.

Phase 2: as progress is made towards demonstration of functionality of the new technology, test methods are developed.

Phase 3: when functionality has been demonstrated, technology choice arises and product standardization is needed to achieve production rationalization, interface compatibility, reliability, etc.

Phase 1 and 2 standardization considerations are becoming part of pre-competitive research efforts, especially those funded through the EC and EUREKA programs.

The Japanese Industrial Standards Committee described the interaction between research and standardization as follows:

"it is important to maintain contact with research and development activities in order to standardize measurement, testing and evaluation methods and to ensure compatibility of products by forward-looking standardization. Thus, standardization can proceed in parallel with research and development. In doing so, standardization itself can become the object of R&D, especially in testing and evaluation methods."[1]

In France, the following government initiatives have been taken to bring the research and standards communities closer together:

- implementation of programs to reinforce the awareness in industry of the implications of standardization;

- the building up of bridges between the research and the standardization communities, in individual firms, regions and countries;

- encouraging the early involvement of research scientists and engineers in standards-related discussions;

- promoting future-oriented efforts on the part of standardization bodies - and with the participation of scientists - to identify future needs for standardization.[2]

Regarding the identification of future needs for standardization the ISO/IEC Presidents Advisory Board on Technological Trends (ABTT) has published a report[3] on a survey which ranked 149 emerging technologies in 12 fields in order of importance as to the needs for international standardization. The 10 most important requiring urgent action are shown in Exhibit 1-1.

ABTT also made the following recommendation:

"Much could be achieved if ISO/IEC viewed their role as including promotion of research knowledge and its diffusion, with the long range view to facilitate the achievement of consensus agreement when the time is right."[4]

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1 Gregory Tassey, *Technology Infrastructure and Competitive Position*, Kluwer Academic Publishers, (NIST) 1992.

2 *Information Technology Standards: The Economic Dimension*, OECD, Paris, 1991.

3 *A Vision for the Future: Standards needs for emerging technologies*, op.cit.

4 Ibid.

3.3.2 How SMEs Obtain Information on Standards

This is also a function of the closeness of the coupling between the supply and demand sides of the industry as discussed above. In a Tempest type market, the information flows very quickly from the regulatory authorities to both the supply and demand sides because they are all involved in the process of generating the standards. In the environmental market, SMEs learn about standards mainly while in the process of trying to secure a contract for the delivery of either products or services. They may respond to a tender which refers to specifications which in turn refer to standards. It is at this stage that they take the time to become informed on the standards. Rarely do they play an active role in their formulation in the first place. This was also confirmed in the above referenced report.

However, there have been instances where Canadian SMEs have identified unusual market niches and they addressed them by the development and/or application of advanced technologies, products and services. Examples are Photovac of Toronto and Armstrong Air Monitoring of Nepean, both of which have developed unique instruments and sensors for different sectors of the air monitoring market. Photovac capitalized on new air quality standards for factories in the U.S. and developed a portable gas analyzer to address them more effectively than existing instruments. Armstrong developed a new type of sensor for measuring contaminants such as H2S. Both worked very closely with organizations such as OSHA, UL and CSA to develop standards that could be accommodated by their technologies. They cite good co-operation because the need (and their solutions) were so obvious.

Armstrong stated that they participated very heavily in the establishment of standards for sensors in their early years, but that they are now less affected by sensor standards then they are by computer standards. They do not take an active role in setting or influencing computer standards and they get their information from scientific organizations such as the IEEE. (Most SMEs adopted this same approach to computer standards; they felt that the computer industry knew best and they did not attempt to influence such standards to any great extent.)

Armstrong had high praise for the assistance they received from government laboratories (CANMET in particular) in helping them interpret and influence the sensor regulations in the very beginning.

Issue: SMEs obtain information about standards in a number of ways, but mainly while they are marketing their products and services. Niche-oriented firms work directly with the standards authorities and sometimes obtain assistance from Canadian government laboratories. Meeting standards in

the marketplace can adversely affect product development strategies. Therefore, providing an "early-warning" system on emerging standards would be of benefit to SMEs.

3.3.3 The Impact of Standards and Regulations on Venture Capital

Most venture capital firms welcome standards provided they are market driven. They feel that their invested companies are capable of finding and developing opportunities that are created by stiffer regulations more rapidly and more effectively than larger established companies. At Globe '92 (an environmental conference) in Vancouver, Michael Brown of Ventures West stated "We are not scared of environmental regulations; in fact we welcome them". If standards can create a stable investment context they will be appreciated by the investment community.

However, the degree to which a venture capital firm is capable of interpreting the regulations is dependent on the expertise that it has on its staff or is capable of accessing on a consulting basis. Unfortunately, most Canadian venture capital firms are not as specialized as their counterparts in other countries, particularly the U.S. An exception to this rule is MDS Ventures of

Toronto which specializes in the life sciences industries. They have demonstrated a good track record in not only interpreting but in predicting changes in regulations pertaining to pharmaceuticals and biomedical products.

There is another aspect to the question of standards as they pertain to venture capital companies, and that is the impact of standards relating to the venture capital companies themselves as opposed to their invested companies. The Canadian tax environment has undergone major changes within the last ten years and one of the reasons cited for the reluctance of venture capital companies to invest in high technology or in any high risk ventures is the uncertainty of the financial environment in which they operate. For example, the tax treatment of stock options has undergone several changes in the last decade and most venture capitalists would agree that they are no longer very effective in attracting key employees. Also, the conditions under which a company can lose its status as a Canadian Controlled Private Corporation (CCPC) seems to be a matter of considerable concern to the venture capital companies. For example, if one of the investors in a firm is publicly owned, Revenue Canada can take the position that the invested company is no longer a CCPC. The loss of CCPC status can be devastating to a firm and its investors, because the tax treatment of capital gains and its eligibility for investment tax credits are dramatically affected.

Issue: Venture capital companies are generally supportive of standards that affect their invested companies, but not all of them have the expertise to interpret them and exploit them. The standards pertaining to the venture capital companies themselves are a cause of much concern at this time and are detrimental to the creation of pools of patient capital.

3.3.4 Cost and Time Delays Related to Testing and Certification

Obviously, large firms are better equipped to accommodate costs and time delays caused by standards. This can not only put an SME at a disadvantage relative to a larger firm in a financial sense, but it may prevent it from capitalizing on a window of opportunity.

Because of the difficulty of accessing venture capital in Canada, most SMEs have weak balance sheets. This means that they are unable to take risks and are more inclined to seek out opportunities in which the payback period is relatively short - usually 18 months. The development and verification of standards can take several years, particularly in the environmental and biomedical fields. On the other hand, the telecommunications field seems to be able to shorten such testing and certification times considerably. This may be a factor in the success of Canadian SMEs in the telecommunications field, because firms can capitalize on opportunities even if their balance sheets are weak provided that the time required to do so is relatively short.

Issue: Cost and time delays related to testing and certification affect SMEs in different ways but they are a particular concern in Canada because of the inability of SMEs to access patient capital.

3.3.5 The Impact on SMEs of the Lack of Compliance to Canadian standards by U.S. Firms Importing into Canada

While it is true that Canadian SMEs find it expensive and time consuming to obtain approvals such as CSA, UL and CGSB, such approval is also required of large foreign firms that export to Canada. The major difference is that a large foreign firm will typically have a form of blanket certification approval which applies to all of its plants and all of the products it manufactures in those plants and can introduce new products without any special application to a Canadian certification body. Canadian SMEs often do not have this same type of blanket approval because it is expensive to obtain and maintain. This means that each new product must be submitted to a certification body, and while this may be less expensive on a case by case basis, it is very time consuming.

A foreign company can export say an electrical product to Canada that has not been CSA approved, because Canada Customs cannot enforce such standards since this is a provincial matter. A related electrical standard can usually be enforced either by a power utility as part of a routine inspection of a user's premises, or by CSA officials who seek out non-approved products at trade shows. Eventually, all foreign companies that intend to seriously pursue the Canadian market must have Canadian certification and the methodologies used to enforce compliance are the same for both domestic and foreign companies. However, multinational firms tend to have an advantage in terms of new product introduction once they have reached the stage where they can use blanket approvals for their production facilities. This is very expensive as SMEs depend more on cheaper product approval. Any efforts that could be made to assist Canadian SME's in obtaining such blanket approvals would be helpful.

In the case of electrical apparatus and electronic instruments, CSA certification is required on that portion of the device which utilizes the standard 110V power from the utility. However, with the advent of transistor technology which requires much lower voltage, such apparatus and instruments can usually be powered by AC adaptors which convert the 110V down to the lower voltages. Canadian SMEs are designing their equipment so that they can be powered by such adaptors. They are available from a wide range of suppliers and since they are CSA approved, they meet the requirement of having the high voltage portion of the equipment CSA approved.

The impact of this is that Canadian SMEs are less likely to pursue opportunities that require instruments that cannot be powered by AC adaptors. Examples would be large factory automation or process control equipment. On the other hand, Canadian firms have no difficulty in supplying field instruments or devices that can be adaptor powered.

This is probably less of a problem today than it was thirty years ago but it does illustrate the intricacies of the standards process and the indirect effects it can have on markets and how firms will address them.

Issue: It is generally easier for large foreign firms to meet certain Canadian standards than for Canadian SMEs. Should support be provided to SMEs?

3.3.6 The Impact on SMEs of the Opening up of Government Procurement Under the FTA to U.S. Firms with Different Standards?

Various pressures on government departments lead to a wide discrepancy in their commitments to use their purchasing power to assist Canadian SMEs in the development of new products, services and markets. For example, many firms complain that departments such as National Defence and Transport that work closely with their counterparts in other countries are heavily influenced by the purchasing decisions of their foreign counterparts because of the requirements for international compatibility.

As a result, when they invite tenders for the supply of such products and services, the requests are usually built around standards (e.g. military specifications) that are more easily met by foreign firms than by domestic firms (particularly SMEs). As a hypothetical example, the Canadian government could issue a tender for a flight simulator and specify that it must use surface mount technology (SMT) in its printed circuit boards. Such a specification might be included because an international "consensus" had developed for SMT in a whole family of devices which might include flight simulators. Canada's internationally-renowned flight simulator company (CAE) would have had difficulty in responding to such a tender until very recently, because it has just recently adopted SMT in its simulators. It has acquired such expertise in as a result of its involvement in the Canadian Space Program, but it has never seen any urgent need for it in its simulators, because one of the main reasons for using SMT is to miniaturize electronic equipment, and miniaturization has never been a driving market force for its flight simulators.

Issue: Canadian SMEs need to identify early-on standards that could be imposed on Canadian procurements as a result of procurement specifications being heavily influenced by the requirement for international collaboration and compatibility.

APPENDIX A

COMMON ACRONYMS

ACRONYM	ORGANIZATION
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BNQ	Bureau de normalisation du Québec
CGA	Canadian Gas Association
CGSB	Canadian General Standards Board
COFI	Council of Forest Industries of British Columbia
CSA	Canadian Standards Association
FTA	Free Trade Agreement
GATT	General Agreement on Tariffs and Trade
IEC	International Electrotechnical Commission
IRAP	Industrial Research Assistance Program
IRC	Institute for Research in Construction
ISO	International Organization for Standardization
NAFTA	North American Free Trade Agreement
NBC	National Building Code of Canada
NRC	National Research Council Canada
NSC	National Standard of Canada
NSS	National Standards System
SCC	Standards Council of Canada
SDO	Standards Development Organization
ULI	Underwriters Laboratories Incorporated
ULC	Underwriters' Laboratories of Canada

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42. WIERSMA, Don
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APPENDIX C

PANEL OF EXPERTS

Graham Cameron	--	Metrology expert (formerly with the Department of National Defence)
John Gilbert	--	Telecommunications expert (formerly with the Department of Communications)
Roy Phillips	--	Past President of the International Organization for Standardization (1989-91)
Philip Preston	--	Standards consultant
Grant Wilson	--	Construction expert (formerly Director General at Public Works Canada)
John Woods	--	Past Executive Director of the Standards Council of Canada

APPENDIX D

STEERING COMMITTEE

Howard Sprigings	--	Industry, Science and Technology Canada
John Buchanan	--	Consumer and Corporate Affairs Canada
Gregory Kostyrsky	--	External Affairs and International Trade Canada
William McCrum	--	Department of Communications
Larry Moore	--	Standards Council of Canada
Jack Perrow	--	Standards Council of Canada
Bob Publicover	--	Consumer and Corporate Affairs Canada
Jennifer Schlemm	--	Supply and Services Canada
George Teather	--	National Research Council of Canada

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TECHNOLOGY DIFFUSION AND THE INTERNATIONAL STANDARDS SETTING ENVIRONMENT: IMPLICATIONS FOR CANADA

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EXECUTIVE SUMMARY

The growing internationalization of the world economy is characterized by the increased diffusion of technology internationally. The technology is either embedded in products or circulates as "know-how". These international technology flows put increased pressure on countries to harmonize standards to facilitate technology diffusion.

The regional level is the first level at which there is pressure to harmonize national standards and to eliminate barriers to trade and to technology flows. Europe is in the lead regionally and has set in place its own standards-setting bodies (e.g. CEN/CENELEC, ETSI) to harmonize national standards. Moreover, Europe adapts international standards whenever possible. It has been estimated that 85 per cent of CEN and CENELEC standards are identical to international standards. To anticipate up-coming standards, European level research and development (R&D) programs increasingly focus on the standards implications of the R&D undertaken.

The Canada-U.S. Free-Trade Agreement (FTA) and more recently the North American Free Trade Agreement (NAFTA) which includes Mexico, are driving the emergence of a North American economic region. The FTA, for example, includes certain provisions in Chapter 6 requiring the elimination or reduction of non-tariff barriers and the harmonization of standards. However, it is expected that it will take some time for a fully harmonized North American region to emerge which means that many issues will have to be resolved at the international level (e.g. GATT; ISO/IEC).

In the Pacific Rim there are nascent attempts at forming regional groups such as the Association of South East Asian Nations (ASEAN). However, major political and economic differences among Pacific Rim countries not to mention the rise of militarism in the region, are expected to slow down the formation of a region wide economic zone. This means that, like North America, issues will have to be settled at the international level.

There is increasing pressure at the international level to deal with issues ranging from climate change to the interoperability of communications systems. International standards-setting forums are increasingly the locus for the establishment and harmonization of standards. For example, the number of international standards set by the International Organization for Standardization (ISO), the principal world standardization organization, nearly doubled between 1982 and 1992.

To anticipate areas that require standardization attention in a rapidly changing technological environment, ISO/IEC have reviewed 149 technological areas and established priority areas for the 1990s. It is not surprising that environmental and information technology standards have been identified as areas requiring urgent attention.

Because of rapid technological change, attention is increasingly being given to standards related issues during the R&D phase of product development. It is at this stage that terminology and measurement issues are addressed to facilitate standards-setting downstream. Therefore, the research and measurement infrastructure that support the development of standards are becoming increasingly linked internationally.

For Canada, a small country, with an open economy which imports a large amount of technology and exports large volumes of primary and manufactured goods, it is imperative to participate actively in international standards-setting activities:

- *to obtain intelligence on and influence emerging standards related to new technologies; and*
- *to ensure that product standards and international trade rules do not act as barriers to the export of Canadian goods.*

The former relates more to the early stages of the innovation cycle (e.g. R&D; demonstration) while the latter relates more to the commercialization end (e.g. health; product safety).

The dynamics of the international standards-setting environment raise a number of key issues for Canada including the following:

- *strategic positioning:* *Canada does not have a strategic approach to international standards-setting which defines priorities in light of our economic interests and rapid technological change. It is becoming increasingly important to anticipate current and emerging technological developments in order to be able to influence international standards-setting in areas of economic importance to Canada;*
- *participation in international standards-setting activities:* *The growing requirement for Canada to participate in international standards-setting activities is adversely affected by on-going budgetary cutbacks of related government activities. An adequate level of funding needs to be maintained to ensure effective Canadian participation in international standards-setting activities; and*
- *information flows:* *it is essential that the information and intelligence obtained be disseminated to Canadian industry, especially to smaller firms which usually can only react to the impact of the standards that they meet in the marketplace. While there is much information flowing through the Canadian National Standards System much of it is not sufficiently targeted to be of value. Therefore mechanisms need to be set in place to ensure that international standardization information is disseminated to Canadian industry in the most effective manner.*

Addressing such issues would help to:

- *develop a strategic perspective on the relationship between technology and international standardization;*
- *ensure effective participation in international standards-setting activities; and*
- *inform and raise the level of awareness of the importance of international standards in Canadian industry.*

1.0 INTRODUCTION

This report reviews the current international context for technology diffusion and standards-setting and presents implications for Canada.[1]

Shifts in the nature of technological change, as well as the internationalization of the world economy, are putting new pressures on the international standards setting system. Traditionally, standardization was largely limited to the role of reducing variety to achieve economies of scale in production. This narrowed technological choices and encouraged the diffusion of standardized technology. However, recent technological advances are permitting the development of specialized and flexible production systems to meet a variety of market needs. Production has shifted from economies of scale to economies of scope.

This new flexibility requires standards at more and more technological interfaces so that technologies can perform in unison within complex systems. This applies both to product technologies (e.g., new materials) that deliver the products to specific market niches and to process technologies (e.g., robotics) that improve the quality and productivity of industrial processes. Since performance is highlighted, technology diffusion becomes stimulated across a broad front, because more than one technology can be used to meet a performance standard.

The development of these new technologies is occurring on a world-wide

[1] This report on the international context for standards development and the impacts on technology diffusion is part of a series of five reports which comprise a comprehensive study of the impacts of standards on technology diffusion in Canada. The first report provides an overview of the standards process in Canada and reviews issues regarding the role and effectiveness of the Canadian standardization infrastructure; the second report is a sector analysis of the communications and information technologies industry; the third report deals with the role of standards and their impacts on technology diffusion in the building construction industry; the fourth report is this one on the international context; and, finally, the fifth report is a synthesis of the results of the overall study.

Readers should read the overview report as a complement to this report on international issues. The overview provides a comprehensive discussion on standards and their interface with technological development and diffusion. Included in the overview are definitions of technology diffusion, physical and measurement standards, and normative standards. Also discussed is the role of standards development activities; the Canadian and international standards-setting infrastructure; and issues concerning the effectiveness of the Canadian system in the national, regional and international context.

basis. Firms scour the world to obtain the technology that they need to incorporate into new products, processes and services. To lower costs and reduce risk, firms are increasingly getting into various international, as well as national, technology development alliances. This phenomenon has come to be called "search and develop" (S&D) in contrast with the traditional "research and develop" (R&D) strategies which are internal to the firm.

Rapid technological change on a world-wide basis is multiplying the interfaces where standards are needed to ensure that technologies are compatible. This compatibility is becoming increasingly needed at the research end of the innovation cycle as well as at the commercialization end which is the natural focus for standards activity. For example, the U.S./Japan Business Council has had working sessions on the inter-comparability of biotechnology research results with proposals made to regulatory authorities in the U.S., Japan and Europe.[1]

Another example is the Versailles Project on Advanced Materials and Standards (VAMAS), initiated in 1987 to provide the technical basis for drafting codes of practice and specifications for advanced materials through international collaboration, pre-standards measurement research, and intercomparison of test results.

In the present world economy, it is clear that technology cannot be considered as belonging to any one company or nation. It is true that there are patent systems which give short-term advantages to inventors, but in the current worldwide system, patents have a small effect in holding back the spread of any technology (perhaps with the exception of well-kept military secrets).

In Japan, for example, the rapid adoption and improvement of technologies for steel production and electronics took place during the post-war generation. Advances in these technologies had previously been mainly occurring in Europe and America. For another example, the development of textile processing technology used to be a British affair, but today it is difficult to

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[1] *A Vision for the Future: Standards needs for emerging technologies*, joint publication of ISO and IEC, printed in Switzerland, 1990, p.8.

associate the development of this technology with any single country.

In the increasingly international world of technology, standards have become a crucial element which can no longer be ignored by policy-makers and politicians. International standards allow countries and firms to :

- *enter existing markets which may have previously been closed to them;*
- *retain present markets even while their technological base is changing;*
- *satisfy national regulations by allowing conformance to local requirements;*
- *create new markets in leading edge technology (e.g., in the high tech and environmental areas);*
- *increase efficiency in worldwide operations; and*
- *establish common practices among international agencies (including control over testing and certification).*

Success in world markets increasingly depends on a supplier's ability to satisfy customers on non-price factors, as well as price. Delivery of products which meet customer's expectations for quality is often the first consideration in purchasing decisions. Conformance to international standards is thus more and more a necessity and prerequisite for international competitiveness. International standards have become a measure of quality -- which embraces the fitness of a product to meet throughout its life basic requirements (including, for example, good design, reliability, ease of maintenance, safety, energy efficiency, environmental considerations).

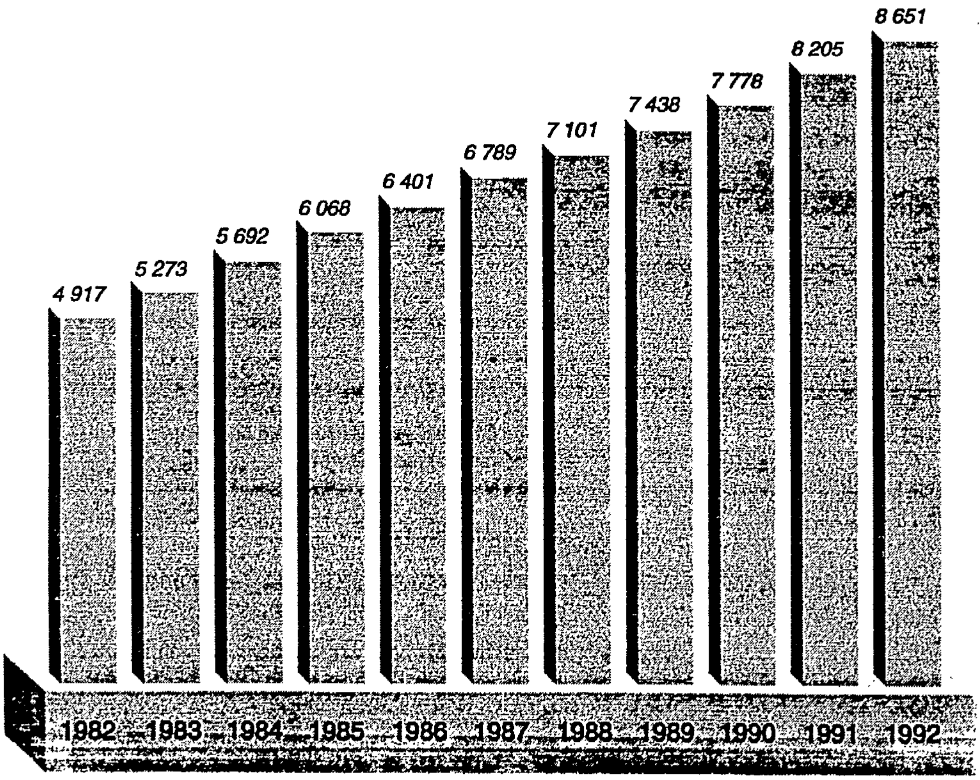
2.0 INTERNATIONALIZATION OF THE WORLD ECONOMY

2.1 Towards Internationalization

The internationalization of the world economy is characterized by the rapid growth of international trade and investment, rapid technological change, more open international competition, the formation of regional groupings of countries, increasing numbers of international strategic alliances among firms and the extension of the global reach of multinational firms. It is a world where the U.S.A. can no longer impose itself, and its standards, as easily as it did in the post-war period until the 1980s. In such a world, international standards come to play an increasingly important role. They become an important element of the "glue" that keeps the international economy turning over. And a strong "glue" is needed to overcome the technology related international barriers described below, many of which relate to regulations and standards. Exhibit 2-1 provides an indication of the rising preeminence of international standards. ISO[1] standards nearly doubled in the period 1982 to 1992. IEC[2] standards, while about one-third those of ISO, have also grown at the same rate as those of ISO.

In the post-war period technological innovation has become a major driving force of economic growth. A growing share of trade is dependent on the speed of technological adjustment in industry. The share of technology-

Exhibit 2-1
International Standards Published (ISO)
(Cumulative)



Source: *ISO in Figures*, January 1993, International Organization for Standardization.

[1] ISO: International Organization for Standardization.

[2] IEC: International Electrotechnical Commission.

based goods and services in total OECD trade have been increasing rapidly.[1] Unfortunately, the growth of technology-based industries is accompanied by a potential for increased trade frictions. These industries are characterized by high developmental costs and short product life cycles which means that products need rapid introduction and wide market access to obtain an adequate return on investment. Trade barriers of various kinds, including differing standards and regulations, can limit market access.

2.2 Barriers to Technology Diffusion

Technology is diffused around the world in two forms: technology embedded in products (e.g., machinery, equipment) and technology as practical knowledge which circulates and is sold as intellectual property and know-how (e.g., licenses, technology transfer agreements). Both forms of diffusion are subject to obstruction brought about by trade barriers, and with the liberalization of trade, non-tariff barriers are becoming more significant. These barriers include the following:

- *Government subsidies: The GATT Subsidies Code permits the use of research and development programs to achieve social and economic policy objectives. However the Code does not distinguish between assistance for R&D and assistance to aid commercial product development. The latter can cause trade frictions, especially where there are large differences in the magnitude and form of subsidies (e.g., defence and space programs).*

- *Control of strategic technologies: The uncertainties and burden placed on firms related to the export of these technologies inhibits technology diffusion.*

- *Government procurement: Discriminatory government procurement influences technology flow. The MTN Agreement on Government Procurement (1981) was set in place to curb such discrimination and requires transparency of regulations and procedures. However, public telecommunications agencies and the procurement of services such as R&D are exempt from the agreement.*

- *Intellectual property (IP): Differing national IP rights practices affect technology flows. The recent amendment to the Canada Patent Act (Bill C-91) to align Canada with practices in other countries, is a case in point.*

- *Rules of origin: These rules affect investment decisions in production facilities and on the sourcing of manufacturing inputs.*

- *Regulations: Based on laws flowing from different legal systems regulations cause barriers to trade.*

- *Professional Qualifications: Differing qualification requirements for professionals in various jurisdictions can create barriers.*

- *Safety/environmental controls: Differing controls can influence investment decisions.*

- *Standards, testing and certification procedures: Differing national procedures can*

[1] *Structural Change and Industrial Performance: A Seven Country Growth Decomposition Study*, OECD, Paris, 1992.

> *provide effective barriers to trade. An MTN Code on Technical Barriers to Trade came into effect on January 1, 1980. It recognizes "the important contribution that international standards and certification systems can make in this regard by improving efficiency of production and facilitating the conduct of international trade." It therefore has a twofold aim: "to encourage the development of such international standards and certifications systems; (and) to ensure that technical regulations and standards, including packaging, marking and labeling requirements, and methods for certifying conformity with technical regulations and standards do not create unnecessary obstacles to international trade."*

To address the above technology-related trade barriers, the OECD countries adopted a General Framework of Principles for International Cooperation in Science and Technology (1988). The framework recommends that member countries promote mutually beneficial scientific and technological exchanges and remove barriers which have harmful effects on scientific and technological progress and its contribution to economic growth.

Member countries are asked to promote international cooperation in science and technology for economic growth through:

- *Promoting international cooperation in research programs for the transfer of scientific and technological knowledge to enterprises.*
- *Encouraging the circulation, exchange and trade of technologies as well as cooperation between enterprises, including small-and medium-sized enterprises, in particular through improved access to worldwide markets and improved harmonization of standards and regulations.*
- *Promoting improved universal protection of intellectual and industrial property rights.*

The electronics industry provides a good barometer of the dynamics of trade barriers and standardization because it is considered a strategic industry by both the industrialized and industrializing countries. As such, it is subject to the type of barriers noted above because of the "politicized" nature of this industry. In their exhaustive study of the electronics industry, Ernst and O'Connor[1] identified the following key regulatory barriers affecting the international diffusion of electronics technology:

- *restrictions on market access, whether through discriminatory access to government procurement markets (telecommunications; computer equipment for the public administration and the*

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[1] D. Ernst and D. O'Connor, *Competing in the Electronic Industry: The Experience of Newly Industrializing Economies*, OECD, Paris, 1992, p.41.

educational sector) or through market share quotas and "market reservation" schemes;

- *restrictions on the establishment of firms in a particular activity, through, for instance, statutory monopolies, investment licensing and restrictions on foreign direct investment (FDI);*

- *regulations concerning standards for product design, quality and reliability, and interface and connectivity requirements;*

- *restrictions on access to scientific and technological knowledge and particular types of qualified labour, through intellectual property rights (IPR) protection, technology export controls, and restrictions on the mobility of scientific-technical personnel;*

- *limitations on access to core components, subassemblies and materials;*

- *restrictions on access to capital;*

- *restrictions on pricing behaviour and the establishment of distribution channels; and,*

- *restrictions concerning the financial behaviour of potential entrants, particularly with regard to discriminatory fiscal treatment and restrictions on profit repatriation.*

Ernst and O'Connor went on to conclude:

> *"All the eight classes of regulatory barriers that we have listed are playing an important role for current patterns of competition in the electronics industry. They are a fact of life, both for intra-OECD competition, and for competition between OECD countries and NIEs. For corporate planners everywhere, such regulatory barriers have had an important impact on the formulation of competitive strategies. At the same time, companies perceive their capacity to influence such barriers and to change them to their own advantage, as an increasingly important competitive weapon."*

In spite of the realities of world economic competitiveness, international standards, and the standardization process itself, is a principal factor in overcoming the barriers to technology diffusion discussed above. It is perhaps appropriate to recall the three "pillars of standardization work" outlined by Olle Sturen, former Secretary-General of ISO: the first pillar is standards development, the second pillar is standards information, and the third pillar is standards application.[1] If these three pillars are to help overcome barriers and facilitate technology diffusion, then the following is required:

- *with respect to standards development, the primary challenge is to increase the speed and efficiency of international standardization;*

- *with respect to standards information, standards dissemination activities need to help give information about international standards to international technologists -- however, this information needs not only to "be available" but also needs to be very easy to use; and*

- *with respect to standards application, international standards need to proliferate and be widely used if indeed technology is to diffuse and become truly international.*

2.3 World Investment and Export Trends

As can be seen from Exhibit 2-2, foreign direct investment (FDI) worldwide has been outpacing trade since 1985. This reflects a shift in corporate strategy, from selling products or services internationally from a base in a specific jurisdiction to seeking comparative advantage by establishing a presence in various jurisdictions and integrating activities on a world-wide basis. Firms, with a presence in several jurisdictions will participate in the research and development programs and the activities of standards-setting bodies in these jurisdictions. They can either try to promote international standards broadly or hedge their bets through supporting national and regional standards.

FDI is very concentrated, with the five leading OECD countries (the G-5) accounting for over 75 percent of international investment flow.[2] On the other hand, the G-5 account for only 40 percent of trade flows. Over 90 percent of technology-related transactions are made between companies with their home base in the G-5 countries. Globalization is very uneven.

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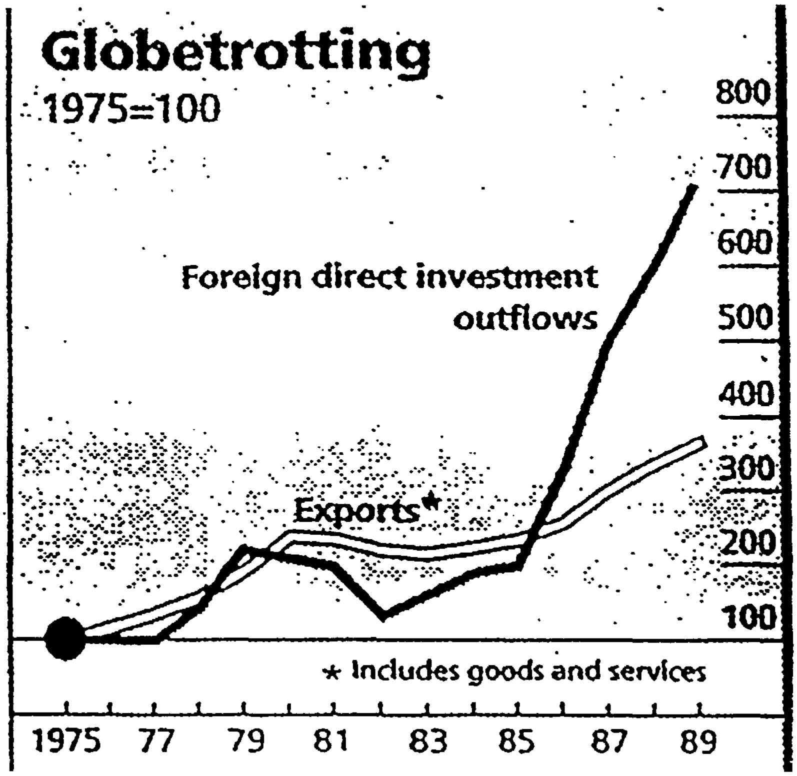
[1] Olle Sturen, "International technology as codified in standards", address given on the occasion of American Society of Mechanical Engineers, Codes and Standards Centennial at New Orleans, U.S.A., December 12, 1984.

[2] Ernst and O'Connor, ibid., p.84.

Exhibit 2-2
World Investment and Export Trends



Source: UN Centre on Transnational Corporations.

2.4 Canadian Competitiveness and Trade

Canada ranked as the industrial world's fifth most competitive nation, according to the *1991 World Competitiveness Report*, issued by the Swiss-based International Management Development Institute and the World Economic Forum. Japan was in first place, followed by the United States, Germany and Switzerland. Among newly industrialized countries, the five most competitive are all located in Asia: Singapore, in top spot, followed by Hong Kong, South Korea, Taiwan and Malaysia.

The key to Canadian competitiveness is our trading status within the world economy. Exhibits 2-3, 2-4, and 2-5 provide a picture of our trading relationships and priority areas. Clearly, to maintain the competitive position we currently enjoy, we will need to preserve the long-standing trading relationship we have with the U.S., and to strengthen the areas were we have trade imbalances, particularly Europe and East Asia.

As technology becomes more and more international so too will standards. To strengthen international competitiveness, we will need to enhance our capability to acquire new technologies, to increase efficiency of Canadian industries. The importance of active participation in international standards activities, and capitalizing on the recognition that Canada has attained internationally in standards matters, is critical to this objective.

There are also significant benefits to be gained by improving the dissemination of information concerning international standards activities within the standards community and Canadian industry. Similarly, there are

Exhibit 2-3
Canada's Top Ten Trading Partners (1991)

	EXPORTS	$ MILLIONS	PERCENT
1.	U.S.A.	103,449	74.9
2.	Japan	7,111	5.2
3.	U.K.	2,920	2.1
4.	Germany	2,125	1.5
5.	Korea, South	1,861	1.3
6.	China	1,844	1.3
7.	Netherlands	1,655	1.2
8.	U.S.S.R.	1,465	1.1
9.	France	1,350	1.0
10.	Belgium	1,073	.8
	Sub-total	124,853	90.4
	Others	13,189	9.6
	TOTAL	138,042	100

Source: Statistics Canada.

Exhibit 2-4
Trade With Regions (1991)

	$ MILLIONS		
	EXPORTS	IMPORTS	TRADE BALANCE
U.S.A.	103,449	86,235	17,214
Asia -- Pacific	15,491	20,759	(5,268)
Western Europe	12,736	18,211	(5,475)
Eastern Europe	1,623	505	1,118
Latin America & Caribbean	2,429	5,204	(2,775)
Middle East	1,466	907	559
Africa	848	1,074	(226)
TOTAL	138,042	132,895	5,147

Source: Statistics Canada.

Exhibit 2-5
Share of World Exports and Imports (1989)

Source: International Monetary Fund.

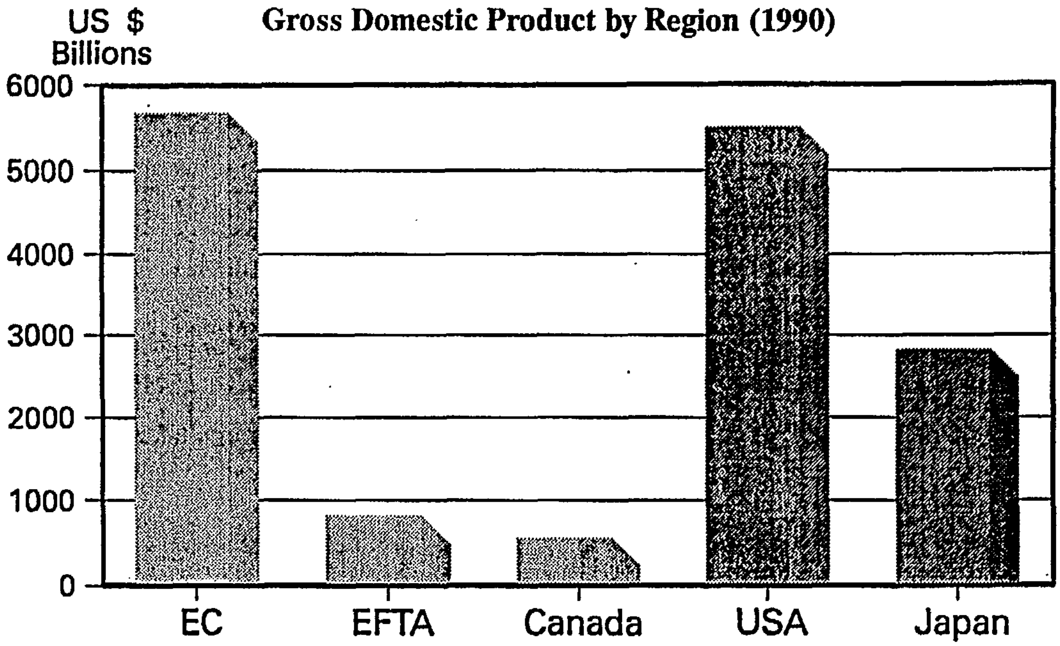
significant benefits to be gained from increasing Canadian industry's knowledge of standards, testing and certification requirements in foreign markets.

International competitiveness in the global economy cannot be based exclusively on North American, let alone Canadian markets. To continue to be competitive, Canadian firms will have to familiarize themselves with the technical requirements of offshore markets and be prepared to meet these requirements.

2.5 Regional Groups

Regional economic and trade groupings of countries are emerging, with the principal ones being Europe and North America (see Exhibit 2-6). In North America there is FTA (Canada and U.S.A.), and more recently NAFTA (Canada, U.S.A., and Mexico). In Europe there is EC (European Community: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, the United Kingdom) and EFTA (European Free Trade Association: Austria, Finland, Iceland, Liechtenstein, Norway, Sweden and Switzerland).

Exhibit 2-6
Gross Domestic Product by Region (1990)



Source: Wharton Econometric Forecasting Associates.

Alongside the economic partnerships, various organizations have been created around the world for standardization at the regional level. These include, for example, the Pan American Standards Commission (COPANT), the Asian Standards Advisory Committee (ASAC), the African Regional Organization for Standardization (ARSO), the Arab Organization for Standardization and Metrology (ASMO), the European Committee for Standardization (CEN), which corresponds to ISO, and the European Committee for Electrotechnical Standardization (CENELEC), which corresponds to IEC.

While Europe has been moving towards integration for some time and has European-wide standards-setting bodies in place (CEN and CENELEC), such is not the case in North America. The FTA, and now NAFTA, are catalyzing closer ties between Canada, the U.S.A. and now Mexico. Various bilateral and trilateral committees have been set in place to bring some harmonization among standards in the three countries. It remains unclear at this time if the lack of central standards-setting organizations in North America will be detrimental to North American interests.

Japan for its part has a highly centralized, government controlled, national standards system. A truly Asian economic and trade zone still has to emerge.

Beyond regional groupings of countries there are some economic and trade related activities that are harmonized at the international level through bodies such as the GATT. The GATT identified standards as a key issue related to trade barriers as early as 1967 (the Kennedy Round of negotiations). The GATT developed a standards code which specifies that international standards are to be used wherever possible in order to facilitate international trade and commerce.

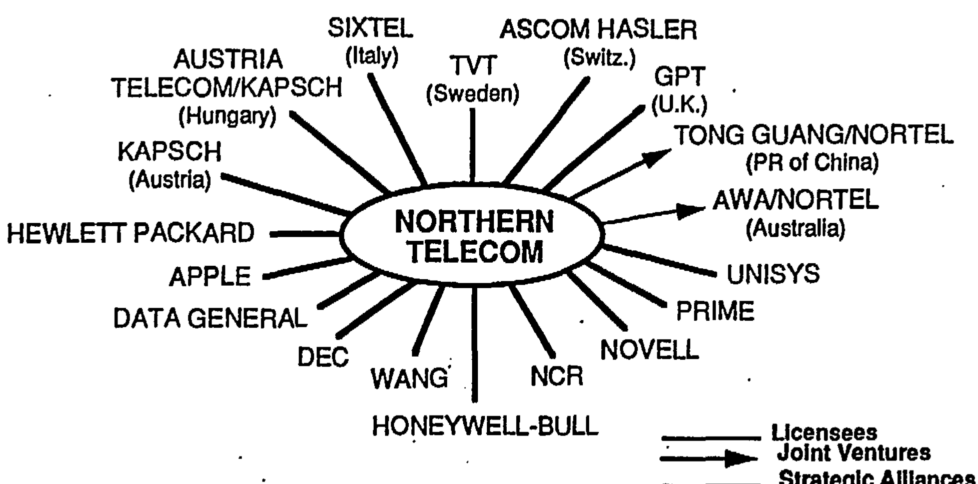
2.6 The Need to Participate in International Standards Setting

Rapid technological change is also driving internationalization. With "time to market" now an important facet of gaining a competitive edge, firms increasingly search out and "buy" technology because they do not have the time to "make" it. International standards are also setting a framework that accelerates "buy" decisions. Proprietary technology is no longer as important because various technologies can be used to meet a standard. "Buying" technology can mean purchasing a license, entering into an alliance with others to develop a technology, or even acquiring another firm with the technology needed. It is no longer surprising to see firms, such as Northern Telecom, entering into various forms of alliances (see Exhibit 2-7) and acquiring entities, such as STC (U.K.). Standards reduce uncertainty about the risks of buying new technologies and thus facilitate technology adoption decisions.

In this international competitive environment, attempts are made to find some harmony through such bodies as the GATT, the United Nations family of agencies, the World Bank and international standards-setting bodies such as ISO and IEC. Some 450 international organizations have liaison status with the ISO.

There is increasing linkage among these international organizations. For example, ISO is an observer at the GATT on technical barriers to trade. But does a move towards more uniform standards encourage or inhibit technology diffusion? There are many examples to show that international standards do both. Once a dominant standard emerges, such as the VHS standard in video-cassette recorders, technology diffusion is stimulated. However, once the standard becomes entrenched only incremental improvements compatible with the standard come about. Most firms now have a vested interest in the established order and only a spectacularly new product would have a chance to upset the established order and set a new standard.

Exhibit 2-7
Forms of Strategic Alliances



Source: Northern Telecom

The more the sector is capital-intensive the more likely will be a commitment to the existing "physical plant" and the associated standards. Therefore new technologies tend not to be introduced into the market, however attractive they may be.

For example, such is the case of high-definition television (HDTV) at the present time. The investment needed to create a new HDTV broadcasting system in both equipment and programs is so large as to present a huge barrier to the adoption and diffusion of this technology. The developmental costs alone have been estimated to be $1 billion or more. Is a clearer picture sufficient for customers to switch over from current colour television technology, which is being improved through various incremental technologies, such as "anti-ghosting algorithms". This uncertainty slows agreement on a HDTV standard.

In some sectors, the costs of developing the next generation of technology requires access to the global market if an adequate return on investment is to be expected. For example, the next generation public telephone digital switch would cost at least $1.5 billion to develop. Other areas with high developmental costs include automobile design (e.g., $1 billion) and robotics production line (e.g., $1 billion).

Such an investment threshold requires a well developed marketing strategy including participation in international, regional and national standards bodies to ensure that the technology does not meet any market barriers. Also such high threshold costs may necessitate international alliances to share the costs and the risks of development of a new piece of sophisticated equipment. The partners in the alliances would also attempt to influence international standards setting.

Therefore, it is not surprising to find the world's leading multinational firms participating actively in international and regional standards-setting bodies such as ISO, IEC, CEN/CENELEC, ETSI[1] and so on.[2]

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[1] ETSI: European Telecommunication Standards Institute.

[2] Northern Telecom's standards group has about 50 people.

In Canada, except for a few firms, such as Northern Telecom, there is little industrial capability to engage in costly developmental activities. The majority of Canadian firms adopt and adapt technology developed elsewhere to their needs. In this way, Canada is very much a "taker" of international standards. As noted in a recent review of imports of intermediate components in six OECD countries, Canada had the highest ratio of imported to domestic sourcing.[1]

That same OECD study attributed the growth in international sourcing to several factors including the following:

- *the rising number of countries with firms capable of providing intermediate goods of high quality, which enlarges the pool of potential sources of supply;*
- *advances in technology that lower the cost of acquiring inputs from abroad and enables production to be organized on an international scale, which reduces the importance of geographic proximity in the sourcing of intermediate inputs;*
- *the surge of cross-border alliances, joint ventures and subcontracting arrangements, which creates extended networks of suppliers and widely dispersed production; and*
- *the increase of foreign investment (greenfield, acquisitions, mergers and equity holdings), which expands intra-firm trade among the affiliates of multinational enterprises.*

The strategic rationale for firms sourcing inputs from abroad are multifaceted, although the major factors tend to be the search for lower costs, the need for specialized products, and the desire to ensure supply by securing multiple sources. These requirements drive the globalization of industry.

2.7 Standardization Priority Areas

The world of international standards-setting is a complex one which now has to cope with rapid technological change. To anticipate this change ISO/IEC have undertaken a technological forecasting exercise to identify areas which

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1 *The International Sourcing of Manufactured Intermediate Inputs*, OECD, DSTI/STII/IND/92(1)/REV(1).

need the attention of standards-setting bodies. Out of the 149 technological areas surveyed, the ten areas requiring immediate attention were identified and are shown in Exhibit 2-8. Out of the ten areas, five are environmental issues, two relate to cancer, two relate to communications/information and one area relates to food/pharmaceutical safety. These priorities suggest where emerging international standards-setting issues lie. The ISO has identified environmental and information technology standards as areas that require urgent attention in the 1990s.

Exhibit 2-8
ISO/IEC Survey Results
Regarding the 10 Technologies Requiring Immediate
International Standards Attention

Storage, management and disposal of highly radioactive solid waste
Communications between heterogeneous computer systems
Elimination of air pollutants
Erasable and rewritable large-capacity optical disk
Treatment, disposal and reuse of low-level radioactive waste
Reduction of NO_x emission from automobiles
Safety assessment of pharmaceuticals/foods
Prevent metastasis of cancer
Environmental water purification technology
Serological testing in cancer screening

Source: *A Vision for the Future: Standards needs for emerging technologies*, joint study by International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC), 1990.

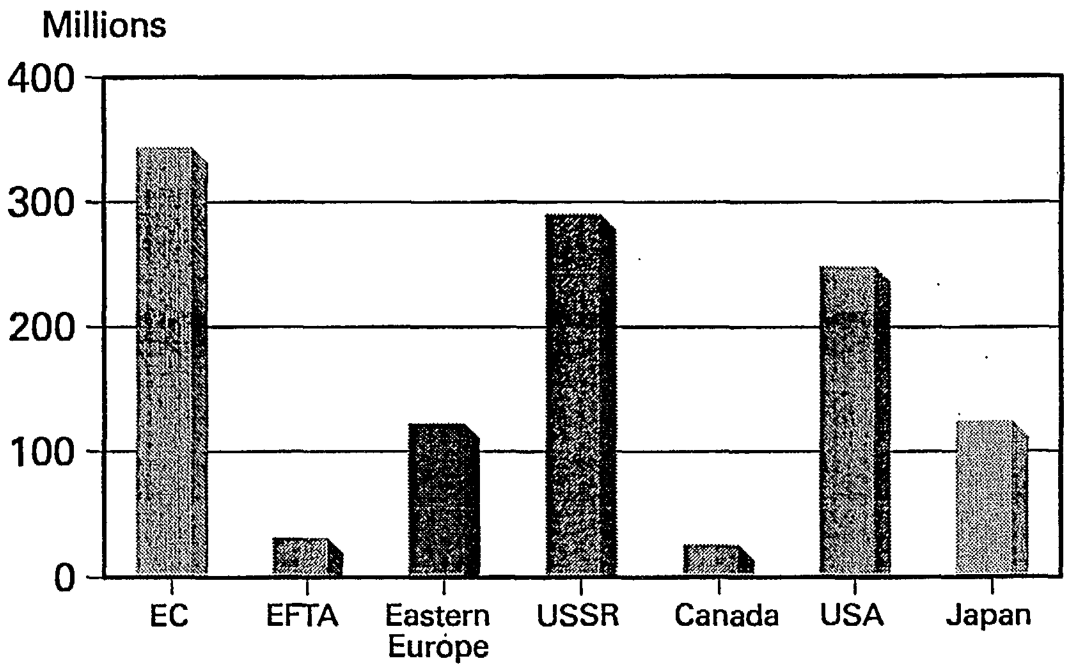
3.0 REGIONAL DYNAMICS

3.1 European Integration

Europe has been moving towards greater economic integration since the signing of the Treaty of Rome in 1957. The principal argument for creating a common market free of internal trade barriers is that it would result in savings of $200-300 billion and add 4 to 7 percent to the EC's GDP.

To accelerate the process of integration and to create a market larger than that of the U.S.A. (see Exhibit 3-1), a 1985 White Paper of the EC Commission proposed 279 legislative initiatives on the completion of the European market by the end of 1992. More than half of these initiatives had to do with technical standards. Business stressed that a standards policy was the most important aspect of the Europe 1992 program.

Exhibit 3-1
Population of Regions/Countries



Source: CIA The World Factbook (reporting various years by country -- 1980s)
Note: Since the USSR is no longer a country, the population figure indicated represents the block of countries that made up the former Soviet Union.

The current EC policy on standards consists of five elements:

- *mutual recognition of voluntary national standards;*
- *legislation of "essential" health, safety, and environmental requirements, combined with support for the harmonization of European standards;*
- *information procedures designed to prevent the emergence of new technical trade barriers; and,*
- *shared procedures and standards for quality assurance and laboratory testing, combine with a European organization to handle mutual recognition of testing and certification regimes.*
- *deferment of the development of national standards in areas where European level standards are being developed.*

The European Commission funds specific standards projects in CEN/CENELEC and ETSI which reflect its overall priorities for standards development. These standards could, at times, be in conflict with the policy of CEN/CENELEC and ETSI to give priority to international standards.

Technology development programs were also set up at the EC level which encourage pre-competitive research involving partners in different European countries. In this way the harmonization of technical solutions is addressed early on. For example, it has been estimated that about 12 percent of the ESPRIT[1] program, between 1983 and 1987, involved standardization.[2] At the near-market stage of technology development, the EUREKA program, launched by 18 European countries in 1985, was aimed at encouraging business deals among European firms. Such deals would lead to the harmonization of standards as well as creating corporate entities of the size needed to compete internationally. These activities are part of Europe's industrial policy thrust.

The impact of European harmonization of standards on Canadian exports has been assessed to be, by and large, positive (see Exhibit 3-2). It is also likely that SMEs will benefit relatively more than larger firms, since they often lack the resources to meet the standards of individual European countries in order to export to Europe.

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[1] ESPRIT: European Strategic Program for Research in Information Technologies.

[2] L.K. Mytelka, *Technological and Economic Benefits of ESPRIT*, prepared for Department of Communications, July 16, 1990, p. 54.

Exhibit 3-2
EC 1992 Standards Developments Impact on Selected Major Canadian Export Sectors to the EC

Sector	Magnitude of Positive Impact	Magnitude of Negative Impact
Telecom Equipment	Strong	Small
Telecom Services	Medium	Small
Forest Products	Strong	Medium
Autos and Parts	Medium	Small
Machinery	Medium	Small
Environmental Equipment	Strong	Small
Electrical/Electronic	Medium	Medium
Aerospace	Small	Small
Processed Foods	Medium	Medium

Source: *Harmonization of Technical Standards in the European Community: Implication for Ontario and Canada -- 1990/91*, a report prepared for Ontario Ministry of Industry, Trade and Technology.
Note: Ratings based on interviews and sector analysis contained in source document.

However, Canadian firms will have to follow the development of European standards in their areas of interest. While the EC policy on standards apply to all industrial products, foodstuffs, information technology, telecommunications and construction and building products have been identified as priority sectors. For example, construction standards often reflect experience with using indigenous building materials which may differ significantly from Canadian experience.

Canadian firms also have to comply with European testing and certification procedures. Ideally, products certified in Canada for the EC market should be able to enter Europe freely. For voluntary standards this is possible if agreements have been signed between Canadian and European private sector agencies such as the CSA which has negotiated agreements with the BSI in the U.K. and KEMA in the Netherlands for electrical and other products. With respect to regulated European standards, it will be essential for Canada to negotiate a mutual recognition agreement with the EC.

It could appear that this is a lot of effort to comply with standards in a market that represents only about 10% of our world trade. As is well known some 75% of Canadian trade is with the U.S.A. However, what needs to be recognized is that Europe represents about 30% of U.S. trade and that American firms are adapting to European standards. For example, Request for proposals (RFPs) from European sources are requiring bidders to be ISO-9000 compliant. This means that Canadian firms will eventually be meeting these standards in the U.S. market.

A case in point is the ISO 9000 series of standards highlighted above which are described in Exhibit 3-3. Under EC legislation certain regulated products, such as medical devices, telecommunications technical equipment and gas appliances, require ISO 9000 registration. This registration is also being used as a marketing tool in non-regulated product areas. Canadian firms have begun to produce to quality levels required under ISO 9000. The federal government has included ISO 9000 as a requirement in its procurement of certain goods (e.g., microcomputers). Several U.S. government agencies are also incorporating ISO 9000 in their requirements. For example, the U.S. Food and Drug Administration (FDA) is incorporating ISO 9001 into its Good Manufacturing Practices (GMP) for medical devices. The Department of Defense (DOD) is replacing its current quality systems standards with the ISO 9000 standards.[1] To date, some 700 U.S. companies are registered as ISO 9000 qualified companies, compared to the 35,000 firms registered in the rest of the world.

Canadian firms have to anticipate the "ripple effect" of European standards in the U.S. market as well as adopting them to sell into the European market. This "ripple effect" extends to other markets as well because some 53 countries, including Japan have adopted ISO 9000 standards. For example, foreign suppliers, which are ISO 9000 qualified, are bidding against Canadian suppliers for federal government contracts requiring ISO 9000. This forces Canadian suppliers to be ISO 9000 qualified if they want to bid.

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[1] S.E. Hagigh, *Obtaining EC Product Approvals After 1992: What American Manufacturers Need to Know*, Business America, February 24, 1992, p.31.

Exhibit 3-3
ISO 9000 Standards

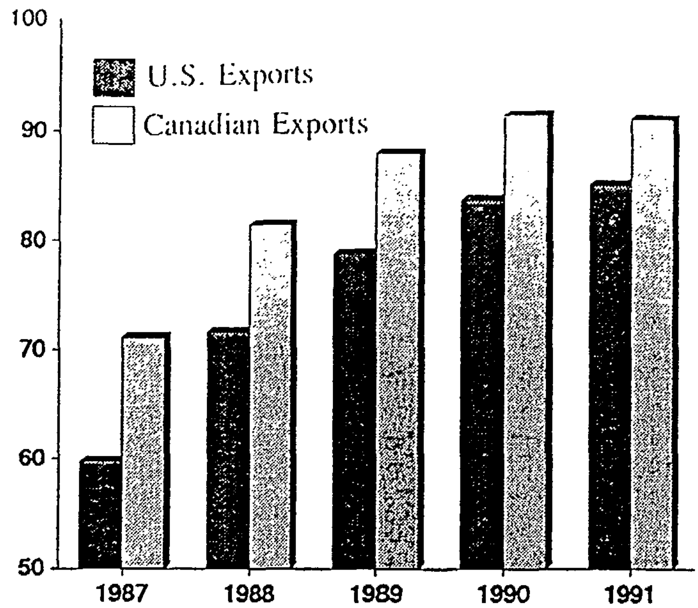
The International Organization for Standardization (ISO), based in Geneva, issued the ISO 9000 series of standards in 1987. These five standards address quality management and quality assurance in product development, production, installation, and service. The standards apply to the elements and practice -- primarily through documentation -- of quality management systems, but not to their specific form or means for implementation. The five standards are:

> *ISO 9000. Entitled "Quality Management and Quality Assurance Standards: Guidelines for Selection and Use," this standard sets forth the principal concepts and describes the use of such standards in purchaser-supplier contracts. It also provides guidance on the use of the other four ISO 9000 series standards.*
>
> *ISO 9001. This standard provides a model for quality assurance in the design, development, production, installation, servicing, and supply of products or services. The most comprehensive of all the standards, it includes all of the requirements found in ISO 9002 and ISO 9003.*
>
> *ISO 9002. A model for quality assurance in production and installation.*
>
> *ISO 9003. A model for quality assurance when only final inspection and testing are required.*
>
> *ISO 9004. In contrast to the other standards, this standard offers guidelines for developing and applying internal quality management elements and activities.*

Although designed to be used in two-party purchaser-supplier contracts, the ISO 9000 series of standards is being applied broadly through third-party certification of a company's quality system operations. In practice, the most important standards are ISO 9001, 9002, and 9003 because they apply directly to company processes, products, and services.

Source: American Society for Quality Control.

Exhibit 3-5
Increased Trade Between Canada and The United States
(Billions US$)



Source: U.S. Department of Commerce.

A major difficulty for Canada in the FTA is that the economic weight of the U.S. has historically placed that country in the dominant position regarding the setting of standards in North America. This historical basis continues to this day, despite the U.S. having to give recognition to the need to harmonize with European and international standards. Officials of the Office of Standards Code and Information of the National Institute of Standards and Technology (NIST) put it this way:

> *"The time for U.S. interests to react to the new policies and programs of EC is now. If the United States does nothing, it may become very difficult or expensive to market U.S. products in Europe in the future and standardized European products may be produced and sold more competitively in the United States."*[1]

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1 "The New European Community Approach: Harmonization of standards and certification systems", *ASTM Standardization News*, December 1988.

Canadian businesses usually have to adopt U.S. standards to ensure access to our most important market (i.e., some 75% of our exports go to the U.S.). Moreover, the U.S. is Canada's most significant source of intermediate components. At times these standards do not reflect Canadian requirements as shown by the following example:

> *"A case in point is electronic data processing (EDI), which is used to transmit business transaction documents such as invoices and purchase orders electronically between parties, based on standard message formats or protocols. The most widely used North American standards, developed in Canada, are now owned and sold by the American National Standards Institute, in Canada through the EDI Council of Canada. Standards reflecting specific Canadian requirements such as metric measurements, bilingualism and accommodation of sales taxes have not been developed. The Department of Industry, Science and Technology, is currently working with the Standards Council, the CGSB and the CSA on a proposal to develop Canadian standards, in an effort to catch up with the application of the technology in Canada."*[1]

If harmonization of standards in North America means increasingly moving towards U.S. standards there could be policy implications that reach far beyond the bilateral trade arena.

Moreover, the U.S. does not have a well defined and easily accessible national standards system.[2] This creates difficulties in the bilateral harmonization process. Pursuant to Chapter 6 of the FTA, each party is required to provide equal access to accreditation of testing and certification organizations located within the territory of the other party. As a result, several U.S. certification organizations (e.g., Underwriters Laboratories Inc., American Plywood Association, etc.) have approved applications for accreditation by the Standards Council of Canada. The Canadian standards community has raised concerns that these provision of Chapter 6 put Canada at a significant disadvantage relative to the U.S. since there is no single accreditation mechanism in the U.S. comparable to that operated by the Standards Council in Canada. Standards bodies in the U.S. must be accredited by various federal agencies, state governments and municipal authorities.

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1 *Standards in Canada: Federal Policy and Regulatory Practice Into the 1990s*, Office of Privatization and Regulatory Affairs, September 1990, p. 70, footnote 12.

2 See *Overview Report* for details.

Such issues will be further complicated under the North American Free Trade Agreement (NAFTA) which will include Mexico. For example, enforcement of mandatory standards and testing and certification requirements for domestic goods is relatively weak in Mexico compared to the strict testing and certification requirements for imported goods.

NAFTA is currently under review by the three parties involved to consider the incorporation of three new issues; environmental standards, labour standards and the prevention of import surges. Canada has suggested the creation of a North American Commission on the Environment. However, it is unlikely that such a Commission would have true "supranational" powers because such powers would likely violate the U.S. Constitution which requires that international agreements not conflict with any domestic legislation. The U.S. Constitution will likely be a powerful force in shaping the mechanisms for bilateral and trilateral harmonization of standards.[1]

The FTA and NAFTA have triggered discussions on harmonization of regional standards across a broad industrial front. Several sectoral committees have been established. For example, EEMAC (Electrical and Electronic Manufacturers Association of Canada) has been participating in such committees for some time.

Generally, however, the NAFTA members will maintain existing import regimes with their other trading partners. There will be no comprehensive harmonization of internal regulations or policies, economic, social, cultural or otherwise.

Because of particular characteristics of the North American region (e.g., supremacy of the U.S., major socio-economic differences between the U.S., Canada and Mexico), it will take some time for a fully harmonized North American region to emerge, if it emerges at all. It is expected that many issues will have to be resolved at the international level (e.g., GATT, ISO/IEC) because of the difficulty of reaching agreement at the North American level.

[1] See for example F. Lazar, *The New Protectionsim: Non-Tariff Barriers and Their Effects on Canada*, Canadian Institute for Economic Policy, 1981.

3.3 Japan and the Pacific Rim

The growing trade links among the countries of the Pacific Rim have prompted various proposals for a Pacific Free Trade Area. Asian countries are adopting Japanese-style industrial planning and technology strategies. However, a broad free trade zone has yet to emerge among these countries.

Five countries, Indonesia, the Philippines, Malaysia, Singapore, and Thailand did form the Association of South East Asian Nations (ASEAN) in 1967. Brunei has since joined the group. The emphasis of the association has been on economic cooperation and on pressuring Japan to provide more aid in technology, to import more goods from ASEAN countries and to provide special assistance for large scale infrastructure and construction projects.

On October 22nd, 1992, ASEAN members met to discuss the creation of the Asian Free Trade Association (AFTA) that would bring together 320 million people. However, major political and economic differences among South-East Asian countries, not to mention the rise of militarism in the region,[1] are expected to slow down the formation of AFTA.

In the standards area, Japan has been providing technical assistance to help ASEAN countries to develop their standards programs. For example, the Japan International Cooperation Agency sponsored a study of the Philippines standardization system and provided a $23.1 million (U.S.) grant to establish three regional labs.

The uneven level of standardization activities in Pacific Rim countries has been raised as an issue by Canadian firms which are questioning the validity of ISO 9000 certification obtained by certain Asian firms they are competing with to obtain federal government contracts. CGSB used to validate the quality assurance certifications of foreign firms but abandoned the practice when it was accused of not being at arm's length from DSS.

As with the North American situation, it is likely that issues will have to be resolved at the international level because of the lack of agreement at the regional level.

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[1] *The Economist*, April 3rd, 1993, p.15.

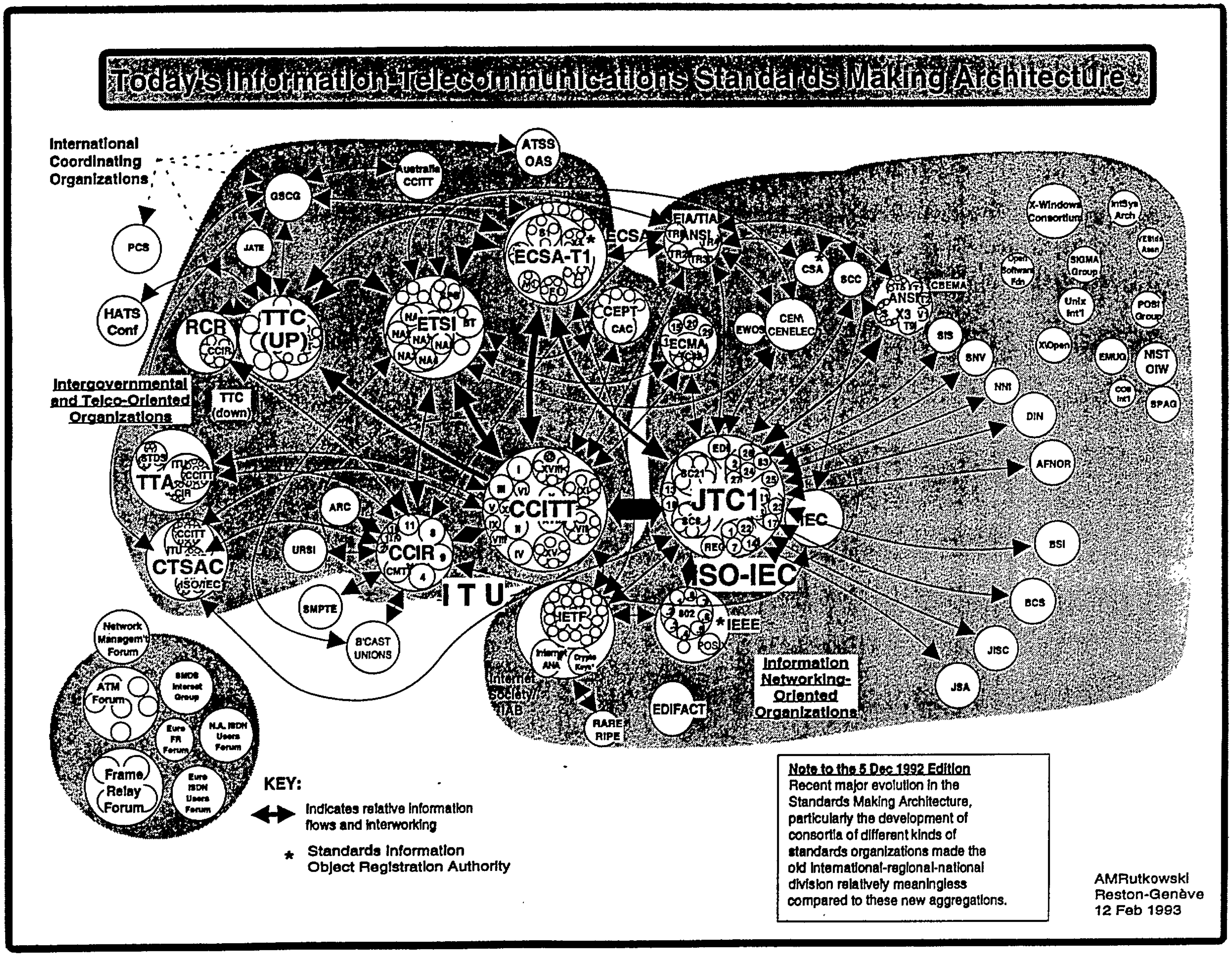
Another set of international issues surrounds the use of communications systems at the international level so that various systems can be internationally compatible. The convergence of computers, information technology and telecommunications is raising its own set of issues. It is felt that the pattern of international standards development does not match that of the convergence of communications and information technology (C&IT). The mismatch seems to be accentuated where the inter-operability of information technology requires the integrated use of telecommunication systems.

This convergence of C&IT is forcing international standards setting bodies to work more closely together. As can be appreciated from Exhibit 4-1 the C&IT standards environment is a complex one. However, ISO and IEC have set up a Joint Technical Committee (JTC1) on information technology. JTC1 interacts with CCITT, the ITU's telecommunications standards development committee.

Another set of issues are those related to the economics of production for international markets and various related standards concerns. These were discussed in Section 2.0.

Exhibit 4-1

Today's Information-Telecommunications Standards Making Architecture



4.2 Role of International Organizations

International organizations, many of which were established after the Second World War, generally have a mandate to promote "internationalism". This direction flowed, in large part, from the belief that the reasons for the War were to be found in restrictive nationalistic policies, especially economic policies. The United Nations and its agencies were set in place along with the Bretton Woods System in the economic arena, with its international agencies (e.g., IMF, GATT, World Bank). Under the auspices of such bodies, the world became increasingly interdependent.

Increasingly, international standards came to be adopted. For example, Europeans now claim that 85 percent of all CEN and CENELEC standards are identical to international standards. On the other hand, the U.S., which was a major force in establishing the post-war international structure, has aligned only 22 percent of its standards with international standards.[1] This situation is changing as the U.S. realizes that it is becoming increasingly difficult to impose its economic hegemony on the world. As noted in a recent article:

> *"Today, in standardization, as in other fields, the U.S. is no longer the unquestioned world leader, but a strong player among strong rivals. Standards developed outside of the United States - particularly in Europe or in international standards organizations - are gaining credibility and acceptance".*[2]

The influence of international standards setting bodies is thus gaining in importance.

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[1] Office of Technology Assessment, *Global Standards: Building Blocks for the Future*, TCT-512, Washington D.C., U.S. Government Printing Office, March 1992.

[2] *Impact of International Standardization and Certification on the U.S. Aerospace Industry*, Standards Engineering, July/August 1992, p.84.

4.3 The International Focus

At the international level, the principal world standardization organization is ISO (the International Organization for Standardization), which was established in 1947, at the same time as GATT, and which covers all fields of standardization, with the exception of electrical and electronic engineering which by agreement are covered by IEC (the International Electrotechnical Commission), which was established in 1906. For a detailed description of ISO and IEC see the *Overview Report.*

ISO has become increasingly involved in a broad range of technological areas which are of interest to both industry and governments, as shown in Exhibit 4-2. Increasingly governments have turned to ISO -- and to IEC -- to prepare basic technical rules that could be referred to or used in national laws and regulations. With the scope of international standardization growing it is not surprising to see that the number of standards published by ISO nearly doubled between 1981 and 1992 (see Exhibit 2-1).

With the growing influence of international standards it is to be expected that the U.S. will become more involved with the ISO and IEC. Until recently, European countries dominated these organizations (see Exhibits 4-3 and 4-4). The U.S. is now intent on capturing more top positions and secretariats in the ISO/IEC to have more influence on the direction of international standards development. For example, the secretariat for JTC1 (see p.25) was awarded to ANSI in the U.S. after an intense competition. As noted by a senior international standards executive:

> *"A lot of money is being made available to support the secretariat of JTC1 in the U.S. and the secretariats of the sub-committees in other countries. There was competition to get the secretariats because they are quite influential in the standards producing process in both the ISO and IEC system, particularly in JTC1".*[1]

[1] L.Salter and R.Hawkins, *The Standards Environment for Communications and Information Technologies*, (Vol.1), prepared for Department of Communications, March 1990, p.38.

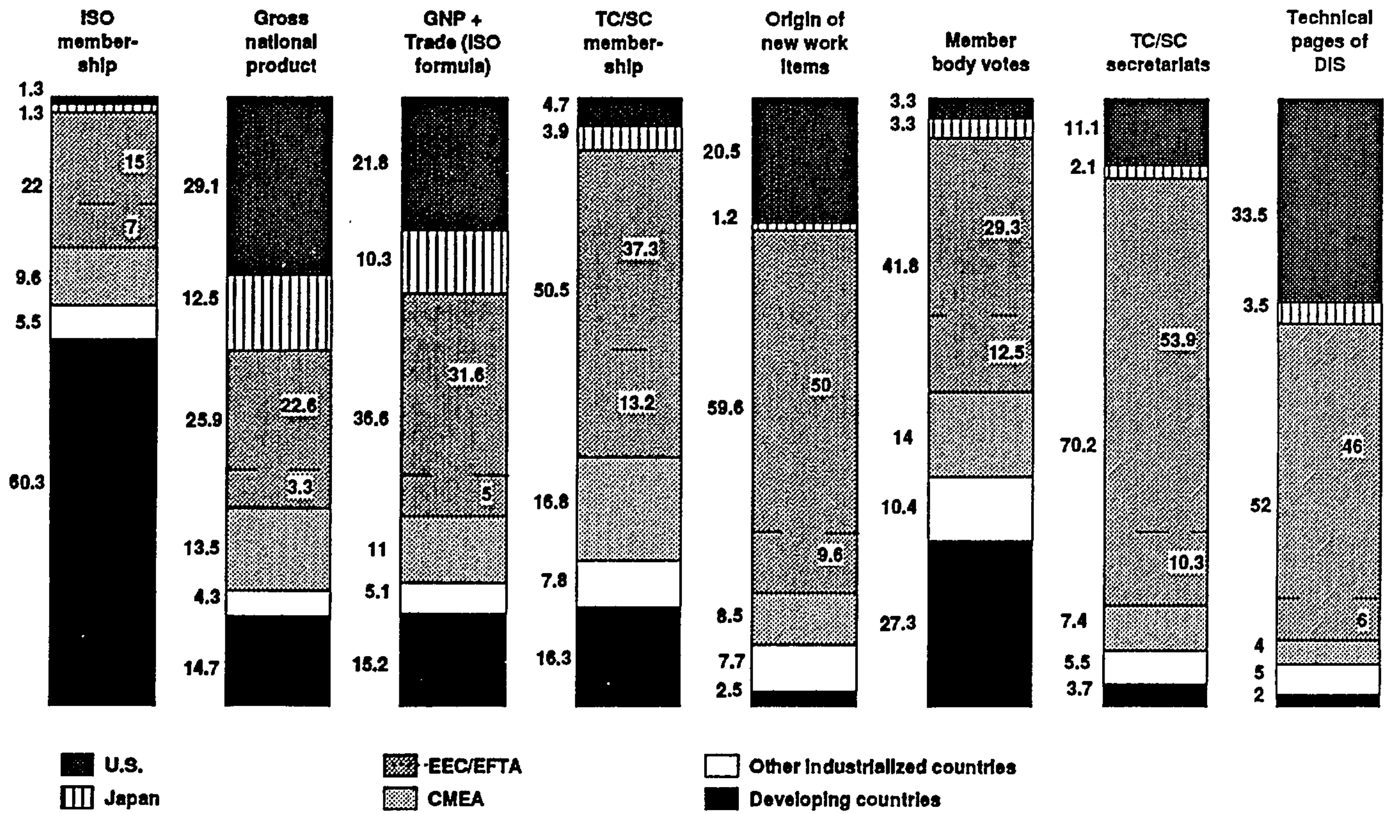
Exhibit 4-2
ISO Standards by Technical Field

TECHNICAL FIELD	INTERNATIONAL PUBLISHED STANDARDS (1992)	PERCENT
Mechanical Engineering	2,532	29.2
Basic Chemicals	1,053	12.2
Non-Metallic Materials	986	11.4
Ores and Metals	761	8.8
Information Processing and photography	990	11.5
Agriculture	691	8.0
Building	336	3.9
Special Technologies	284	3.3
Health and Medecine	322	3.7
Basic Subjects	269	3.1
Environment	263	3.0
Packaging/Distribution of goods	163	1.9
TOTAL	8,651	100

Source: *ISO in figures*, International Organization for Standardization, January 1993, p.3.

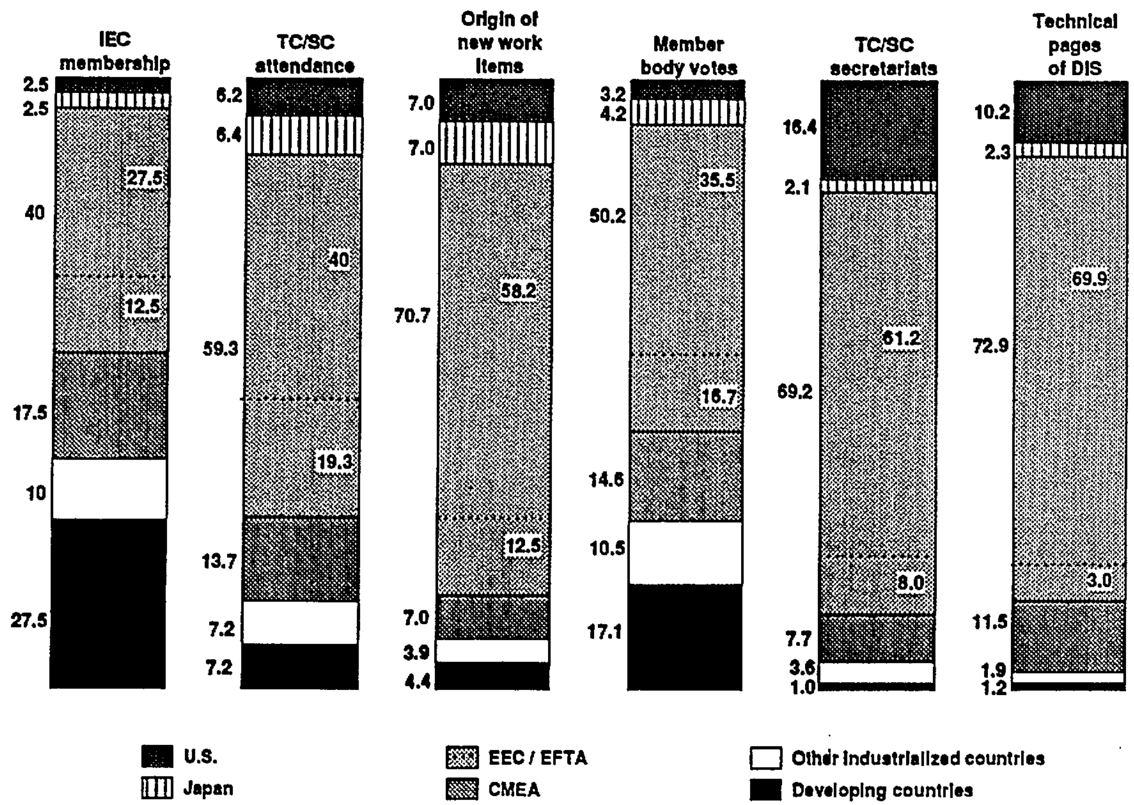
Note: About 70 percent of the above standards are in natural resources sectors, that is in areas where Canadian exports are dominant.

Exhibit 4-3
Participation in International Standards Work International Organization for Standardization



KEY: DIS=Draft International Standards; EEC=European Economic Community; EFTA=European Free Trade Association ; SC=Subcommittee Chairman; TC=Tag Chairman.
SOURCE: International Organization for Standardization (ISO), 1988.

Exhibit 4-4
Participation in International Standards Work
International Electrotechnical Commission



KEY: DIS= Draft International Standards; EEC=European Economic Community; EFTA=European Free Trade Association; IEC=International Electrotechnical Commission; TC=Tag Chairman; SC=Subcommittee Chairman.

SOURCE: International Electrotechnical Commission, 1988.

Canada, for its part, is a relatively active participant in ISO activities and manages about 3 percent of the secretariats. This places Canada seventh in rank overall, after Germany, U.K., U.S.A., France, Sweden and Netherlands (see Exhibit 4-5). However, Canada has two important Technical Committees, Quality and Environmental Management. Several smaller countries with open economies like Canada participate actively in ISO activities.

Exhibit 4-5
ISO Technical Committees, Sub-Committees and Working Groups -- Distribution of Secretariats

		Number of Secretariats	Percentages
DIN	Germany	495	19.2
BSI	U.K.	434	16.8
ANSI	U.S.A.	392	15.2
AFNOR	France	319	12.4
SIS	Sweden	108	4.2
NNI	Netherlands	82	3.2
SCC	Canada	77	3.0
UNI	Italy	65	2.5
JISC	Japan	61	2.4
GOST	Russian Fed.	52	2.0
SAA	Australia	40	1.6
	All Others(1)	455	17.6
	TOTAL	2580	100.0

Source: *ISO Memento*, 1993.

Note: (1) Includes 285 for all other countries plus 170 for technical committees, sub-committees and working groups which have no secretariat. Does not include JTC1, and does not include 25 ad hoc study groups.

As shown in Exhibit 4-1, ISO/IEC cooperate with many international, regional and national standards bodies. In fact, it has been normal practice to have "cross-memberships" on related committees irrespective of which organization provides sponsorship. This informal method of communication has been identified as the principal mechanism for coordinating standards development. This coordination thus depends on a relatively small pool of experts doing most of the work.[1]

[1] Salter and Hawkins, ibid., p.45.

4.4 Linking Infrastructures

In the same way that a web of international, regional and national relationships is developed around the activities of the ISO/IEC, at the standards setting level, other networks have developed at the testing and certification, measurement, and research and development levels.

For testing and certification some Canadian companies have their own agreements with organizations in some EC member states. In all provinces, associations representing forest industries are approved for certification of grading rules under standards that apply to lumber imports to the United Kingdom (British Standards Institution (BSI) and others). The Canadian Standards Association (CSA) has agreements with BSI and KEMA for the recognition of the testing and certification of electrical and other products. CSA and UL (U.S.) are entering into an agreement to harmonize their electrical standards and to accept each others' test results. CSA has agreements with some 20 counterparts in other countries.

At the measurement level, the National Research Council (NRC), which is Canada's focal point for standards measurements, has Memoranda of Understanding (MOUs) with counterparts in other countries. For example, NRC has MOUs, with the National Institute of Standards and Technology (U.S.), the Korea Standards Research Institute and the U.K. National Physical Laboratory.

Such MOUs are part of the 275 international science and technology agreements between Canada and other countries.[1] These agreements range from broad enabling agreements to very specific agreements between research agencies. Moreover, Canada is entering into discussions with the EC regarding a possible bilateral science and technology (S&T) agreement that would give direct access to EC research and development programs. A bilateral S&T agreement with Japan was signed in 1986 and is supported by a fund to encourage joint R&D programs.

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[1] External Affairs and International Trade Canada database.

These international networks support the infrastructure related to the international standards setting system. The world of standards development has been characterized by ISO as shown in Exhibit 4-6. The infrastructure surrounding standards setting is built around this conceptual model. The elements of this infrastructure come into play at different places in the innovation cycle. There are three phases in the standardization process related to the development of a new technology:

<u>Phase 1:</u> *In the very early stages of the development of a new technology, standardization is mainly concerned with the standardizing of the language and terminology of the new technology. This is not commercially or politically controversial.*

<u>Phase 2:</u> *As progress is made towards demonstration of functionality of the new technology, test methods are developed.*

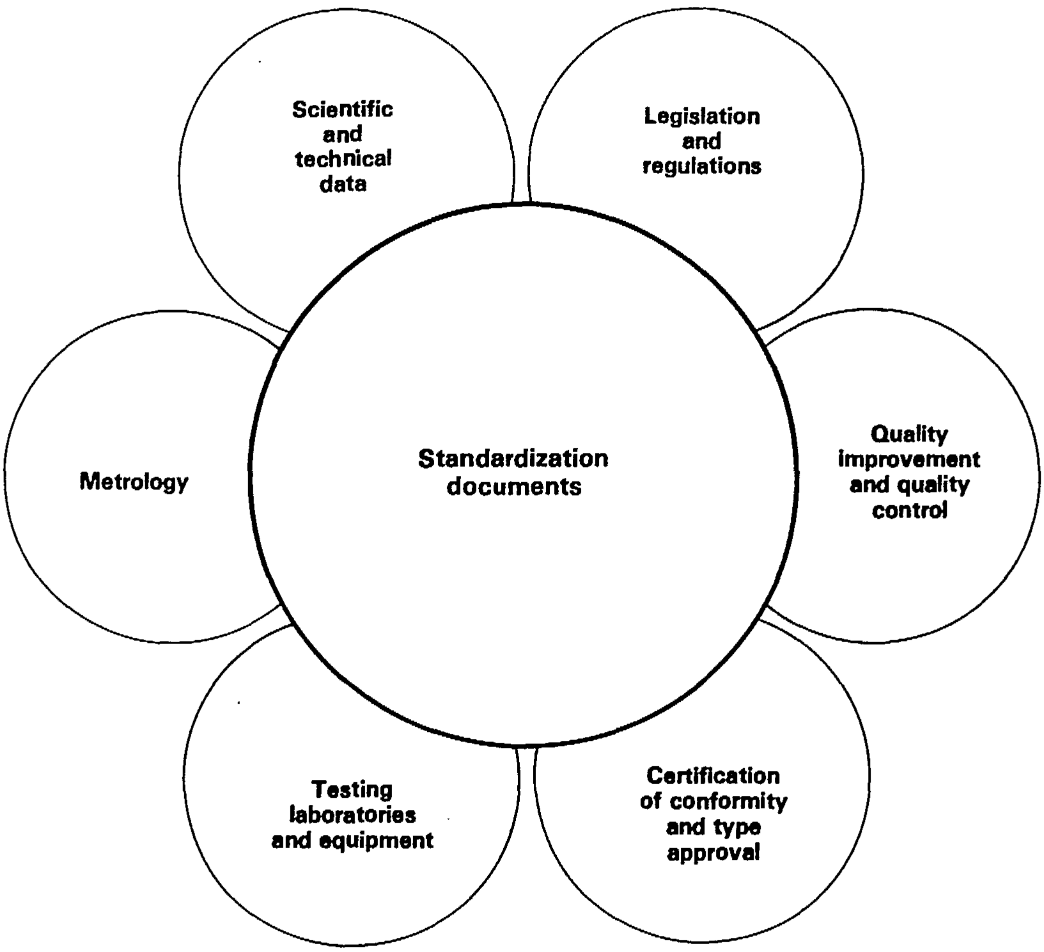
<u>Phase 3:</u> *When functionality has been demonstrated, technology choice arises and product standardization is needed to achieve production rationalization, interface compatibility, reliability, etc.*

Standards concerns are increasingly being taken into consideration in the very early stages of the innovation cycle. For example, some of the R&D work carried out by the Buildings Group, at CANMET, Energy Mines and Resources Canada, includes standards as an activity embodied in the different stages of the innovation/technology development cycle. The aim is to accelerate the diffusion of proven technologies and to increase support for emerging energy efficiency technologies. This represents an energy efficient technology strategy which is an integrated approach involving:

- research and technology development,
- lab testing and field trials,
- standards and guidelines,
- technology transfer, and
- quality assurance.

These complementary activities are applied to various CANMET programs such as R-2000 housing, C-2000 Advanced Commercial Buildings Program, Advanced Houses Program, and Building Systems and Indoor Environment

Exhibit 4-6
The World of Standards Development



Source: *Access to standards information*, joint ISO/UNESCO publication, printed in Switzerland, 1986.

Program.[1] This strategy has also led to successful commercialization of the technologies, particularly R-2000, in the international arena (e.g., in Japan). In addition, being active in the standardization activities at an early stage of the development process facilitates the interface of scientists and engineers with the international R&D community.

As noted in a study of technology and standards commissioned by ISO/IEC:

> *"Much could be achieved if ISO/IEC viewed their role as including promotion of research knowledge and its diffusion, with the long range view to facilitate the achievement of consensus agreement when the time is right".*[2]

The timing and degree of standardization activity is linked to the innovation cycle and the scientific and technological infrastructure that supports the innovation process.

[1] For more details on the Buildings Group technology development strategy, see *The Effects of Standards and Regulations on Technology Diffusion: Building Construction Sector Report*, NGL Nordicity Group Ltd, March 22, 1993, pages 26-29.

[2] *A Vision for the Future* ..., op.cit.

5.0 IMPLICATIONS FOR CANADA

5.1 Technology Flow

In technological terms, Canada is a small country which generates only a small fraction of the world's scientific and technological knowledge. For example, Canadian researchers author about 4 per cent of the world's research papers. Canada needs access to the world's technical knowledge to support the development of an advanced industrial base.

In fact, the principal strategy of Canadian firms, especially in mature sectors, has been to adopt and adapt international technology to meet their needs,[1] as shown in Exhibit 5-1. This bias towards an international technology diffusion strategy is well illustrated by the fact that Canada outperforms other major industrialized countries in importing intermediate inputs (Exhibit 5-2) to be incorporated in Canadian products and processes. Imports of intermediate inputs are especially significant in the advanced technology sectors (Exhibit 5-3). These technology imports are then used to develop products that are, in large part, exported abroad, especially to the U.S.A.

The major implication of this technology flow pattern is that the international standards setting environment should be used

(1) as a listening post as well as to influence proceedings on emerging standards related to new technologies; and

(2) as forums to ensure that product standards and international trade rules do not act as barriers to the export of Canadian goods.

The former relates more to early stages of the innovation cycle (e.g., research, development, demonstration), while the latter relates more to the commercialization end (e.g., health, safety of products).

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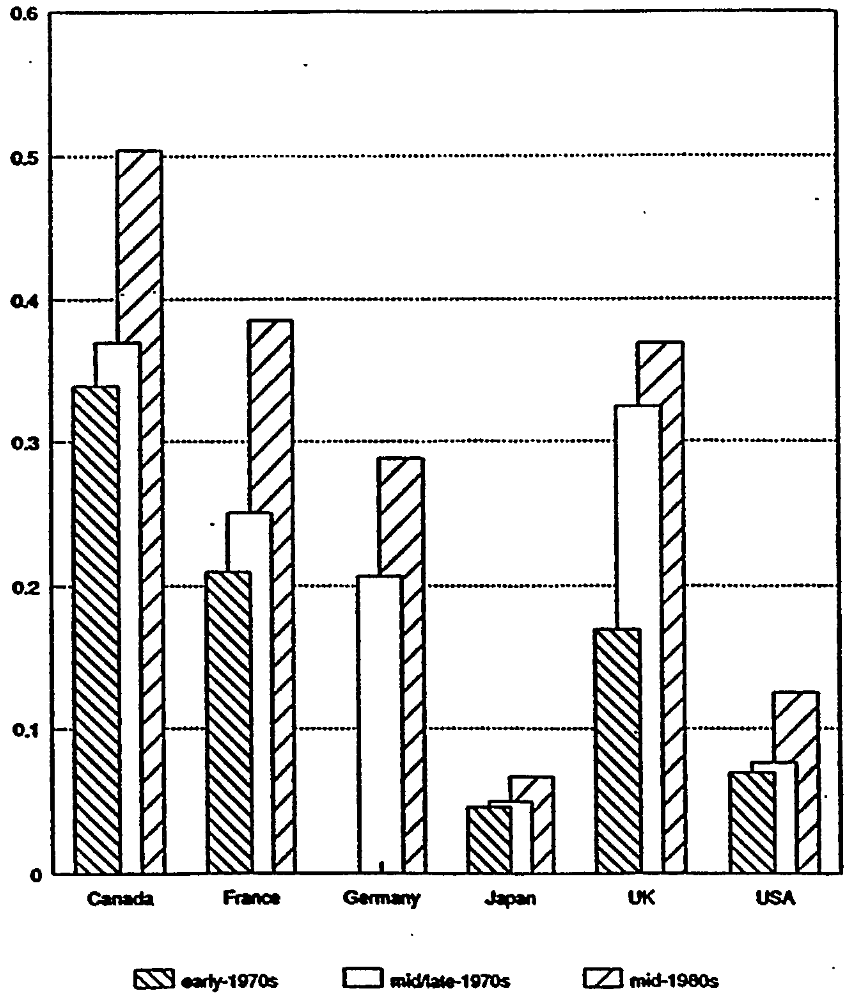
[1] J.Halliwell and S.Curry, "Presentation in the Science Council's Sectoral Innovation Strategies Project", The National Forum of Science and Technology Advisory Councils, September 11, 1991.

Exhibit 5-1
Technology Strategies of Canadian Firms

SECTOR	EXAMPLE OF MAJOR CANADIAN FIRMS IN SECTOR	SIZE OF CANADIAN FIRMS IN GLOBAL CONTEXT	TECHNOLOGY STRATEGY OF CANADIAN FIRMS IN SECTOR OVERALL	EXCEPTIONS
Telecommunications	Northern Telecom, Mitel	Large, Medium	Product Innovation	
Auto Parts	Magna, Woodbridge, numerous foreign subsidiaries	Small, Medium	Process Adopt/Adapt	Product Innovations from some medium-sized firms
Iron and Steel	Dofasco, Stelco	Large, Medium	Process Adopt/Adapt	
Auto Vehicles	G.M., Ford, Chrysler, Toyota	Large	Process Adopt/Adapt	
Oil and Gas	Esso Resources, Shell, Petro-Canada	Medium, Large	Process Adopt/Adapt	Process Innovations
Petrochemicals	DuPont Canada, Nova Chemicals	Large	Process Adopt/Adapt	
Banking	Royal Bank, CIBC	Large	Process Adopt/Adapt	Some Product Innovations from larger firms
Non-Ferrous Metals	Inco, Alcan, Noranda	Large	Process Adopt/Adapt	
Forest Products	MacMillan-Bloedel	Large	Process Adopt/Adapt	Some Product Innovations
Machinery	Husky, Timberjack	Small, Medium	Process Adopt/Adapt and Product Innovation	
Food and Beverage	McCains, Maple Leaf Foods	Small, Medium	Process Adopt/Adapt	Some Process and Product Innovations
Electric Power	Ontario Hydro, Hydro-Quebec, AECL	Large	Process Innovations and Process Adopt/Adapt	
Consulting Engineering	SNC-Lavellin, H.A. Symonds	Small, Medium and Large	Process Adopt/Adapt and Product Innovations	
Electronics	CAE, Spar, many small firms	Small	Product Innovations	
Software	IBM Canada, many small firms	Small	Product Innovations	

Exhibit 5-2
Ratio of Imported to Domestic Sourcing of Inputs
Average of Manufacturing Goods



Source:

The International Sourcing of Manufactured Intermediate Inputs: by Canada, France, Germany, Japan, the United Kingdom and the United States, DSTI/STII/IND/92(1)/REV(1).

Exhibit 5-3
Ranking of Intermediate Inputs
by the Ratio of Imported to Domestic Sourcing

	Canada 1986	France 1985*	Germany 1986	Japan 1985	UK 1984	USA 1985
1	Motor Vehicles *4.8*	Instruments *1.7*	Computers *1.2*	Aerospace *0.6*	Aerospace *3.2*	Other Manufacturing+ *0.4*
2	Computers *3.2*	Non-ferrous Metals *1.0*	Non-ferrous Metals *0.9*	Non-ferrous Metals *0.4*	Non-ferrous Metals *1.3*	Computers *0.3*
3	Aerospace *2.1*	Chemicals *0.8*	Textiles, Apparel & Footwear *0.6*	Computers *0.2*	Chemicals *0.7*	Comm. & Semi. Equipment *0.3*
4	Comm. & Semi. Equipment *2.0*	Computers *0.8*	Aerospace *0.6*	Petroleum Refining *0.2*	Computers *0.6*	Motor Vehicles *0.3*
5	Instruments *1.4*	Comm. & Semi. Equipment *0.7*	Petroleum Refin-ing *0.6*	Food, Drink, & Tobacco *0.1*	Comm. & Semi. Equipment *0.6*	Instruments *0.2*
6	Non-elec. Machinery *1.3*	Non-elec. Machinery *0.5*	Electrical Machinery *0.4*	Wood, Cork & Furniture *0.1*	Wood, Cork & Furniture *0.6*	Shipbuilding *0.2*
7	Other Transport@ *0.9*	Petroleum Refining *0.4*	Chemicals *0.4*	Textiles, Apparel & Footwear *0.1*	Electrical Machinery *0.5*	Other Transport@ *0.2*
8	Textiles, Apparel & Footwear *0.6*	Other Manufacturing+ *0.4*	Instruments *0.3*	Pharmaceuticals *0.1*	Petroleum Refining *0.5*	Ferrous Metals *0.2*
9	Non-ferrous Metals *0.6*	Textiles, Apparel & Footwear *0.4*	Non-elec. Machinery *0.3*	Chemicals *0.1*	Motor Vehicles *0.5*	Non-elec. Machinery *0.1*
10	Electrical Machinery *0.5*	Ferrous Metals *0.3*	Motor Vehicles *0.2*	Instruments *0.1*	Textiles, Apparel & Footwear *0.5*	Electrical Machinery *0.1*

* French data are in constant 1980 French Francs; all other countries are expressed in current domestic currencies.
@ Other Transportation includes railroad equipment, motorcycles, bicycles, and travel trailers and campers and other transportation not elsewhere classified.
+ Other Manufacturing includes jewelry, musical instruments, toys, sporting goods, pens and pencils, and other manufacturing, not elsewhere classified.

Source:

The International Sourcing of Manufactured Intermediate Inputs: by Canada, France, Germany, Japan, the United Kingdom and the United States, DSTI/STII/IND/92(1)/REV(1).

Acceptance of this paradigm has major implications for the development of the international dimension of a Canadian Standards Strategy, such as that proposed by the OPRA study,[1] because such a strategy would have to deal with standards requirements at all phases of the innovation cycle, and not principally at the commercial end where the activity has traditionally been centered.

5.2 Standards Activities

As noted in the *Overview Report*, while Canada does not have a strategic approach to standards at the international level, a number of activities are in play. They include:

1. *Participating in standardization activities of ISO and other international standards organizations for policy implications and coordinating activities where resources permit.*

2. *Working to improve coordination between national and international activities of Canadian standards development organizations and those of government.*

3. *Trying in GATT, NAFTA, etc., to ensure that trading partners*
   - *use technical requirements only for legitimate objectives,*
   - *restrict trade no more than needed to achieve objectives,*
   - *regulate transparently.*

4. *Encouraging development of international links (e.g., between private sectors in Canada, U.S.A., and Mexico), and negotiation by industry and government of agreements on*
   - *mutual recognition of test results/certification in respect of selected goods*
   - *harmonization of standards.*

5. *Discussing with EC negotiators of what would be Canada's first cross-sectoral mutual recognition agreement with Europe.*

6. *Obtaining information on foreign requirements from GATT Enquiry Point (SCC) for Canadian exporters, and organizing information seminars.*

7. *Keeping informed about international standards developments and consulting on development of appropriate Canadian strategy with Canadian stakeholders (federal/provincial government departments, SCC, standards organizations, and industry).*

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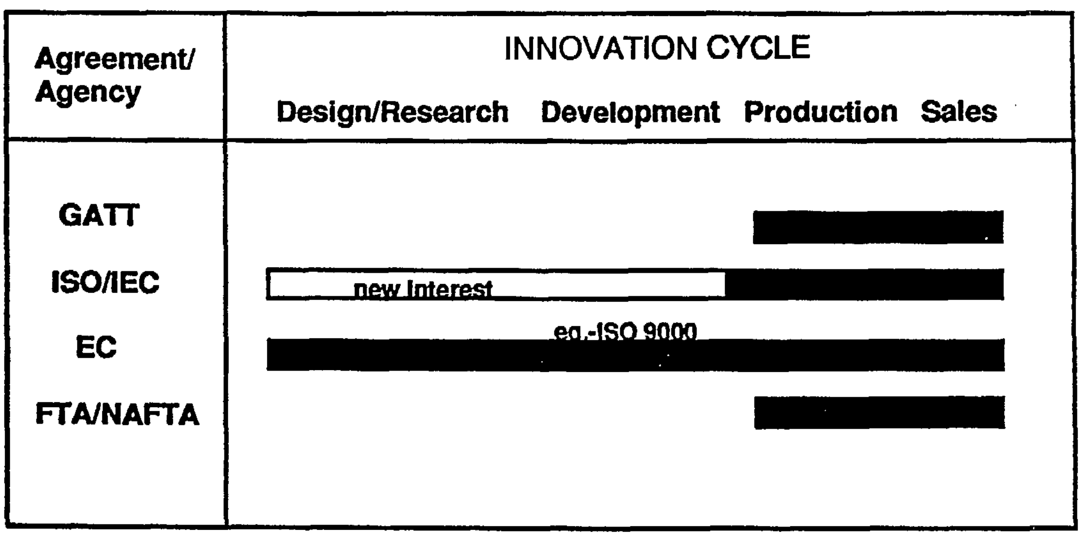
[1] Office of Privatization and Regulatory Affairs, *Towards a Standards Policy for the 1990s: A Discussion Paper*, December 1989.

8. *Addressing access problems in export markets by appropriate use of consultation and other mechanisms of resolution of differences in GATT and other agreements.*

9. *Assisting less developed countries in the implementation of standards.*

Such activities should be "mapped out" as to their relation to the elements of the innovation cycle, from research to commercialization, to determine what should be the key strategic thrust of each international standards initiative by Canada in each international forum (i.e., does it relate to inward technology diffusion or product export?). As illustrated in Exhibit 5-4, the focus of interest can vary from one international context to another. For example, GATT has focussed more on international trading rules, while ISO and IEC have become increasingly interested in emerging technologies. The EC, for its part, is funding R&D programs related to standards, and has led in the introduction of the ISO 9000 series of standards which cover the entire innovation cycle.

Exhibit 5-4
The Focus of International Agreements/Agencies



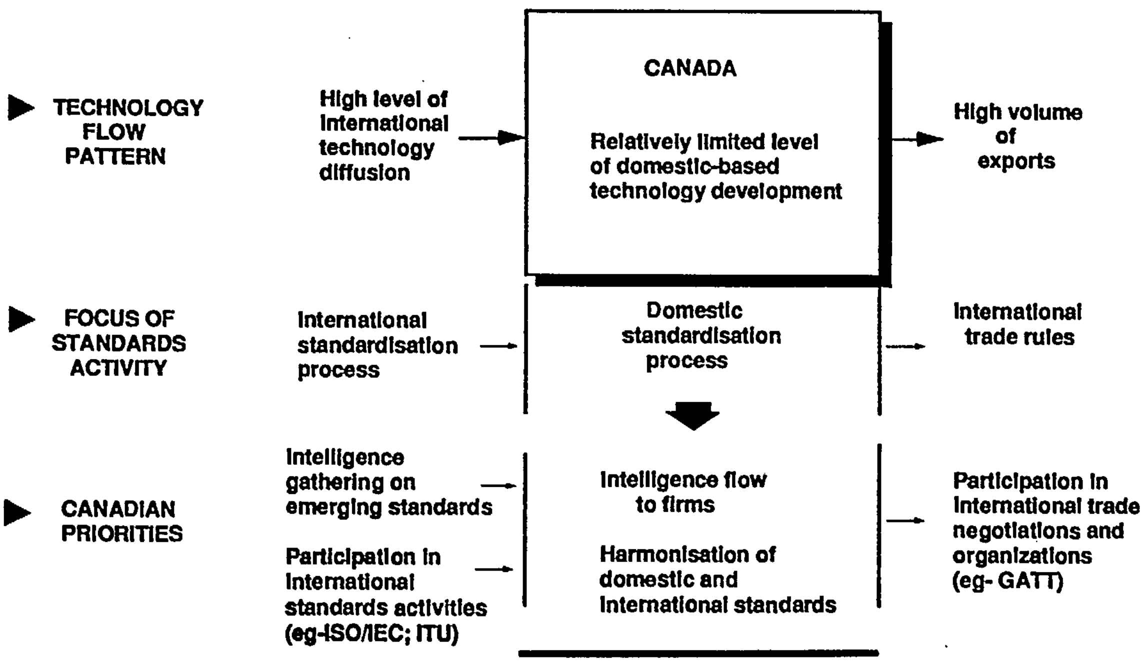
5.3 Setting Priorities

Sorting out our principal strategic interests in relation to the elements of the innovation cycle would also help to determine:

- *the level of participation needed in particular international standards-setting bodies;*
- *how to get the relevant industry sectors involved;*
- *how to ensure that the information flows to the appropriate industry sectors and firms (especially SMEs); and*
- *who should participate in the work of international standards committees.*

Such a "mapping" exercise within the above framework, which is summarized in Exhibit 5-5, would be a first step in elaborating an overall Canadian standards strategy.

Exhibit 5-5
Technology Flows and Related Standards Foci



Such a strategy might emphasize certain key principles as:

- *reinforcing the awareness in industry of the implications of international standardization;*

- *building up bridges between research and standardization communities -- nationally and internationally;*

- *encouraging the early involvement of research scientists and engineers in international standards-related discussions; and*

- *promoting future-oriented efforts on the part of standardization bodies.*

As the examples identified in this report show, some firms and government programs have taken the lead in developing approaches which embody these principles. Adopting these principles is an acknowledgement of the importance of standards and standardization to technology diffusion.

6.0 ISSUES

In the previous pages, three interlocked trends have been described: that of the increasing internationalization of the world economy, the related international flows of technology and the growing acceptance of international standards.

Canada is a major importer of technology and exporter of primary and manufactured goods. As such, we need to have a detailed understanding of the directions being taken in international standards-setting, because the resulting standards impact directly on our economic well-being.

However, a number of issues have arisen related to Canada's capacity to participate effectively in international standards-setting processes.

6.1 Strategic Positioning

Canada does not have a strategic approach to international standards-setting. What is needed is an in-depth undertaking of the direction of technology development in all key economic sectors of importance to Canada. It is only by having such an understanding can Canadians participate effectively in the negotiations that take place in international standardization forums. This means that government departments and agencies should have in place activities that "map" current and emerging technology development in relation to Canada's economic interests. Otherwise our capacity to influence international standards-setting will be limited indeed, especially in the face of rapid technological change.

Issue: What types of analytical functions should be set in place within government to ensure that Canadian representatives to international standardization bodies have the necessary "technological intelligence" to participate effectively?

6.2 Participation in International Standards-Setting Activities

The growing requirement to participate in international standards-setting activities is blunted by on-going budgetary cut-backs of related government activities.

For example, the Standards Council of Canada (SCC) has the responsibility to represent Canada in international standardization forums. The SCC has been a major player in establishing Canada's high level of respect in international standardization activities. However, with the cut-backs in its budget in recent years, the SCC finds it increasingly difficult to maintain the presence needed at the international level. It has been estimated that an increase of $1 million to the SCC's budget of $8.5 million (1992) would be needed to restore the level of activity felt necessary to ensure effective Canadian participation in international standards-setting activities. This budgetary situation is also felt in various government departments involved in international standards and regulations activities (e.g. DOC's participation in ITU).

A related issue is the participation of the corporate sector, especially smaller firms, in international standards-setting activities. For example, some 3,000 volunteers from across Canada participate in various Advisory Committees that establish positions for Canadian representatives going to international meetings of various ISO/IEC Technical Committees. Some of these people are finding it increasingly difficult to participate in these activities. There could possibly be more involvement of industry associations in this area. Industry associations could receive inputs from the "mapping" activities referred to in 6.1 above.

Issue: What is the level of funding needed to maintain an effective Canadian presence in international standards-setting activities?

6.3 Information Flows

Industry needs to be informed of developments in international standardization forums. There are various information services such as those of the SCC.[1]

There seems to be a need for complementary services, especially for SMEs, which need very targetted information. Two suggestions made in this regard are the following:

- Firms should have direct access to the people who represent Canada in international standards-setting forums. It should be a requirement that these individuals, not only prepare a report to be circulated but should be available to brief interested individuals on international standardization developments of interest. The SCC, for example, has the names of all the representatives which participate in international activities that it supports; and could publicize them.

- A targetted information service could be developed based on a profile of interest to specific firms. Such a service would regularly flag international developments of interest to firms subscribing to the service.

Participation in international standardization activities can only be effective if it relates to the needs of Canadian industry.

Issues: **What mechanisms should be set in place to ensure that international standardization information is disseminated in the most effective manner to Canadian industry?**

[1] The 12th edition of the annual Directory of Index of Standards and sixth edition of the Catalogue of National Standards in Canada, published in 1992, contain information on more than 7,500 standards. This information is also available electronically.

6

Nordicity Group Ltd.
Le Groupe Nordicité ltée

A STUDY OF THE EFFECT OF STANDARDS AND REGULATIONS ON TECHNOLOGY DIFFUSION: COMMUNICATIONS AND INFORMATION TECHNOLOGY SECTOR

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SUMMARY

This report describes the Canadian national standardization and regulatory system as it relates to the communications and information technology (C&IT) sector. It reviews the role of Canadian standards and regulatory organizations, and it identifies and discusses issues related to how standardization impacts on C&IT technology diffusion.

The communications and information technology sector constitutes one of the world's fastest growing and strategically most important hybrid industries. Today, this is one of the few high-tech sectors in which Canada is a strong world player. In Canada, the sector consists of about 12,000 firms with nearly 300,000 employees who generate products and services worth more than $40 billion annually.

Until recently, the communications and information technology industries have been quite separate, having different communities of individuals, different styles of operation and distinct processes for standards-setting. The information technology field was characterized as having many suppliers, limited regulation by government, many products and systems, and a great number of de facto standards with a lack of compatibility between them. In telecommunications, much more standardization took place within each nation because the telephone companies were monopolies.

Ten to twenty years ago, technology was diffused before standards were in place. In other words, in the past, proprietary implementation of technologies was abundant. However, the environment has changed significantly over the past ten years, particularly with respect to the telecommunications industry. Because of the international focus of many of today's telecommunications vendors, it has become essential to have sufficient standards in place before new products are diffused. The standards-setting process, both within formal international groups and within industry fora, has become increasingly important.

As illustrated in the following examples, standards and regulations significantly influence the diffusion of C&IT technologies.

- *Australia's absence at important standards meetings left that country with an electronic banking network that is incompatible with the rest of the world.*

- *Having failed to participate in international standardization efforts at a key time, Japanese banks had to spend billions of yen to recall 6 million credit cards, produced with the magnetic strip on the front instead of the back, and replace them with standardized ones.*

- *Canada's Advanced Information Technologies Corp. (AIT), has succeeded in dominating the world market for quality-assurance readers by being actively involved in the early stages of this developing technology. Participation in the international standards-setting process has been a strategic and integral factor in AIT's success.*

- *Northern Telecom's decision, in the late 1970s, to implement proprietary digital switching technology resulted in that organization becoming one of the leading manufacturers of switching technology in the world. However, Northern Telecom now recognizes that, in today's environment, its equipment must conform to international standards if it is to maintain its dominant position.*

- *Newbridge Networks, with its decision to deploy products that are in accordance with international ATM standards, is now one of Canada's fastest growing companies, with revenues expected to exceed $1 billion in the near future.*

These examples illustrate not only the significance of C&IT standards themselves, but the importance of fully participating in the international standards-setting process. Absence from key meetings (or the intelligence from such) can result in manufacturers making poor decisions regarding the development, and eventual diffusion, of C&IT products.

Therefore, standards significantly influence the diffusion of C&IT technologies. Their importance to this sector, as well as all sectors that use C&IT products and services, is increasing. Even though products will still continue to be developed and diffused where standards have not been formalized, it is becoming more and more necessary for manufacturers, service providers and users to be familiar with standards, both existing and under development, in order to optimize their strategies and business decisions pertaining to the development, introduction and use of C&IT.

Several issues are identified in this report mostly of a process nature. These issues relate principally to increasing the role of the federal government as a strategic partner in the standards-setting process; rationalizing and streamlining the Canadian standards process; harmonizing the policy and regulatory environment in Canada; improving the efficiency and effectiveness of compliance testing and certification; and addressing the requirements for improved communications and information disseminated on C&IT standards, particularly to the small and medium-sized enterprises across Canada.

There is clearly a need to raise the level of awareness of the importance of C&IT standards and regulations to Canada's overall development and prosperity. There is also a need to more adequately involve or represent the users and small businesses in the standards process.

Based on the analysis and synthesis of issues identified in the course of this study, it is recommended that:

- *A comprehensive awareness/education program be developed and implemented to enhance awareness within government, industry and the educational community, of the importance of C&IT standards and their relationship to technology development and diffusion.*

- *The federal government place a high priority on supporting the development of international C&IT standards that will enable a higher degree of inter-operability between networks, terminal equipment and systems.*

- *Federal and provincial governments promote a greater role for sector campaigns and peer groups in the development of international C&IT standards.*

- *The federal government play a key role in establishing the state-of-the-art facilities and associated procedures to test and certify C&IT products for inter-operability in Canada.*

1.0 INTRODUCTION

1.1 Context of the Study

The trade and financial regime of the future is characterized by globalized competition and renewed regionalism. Technology and investment, particularly in services and knowledge based industries, will continue to be a force behind growth in world trade and global integration. Communications and information technologies (C&IT) are providing the underlying revolutionary infrastructures for this future global society.

The convergence of C&IT constitutes one of the world's fastest growing and strategically most important hybrid industries. Today, this is one of the few high-tech sectors in which Canada is a strong world player.

Within this sector, the idea of moving from monopoly situations to free-market competition, has been gaining momentum both in Canada and abroad. If Canada is to take advantage of leading edge technologies in this area, this country will need a domestic environment that will encourage its suppliers and service providers to become global leaders. Regulatory roadblocks need to be removed.

In order to promote an internationally competitive industry in Canada, priority will have to be given to telecommunications deregulation, both domestic and international. The Canadian government can influence international regulatory bodies, such as the International Telecommunication Union (ITU), as well as Canada's major trading partners, to deregulate foreign and international telecommunications markets to the utmost, thereby increasing Canadian export opportunities.

Generally, the challenge for Canadian and international C&IT standards-makers is to ensure a standards writing process which accounts for rapid technological change and user needs, and which produces internationally harmonized standards. In addition, standards-makers must assure the availability of accredited testing services which are mutually recognized among trading nations.

Through the work of the various international regulatory bodies, many standards and regulations are undergoing major changes to accommodate the new technological realities of the 1990s and beyond. However, numerous other standardization bodies (e.g. regional bodies, policy councils and user groups) are having an increasing impact on C&IT standards.

Canada needs to remain active in this changing international infrastructure of C&IT standards. In addition, Canada must identify issues regarding the development and exploitation of standards as they impact on technology diffusion and the competitive situation of Canadian firms.

This report is one of the two sector-specific studies[1] to investigate the role that standards play in the technological innovation process and how they impact the competitiveness of Canadian firms. The report is intended to inform the reader of accelerating developments in the C&IT sector and also deals with how Canada might establish priorities for our involvement in standards developments to ensure aggressive representation of this country's interests.

1.2 Objectives of the Report

This report examines the role that C&IT standards play in the technological innovation and diffusion process, and how they impact the international competitiveness of Canadian firms.

Specifically, the objectives of this report are:

- to present an overview of the C&IT standards situation in Canada, including government regulations and industry standards;
- to provide a review of the role of Canadian C&IT standards structures, how they are changing, and their effects on technological innovation and competitiveness;
- to address the involvement of Canadian corporations in the C&IT standards process;
- to present an examination of the international context of C&IT standards and, how they impact technology diffusion in Canada, as well as Canada's competitiveness in world markets; and
- to compare Canada to other industrialized countries with respect to C&IT standards and the stimulation of technological innovation.

1 The other sector-specific study is of the construction industry.

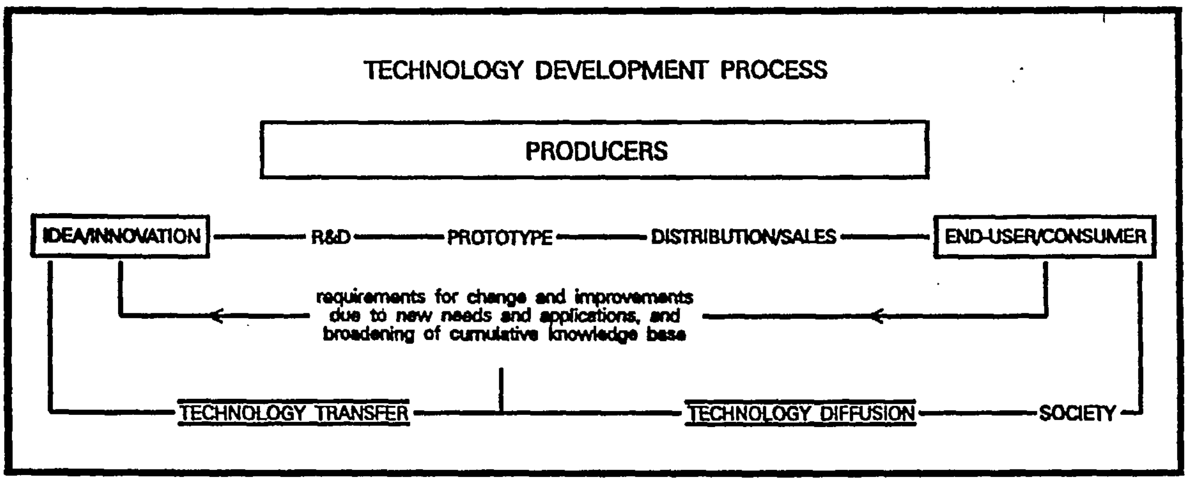
1.3 Definitions

Definitions for purposes of this report are as follows.

Technology Diffusion

Technology diffusion may be defined as "the spread of a technology already put to use by at least one firm or public institution, either in Canada or elsewhere in the world".[2] This definition helps to distinguish technology diffusion from technology transfer, which is the transfer of an idea to an initial use (prototype), either for commercial or public purposes. The following exhibit illustrates technology diffusion as a part of the technology development process.

Exhibit 1-1
Diffusion as a Part of the Technology Development Process



For the purpose of this report, technology diffusion will be defined broadly, because the techno-economic context in which it takes place, including the preconditions related to technology development, also influence the setting of standards. In the real world, standards impact on all different stages of the technology development process.

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2 A. Millington and Y. Van Ruskenveld, *Technology Diffusion in Canada: Myths and Realities*, MOSST, Sept. 1986.

Standards

A standard "implies a commonly accepted way of doing something".[3] There are various ways of describing standards. There are standards which are characterized on the basis of their purpose, by the development process through which they are achieved, or by their application.

Standards typified on the basis of what they define or their purpose, include:

- product design standards, which specify the characteristics of a product, or group of products, to ensure their fitness for use;
- performance standards, which specify requirements for one or more performance characteristics; and
- process standards, which facilitate and support socioeconomic transactions and interactions.

These standards are sometimes referred to as "functional standards". Functional standards relate to specific uses of the technologies, and in particular contexts.

Standards characterized on the basis of how or by which organization they were developed include:

- proprietary standards, which indicate that access to the product's or system's specifications are controlled by the manufacturer, and as such, the product or system cannot be reproduced by others (such as IBM's System Network Architecture (SNA) protocol);
- de facto standards, which are developed by industry within the context of market forces (i.e. simply through widespread use such as the Hayes modem); and
- de jure standards, which are official standards, arrived at by a duly constituted standards writing organization which has followed an established procedure (such as the International Organization for Standardization's (ISO) Open Systems Interconnection (OSI) set of standards.

[3] L. Salter and R. Hawkins, *The Standards Environment for Communications and Information Technologies: A Guide*, Simon Fraser University, March 1990.

Lastly, standards may also be described as "mandatory" or "voluntary". Mandatory standards are standards for which the application has been made mandatory by a regulation such as the CS-03 standard for terminal attachment to telephone networks. Voluntary standards are standards developed and used through consensus (freely and without coercion). All of the standards of the ISO and the ITU appear as recommendations and in the case of radio some are incorporated as regulations.

Regulations

Generally, regulatory standards arise from political choices and are mandated by government authorities from the top down. They are often driven by public concern and are sometimes introduced to regulate market structures. They may be implemented at either the federal, provincial or municipal level of government. In the area of radio standards, the overriding public concern is the avoidance of interference.

It should be noted that, throughout the report, when reference is made to standards, it is to both standards and regulations.

1.4 C&IT Standards

Communications and information technologies, like other fields, are characterized by products, technologies, systems and activities that appear to require standardization. However, until recently these two fields have historically been regarded as separate realms of activity.

1.4.1 Convergence of C&IT

Telecommunications is now moving towards more personal communications and the radio medium provides an essential link in providing these services. In most countries, the setting of communications standards for radio, telephone and telecom services has traditionally been the responsibility of governmental departments and regulatory agencies. Government involvement and regulation has been said to be necessary because:

- international conventions and treaties are often involved;
- telecommunications service providers have either been governments (public telephone networks) or monopolies; and

- access to the spectrum is constrained by the need to co-ordinate the open use of radio spectrum.

Heavy government involvement does not suggest that there is no role for private standards-writing organizations in telecommunications. Instead, close co-ordination between public and private sector standards activities must exist. The establishment of international communication standards is, and has been, the responsibility of national governments.

Information technologies, in general, deal with computers and data systems, applications and data transmission. Worldwide, this has largely been a field characterized by:

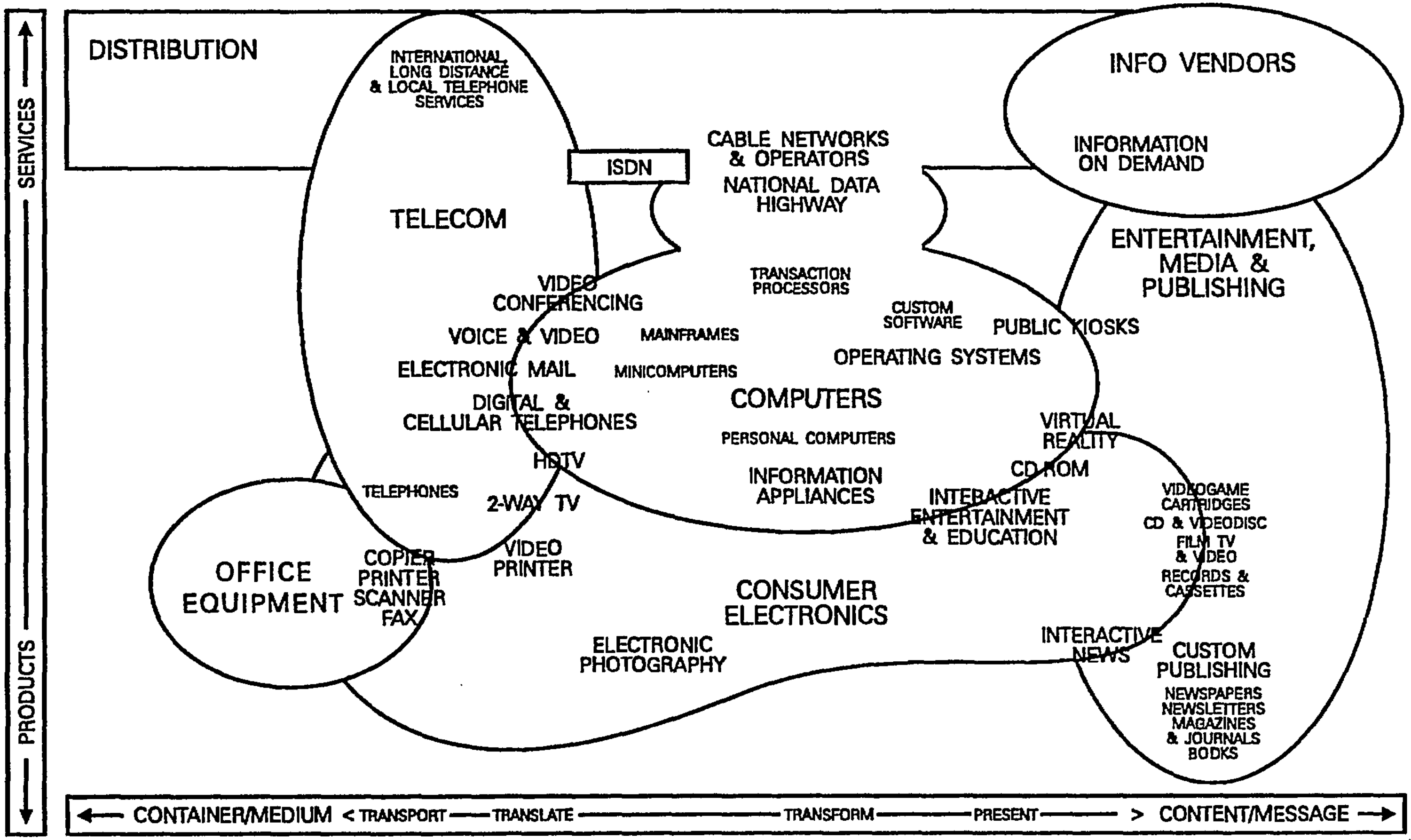
- private sector participation;
- limited regulation by governments;
- many products, different systems, different approaches to data transmission and a lack of compatibility between them;
- great numbers of de facto standards; and
- many suppliers and many users, each with different needs.

Notwithstanding, traditional organizations and procedures do exist for de jure standards in the field of information technologies. These organizations may be constituted standards-writing organizations, consortia of major manufacturers, groups of professional engineers, or bodies closely linked to government.

It is common, then, to speak of two cultures in the C&IT standards community. This alludes to the separate worlds of standard-setting for the communications and the information technologies - worlds characterized by different values, different styles of operation, and the involvement of different communities of individuals.

However, these two worlds can no longer be segregated with certainty. The use of new technologies seem to demand the integration of C&IT products, systems and activities. This is demonstrated by new developments, such as ISDN (Integrated Services Digital Network) and OSI (Open Systems Interconnection), which by their very nature represent the convergence of C&IT. Exhibit 1-2 illustrates the integration of C&IT products, as perceived by the year 2001. Significant efforts are now being made to merge or co-ordinate the various organizations from both cultures.

Exhibit 1-2
The C&IT Information Industry in 2001



Source: The Economist, February 27, 1993

1.4.2 An International Trend

The convergence of C&IT is definitely an international phenomena. However, at present, it is quite a problem in the international standards context. While the technology brings the communications and information sectors closer together there still remains some doubt as to the level of awareness of this technology as demonstrated by the respective institutional structures - very few people think of both environments and most organizations operate as they have in the past. To solve this problem, agreement must first be reached at the international level, such that costly and time consuming battles among competing national or de facto standards in the marketplace are avoided.

An additional difficulty presented by the convergence of C&IT is that responsibility for international standards development in each area is allocated to two separate organizations (ISO for information technology standards; ITU for communications standards). These organizations have traditionally had quite different operating procedures and formal co-ordination of work where subject matters overlap has not been very well structured.

In recent years, the concerns of the International Telephone and Telegraph Consultative Committee, or CCITT (now contained in the new Telecommunication Standardization Sector), an organ of the ITU, began to intersect with those of the ISO, especially with respect to the development of base standards for the open systems concept. In fact, many of the standards referenced by the OSI model are CCITT standards. The ISO dealt with protocols and set up the protocol framework. The ITU deals with standards for particular applications and services in accordance with these protocols. The success of this concept is in turn related to the development and acceptance of OSI. The two organizations have agreed on many common areas, along with a third body, the International Electrotechnical Commission (IEC), and this has resulted in practical arrangements such as common text where similar subject matter is involved.

1.4.3 Issues in C&IT Standards

There are a number of issues of direct concern to both C&IT standards. These are:

Access

The issue of access is associated primarily with the users of telephone and telecommunications systems. It refers to:

- the ability of users to connect to, and make use of, the telephone and telecommunications systems;
- the ability of suppliers to make use of some or all components of the basic telephone system; and
- access to the common resource of the radio spectrum.

Openness

Openness is more frequently associated with information technologies, but is also applicable to C&IT. From the viewpoint of a manufacturer or supplier, openness means:

- there are no proprietary standards which would prevent it from producing components for the network or for applications to be used with it; and
- providing customers with reassurance that components will be compatible with what is being provided by others.

While significant efforts are under way to promote OSI, a great deal must still be done before open systems exist.

Compatibility

Systems are compatible when they are inter-connectable and inter-operable. Inter-connectability alludes to the physical compatibility of different communications systems or networks and the ability to join them together (connecting the various pieces of equipment together). Inter-operability refers to the further development of compatibility and the stage when systems can actually exchange data meaningfully (achieved through the design of equipment capable of it or by the use of software designed to create compatibility).

New Approaches to Standard-Setting

People say that there is a new approach to setting standards which involves the development of standards in conjunction with the development of technologies. Open systems are a response by some segments of the communications and information technologies sectors to take into account competitive factors such as:

- the need for users to be sure that vendors' products will talk to each other; and

- the rapid pace of change and the short market life of any product or system.

1.5 Key New Technologies within the International Standards Environment

1.5.1 Historical Perspective in the Role of Standards in C&IT Diffusion

Based upon our interviews, the consensus is that today, standards are more important than they have been in the past.

Ten to twenty years ago technology was diffused before standards were in place. In other words, in the past, proprietary implementation of technologies has been abundant. In the process of standards gaining in importance, we have experienced a transition phase whereby the time lag between the issuance of standards and the diffusion of technologies began to shorten.

In the real world, events often overtake the standards effort early in the process. In some cases this results from an unusually fast and successful research and development effort, and in others from an innovative use of an existing technology. In either case, a rapid advance results in the creation of a commercial opportunity before completion of a formal consideration of the technology. Communications vendors cannot ignore profitable opportunities, and the rush to market may push one firm to the forefront. This is normally the company that opens the market. And when the media publicizes the company's breakthrough, the product's operating parameters and terminology become the benchmarks against which subsequent offerings are judged. Sometimes these earlier market developments are so successful that they deter formal standardization altogether; thus, the de facto standard.[4]

However, being first in the marketplace is not always enough. Certain large organizations such as AT&T and IBM set de facto standards. These organizations often establish a preferred solution by virtue of their resources and influence. In 1974, IBM announced its Systems Network Architecture (SNA). SNA did not support a single, formal protocol standard but generally conformed to protocol structure rules then being

[4] **International Communications Standards. Datapro Reports on International Telecommunications, 1990, p. 103.**

developed by the international standards community. Nevertheless, SNA is an important industry standard.[5]

In 1982, standards emerged as a driving force in the computer and communications industries. Ethernet inter-operability problems drove the industry to work together to pinpoint and correct incompatibilities at the physical layer of the OSI model. As a result, vendors shared their findings with the standards community and cleared a major hurdle on Ethernet's standards path to long-term success. A more recent example of such industry collaboration is the adoption of Simple Network Management Protocol (SNMP) for TCP/IP based networks.[6]

Today, it appears that the tide has shifted significantly due to the emergence of new digital/broadband technologies. The emergence of new information technologies has meant that the standards-setting process has become more important, and that a minimum level of standards should be in place before technology diffusion begins. There are several reasons for this change in focus.

First, telecommunication companies have realized that to survive they must become international in scope, ie. produce and market products and services around the world that conform to international or global standards. Second, as mentioned above, proprietary technologies were often commercialized in the past. However, today companies are more and more attempting to design and build products that meet an open standard, or at least some level of standard. Proprietary roll-outs of technology still occur, but once a technology is widely diffused users do not want it to be proprietary, since they want services that are inter-operable and allow them to purchase equipment from any vendor. Third, new implementation forums such as The ATM Forum and The Frame Relay Forum have become key links to diffusing newer technologies. Industry vendors and suppliers realize that they must have a presence at these levels of standards development. Their participation is often in fact crucial, from the point of view of gathering information, being able to influence the standard-setting process, and feeding the forum progress into the actual design of products, given a stronger desire on industry's part today to design products that will function within a more open system. Because the availability of common standards is expected to accelerate the market for all kinds of high bandwidth traffic, few companies can afford to ignore the standards fora.

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[5] Ibid.

[6] Paul Severino, *The Critical Importance of Standards in Internetworking*, Telecommunications, February 1992, p. 7.

- In the late 1970s and early 1980s, two formats existed for consumers video cassette recorders, Beta and VHS. The Beta format was proprietary to Sony but the VHS format was licensed to several equipment manufacturers. Within ten years, the market had shown a clear preference for the VHS format resulting in significant financial losses to Sony and wasteful spending by millions of consumers. An international standard followed by all manufacturers would have avoided this outcome.

- In the broadcast industry, the U.S., Japan and Canada adopted the NTSC broadcast TV standard. However, the standard was not adopted by European countries for technical reasons such as vertical frequency, line resolution, and colour performance. Instead, the PAL standard was adopted in nearly all of Europe except France which adopted its own sequential-and-memory [French and Soviet television system] (SECAM) standard. These various standards have served to limit access of some television equipment manufacturers to the overall world market and, in some cases, created the requirement for multi-function television sets and VCRs. For example, in Geneva, one needs a TV with PAL capability because Switzerland has adopted the PAL system but one also needs the SECAM capability in order to receive TV signals from France.

- The development of standards for attachment of terminals to the Public Switched Telephone Network (PSTN) significantly contributed to the diffusion of a wide range of technologies. Prior to the 1981 Terminal Attachment Decision in Canada, telephones, facsimiles, and modems were supplied by the monopoly telephone companies. After the Terminal Attachment Decision, there was widespread diffusion of many different types of telephones, data communications terminals and facsimile machines. Modems and facsimile machines diffused at even a much higher rate after appropriate CCITT standards were developed and adhered to by manufacturers. In particular, the Group III facsimile standard and V.32 bits modem standards contributed to the proliferation of this equipment. These standards created a market environment where manufacturers could take advantage of economies of scale to provide equipment at costs affordable to businesses and consumers.

- Throughout the past decade, Canadian conglomerates have implemented cable service in the U.S., England, France and Hong Kong. As such, they have earned millions of dollars from these ventures. A key factor in this success is Canada's strong influence in the development of international standards.

Canadian leadership in IEC's cable subcommittee has resulted in standards largely based on procedures developed in Canada. This, in addition to the some 40 years experience in building cable systems at home, is the reason companies such as Rogers Communications Inc. and Maclean Hunter Cable TV have been competing for, and winning, cable franchises in Europe and the U.S.

- A recent Globe & Mail article described one Canadian company's ability to diffuse its product worldwide and the role that international standards played in the process.[9] In 1985, the same year that Canada introduced machine-readable passports, AIT (Advanced Information Technologies Corp.) entered the business of designing readers. Based on the standard for machine-readable passports, developed by the International Civil Aviation Organization (ICAO) in the 1970s, AIT designed a quality-assurance reader used to make sure the machine-readable passports met the rigorous specifications demanded for such documents. Soon after, the company began to furnish additional components, such as printers and passport-issuance software, to complete the system.

  AIT also chairs the ISO committee which gives the firm leading edge intelligence on standards under development and the business opportunities that will result from such.

  Since its inception, AIT has been consistently profitable. In 1993, the company expects sales to exceed $20 million. AIT's success clearly demonstrates how a small company, that gets involved in the early stages of a developing technology, and participates in the standards-setting process can build a profitable international niche.

[9] The Globe & Mail, *AIT Technology Provides Passport to World Market*, May 17, 1993.

In some cases, absence at important standards meetings resulted in incompatible technologies.

- Late in the 1960s, when ISO was developing the standard for credit cards, Japan proceeded to produce over a million cards with the magnetic strip on the logo side of the card, assuming the standard under discussion at the most recent meeting was in final form. However, at a subsequent meeting, not attended by Japanese delegates, it was decided to put the magnetic strip on the non-logo side so that it would not interfere with the logos and names. As a result, Japanese manufacturers had to recall and destroy the existing cards and retool to put the strips on the non-logo side.

- Shortly before the development of the world payment system, Canadian banks joined SWIFT, an association comprised of 17,200 world banks. Soon thereafter, the standards and systems to SWIFT went under development. Canada's absence throughout the developmental process resulted in the development of a national system which could not access SWIFT. Canadian banks invested vast amounts of money to alter the existing system such that it would conform to SWIFT's protocols for data interchange, telecommunications and automated teller machine networking. Australia's non-representation in SWIFT left the country with an electronic banking network that is incompatible with the rest of the world.

These examples illustrate not only the significance of C&IT standards themselves but the importance of fully participating in the international standards-setting process in order to ensure that a firm has the necessary intelligence to maximize its opportunities for diffusing technology.

1.7.2 The Impact of Some Emerging C&IT Standards on Technology Diffusion

This section of the report attempts to give the reader a flavour of what has happened within the international C&IT standards environment, and to comment upon the impact of standards-setting on technology diffusion. Within this context, we will briefly review the experience to date of certain key new technologies such as narrowband and broadband ISDN, SONET, and ATM. In addition, some general observations about OSI are made in this section, even though OSI is not a standard in itself but a protocol framework.

Narrowband-ISDN (N-ISDN)

Narrowband-ISDN in North America is a good example of what happens when the standards are set too early. N-ISDN standards have been in place since the mid-1970s, but widespread technology diffusion has not occurred. The reasons for this are complex, but in general, the slow progress of N-ISDN diffusion was due to a lack of compatible or inter-operable systems and a lack of demand by users.

Some would argue that the primary obstacle to ubiquitous narrowband-ISDN has been the lack of industry agreement on how to implement standard procedures and protocols to provide the service. As a result, this led to the emergence of ISDN "islands" in North America since different telecommunication manufacturers and service providers used proprietary or custom approaches in the roll-out of ISDN. The 1980s can be described as a period within which multiple, incompatible versions of N-ISDN began to emerge.

For the first time in February of 1992, industry-wide consensus was reached in the U.S. to develop and deliver ISDN services in the public network based on a standard set of technical specifications and implementation agreements.[10] National ISDN-ONE was forced by Bellcore, the Regional Bell Operating companies (RBOCs), the switch manufacturers, and the Corporation for Open Systems (COS) in response to the user needs specified by the North American ISDN Users' Forum (NIU-F).

Therefore, in the U.S., ISDN services were only inter-operable from coast to coast in November of 1992. Even then, only 22 switches were connected to the newly inaugurated network.

While the "inter-operability" factor may not ensure the ultimate diffusion of narrowband ISDN, it was clearly recognized as one of the most significant barriers to deploying ISDN or any other new network services.

Broadband-ISDN (B-ISDN)

B-ISDN standards development work began in the 1980s within the CCITT and ANSI. Since then, the T1 committee of ANSI has issued most of the higher level standards of today, e.g. signalling, network management, operations and maintenance, traffic management and the longer term requirements for multimedia services.

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[10] Steve Jones, National ISDN-ONE, Telecommunications, September 1991, p. 18.

The importance of B-ISDN is that it is designed to handle high bandwidth traffic (e.g. above the primary N-ISDN bit rate of 1.544 Mb/s). However, "just as facsimile machines did not realize a large market and facsimile usage did not explode until common facsimile standards were adopted in 1983, high bandwidth traffic cannot grow until it can be routed to wherever the user wishes it to go." The common standards now being implemented throughout the network, are expected to accelerate the diffusion of a variety of new higher bandwidth terminals and services.

Fibre and the Synchronous Optical Network (SONET)

SONET is an optical transmission interface originally proposed by Bellcore and standardized by ANSI in the U.S. It defines a set of interfaces to allow multi-vendor connectivity and the networking of broadband applications (the CCITT has adopted an equivalent international standard, known as SDH).

Again, although the SONET standard has been developed, it is only now making its way into the network. This is because SONET is the logical follow on to today's high-speed, synchronous wider area telecommunications services, such as DS1 (1.544 Mb/s) and DS3 (45 Mb/s), which remain in existence today. SONET Phase 1 is just now being deployed in the telco network, and its first use is for trunking between central offices (COs). An open standard has not yet been developed for connections between a CO and the customer's premises.

In addition, SONET is being positioned to meet rising customer demand for switched high-bandwidth services, demand that thus far is slowly materializing. SONET also has a competitor, or complement, in the form of FDDI, another fibre-based transmission medium. FDDI, designed as a 100 Mb/s backbone technology, can accommodate the high bandwidth needs of work stations and appears to meet most networking needs of today.

What is important to note about SONET is that it was developed as an open standard, in an open forum under ANSI/Bellcore. Before the emergence of SONET as a transmission standard, fibre transmission solutions from telecom vendors were all proprietary. B-ISDN and SONET standards are highly compatible and will jointly provide the foundation for future broadband highways. The role that SONET will play will be that of the backbone carrier for broadband ISDN.

Therefore, it is anticipated that SONET will allow users to purchase customer premises equipment (CPE) from several vendors and thereby stimulate the diffusion of broadband and related services.

Asynchronous Transfer Mode (ATM)

ATM offers high bandwidth and the flexibility to handle not only data but other types of information, such as voice and video. ATM is gaining in popularity because it will provide vast quantities of bandwidth to local area networks (LAN) users, and has also been accepted by the CCITT as an international message transfer mode for broadband ISDN.

Canada's Newbridge Networks is one of a handful of companies at the forefront in the diffusion of ATM technology. Newbridge Networks is commercializing ATM switching technology licensed by MPR Teltech of Burnaby, British Columbia. The current Newbridge ATM Net Switch was demonstrated at a recent conference as being inter-operable with the equipment of four large system operators. Newbridge, with its strategic decision to deploy ATM products prior to complete international standardization, is now one of Canada's fastest growing companies with revenues expected to exceed $1 billion in the near future.

Open Systems Interconnection (OSI)

OSI is not a standard in itself but a framework for standards. The OSI model has become the reference point and measure of future developments in communications architectures for both users and vendors. Users and suppliers, despite the massive investments already made in proprietary architectures such as TCP/IP and SNA, are preparing for the migration to OSI in anticipation of multivendor inter-operability and global connectivity that current systems cannot provide.[11]

OSI specifies an architectural model that allows open communications between the most simple or the most sophisticated computing devices. Physical connections are addressed at the lower three layers of the OSI model, while the upper four layers address many other features including data transport, error detection and recovery, and specific applications. All seven layers in the ISO basic reference model for OSI have been substantially defined, and protocols for the three lowest layers can now be implemented.

The OSI defines a system as a set of one or more computers and associated hardware, software, human operators, physical processes, etc. which, combined, form an autonomous whole capable of performing information processing and/or information

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[11] ISO Reference Model for Open System Interconnection (OSI), DataPro Research, September 1989, p. 101.

transfer. An open system is one that obeys OSI standards in its communication with other systems.[12]

During the late 1970s and early 1980s vendor support for the OSI model ranged from indifferent to wholehearted. However, by 1985 it became apparent that co-operation among vendors would be critical to the success of open standards. In 1985 major vendors such as Northern Telecom, NCR, IBM, Digital Equipment Corp. and AT&T officially announced their support for OSI and formed the Corporation for Open Systems (COS). The goal of the COS is to promote implementation of OSI standards and to develop conformance testing procedures. The Canadian Interest Group on Open Systems (CIGOS) was established to promote open systems adoption in Canada.

Today, a full set of OSI standards exist for a wide range of network technologies and numerous classes of computer interaction. Products based on OSI standards are largely available and, in some cases, have been mandated by large users, such as the U.S. federal government.

Perhaps the best example of an OSI application is ITU's X.400 Message Handling System. The X.400 provides the basis for a world-wide electronic postal system that supports the eventual integration of various store-and-forward services (including voice mail, facsimile mail and EDI). These standards were first published in 1984, extended in 1988 and enhanced in 1992.

Other areas of standardization include: File Transfer Access and Management (FTAM) for access to and exchange of computer files; the X.500 series of directory services; and network routing protocols.

Nevertheless, existing protocols such as SNA and TCP/IP remain popular largely because they have been implemented and are proven. Therefore, it is expected that there will be a trend towards developing the appropriate interfaces to make these systems inter-operable with the OSI framework, thereby creating an environment for the diffusion of a multitude of telecommunications network services and products in the latter 1990s.

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[12] Ibid.

1.8 Conclusion

In conclusion, over the past 10 to 20 years, we have seen a significant change in C&IT standards development, particularly with respect to telecommunications. Because of the international focus of many of today's telecommunication vendors, it has become essential to have sufficient standards in place before new C&IT products are diffused. The standards-setting process, both within formal international groups and within industry fora, has become increasingly important.

C&IT manufacturers and service providers realize that it is to their advantage to collaborate in the early establishment of open standards, at certain levels, because users are more than ever demanding inter-operable services and equipment.

Equipment based on proprietary standards can limit technology diffusion. The extent of this limitation depends on a number of factors. It may be minimal in the case of user equipment such as voice processing equipment, or it could be significant for an equipment manufacturer developing digital switches or terminals that must inter-operate on a regional or global basis.

The previous examples also demonstrate the importance of participating in the C&IT standards-setting process, a process which is dynamic and where absence from key meetings (or the intelligence from such) can result in manufacturers making poor decisions regarding the development and eventual diffusion of C&IT products.

2.0 OVERVIEW OF THE CANADIAN C&IT STANDARDS ENVIRONMENT

The following sections present a general examination of the Canadian C&IT standards arena. More specifically, the chapter takes a look at the value of standards to the C&IT sector, the relationship between standards development and the research and development (R&D) process, various C&IT standards organizations in Canada, and findings of recent studies.

2.1 The Value of Standards to the C&IT Sector

In the past four decades, Canadians have relied extensively on the creation, communication and consumption of information as a source of jobs, wealth and social progress, and less on the exploitation of raw materials and physical labour. It is expected that this trend will continue into the foreseeable future as Canada becomes an increasingly information-based society.

The shift to an information-based society is evident from the rapid growth in the service industry sector of the economy. In 1946, less than 41 per cent of the Canadian population was employed in the service sector; by 1986, that figure had increased to 71 per cent. Over the same period, the number of people employed in the manufacturing sector dropped from 30 per cent to 23 per cent, while those employed in the resources sector declined from 29 per cent to 4 per cent.

According to the Organization for Economic Cooperation and Development (OECD), by 1986, information workers constituted 45 per cent of the total employment in Canada. This has been mainly achieved because information processing, analysis and dissemination often form the basis of the service provided by the rapidly growing service industries.

Revenues in traditional information industries (i.e. film, video, publishing) have grown rapidly (almost three times over), from nearly $4.5 billion in 1977 to $11 billion in 1985. At the same time a wide variety of entirely new businesses, that sell electronically encoded information, have entered the marketplace. These emerging information industries are contributing to Canada's Gross Domestic Product (GDP) at rates far beyond those of the more traditional information industries. Between 1977 and 1985, revenues for the new industries increased sevenfold from $300 million to $2.1 billion, while GDP only doubled.

By 1991, Canadian C&IT was a $40 billion industry[13], consisting of 12,000 firms and employing slightly less than 300,000 people. It accounted for about 3 per cent of the world's products and services, estimated at approximately $1 trillion. It was the seventh largest domestic market and contributed 7 per cent of manufacturing GDP (compared to pulp and paper) and 5 per cent of services (more than transportation). At the time, the growth rate of the Canadian information technology industry was significantly larger than the economy as a whole, and was predicted to reach 10 per cent of Gross National Product (GNP) by the year 2000.[14]

The telecommunications equipment sector alone had a Canadian market of $5.8 billion, by 1991. It was reported to be approximately 4 per cent of the world telecommunications equipment market, valued at $130 billion. Today, the telecommunications equipment sector of the C&IT industry continues to be one of the fastest growing sectors, contributing as much to the economy as the forestry, textiles, aviation and chemical industries combined.

While standards create a relatively predictable world for the manufacturer and supplier of products and components of communications and information systems, and links that manufacturer to the fastest growing industrial sector today, some manufacturers can obtain an innovation advantage by introducing products prior to completion of the standards process (e.g. Newbridge Networks).

The existence of C&IT standards make it possible for industry to make reasonable decisions about what to purchase and how to integrate new C&IT into every aspect of its operation. Efforts to promote new open system standards are creating new competitive opportunities for Canadian manufacturers and suppliers. However, this new competitive environment, in many aspects of telecommunications, requires potential suppliers to have strategies with respect to the standardization of the equipment and systems which will be used to take advantage of the opportunities involved.

The OECD noted[15] that the rapid growth of the total information technology activity brings with it a risk of chaos and unmanagability. As such, standards are necessary to bring some level of order and stability to the market. Standardization restores a certain

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[13] Includes telecommunications equipment and services, computer services and software, microelectronics and components, computers and peripheral equipment, and instrumentation.

[14] Industry, Science and Technology Canada, *1993-1994 International Trade Business Plan: An Integrated Plan for Trade, Investment and Technology Promotion and Development* (Ottawa, 1993), p.111-112.

[15] Organization for Economic Co-operation and Development, *Information Technology Standards: The Economic Dimension*, Paris, 1991.

degree of order in the market and ensures that the promised competition can be initiated and promoted therein. It is compatible with increasing competitive opportunities and freer markets because it is significantly influenced by industry.

Potential barriers to open markets and systems automatically exist where standards for products, processes and systems are different between trading partners and where trading partners have different schemes for conformity assessment. Governments world-wide are now trying to remove these non-tariff barriers to trade with standards and their application in conformity assessment programs. At the international level, the General Agreement on Tariffs and Trade (GATT) has developed a Code of Conduct for standards development and their usage in conformity assessment program. The Canada/U.S. FTA also reflects the same concerns. The elimination of trade barriers caused by the different standards used by the member countries of the European Community is also the main impetus behind the Europe 1992 concept.

The standards community, in Canada and in other countries, must respond in both a positive and proactive manner to ensure that standards are not used as non-tariff barriers to trade. In addition, it is necessary to ensure that all affected parties are fully involved in the standards development process. This is especially important when the standards organizations are required to develop standards where the technology is continuing to evolve.

2.2 C&IT Standards and the R&D Process

Many standards focus on what might be called the end of the production process, and emphasize product safety. Others focus on a user interest, and deal with aspects of product performance or functionality. Regardless, both affect the way products are built, and thus exercise their influence in the early stages of production.

However, in C&IT, standard features of the service are as early in the R&D process as possible. This is essential if issues of interconnection and inter-operability are to be addressed.

At this point, the issues become extremely complicated. First, while some argue that there should be no central planning, through standards, of the longer term development of technology, others believe that some consideration of standards during the R&D process would improve the flow of benefits from new technology. However, determining the right place to introduce standards, and what degree of influence they should have, remains unanswered and often unaddressed.

Second, the farther back toward basic research that standards begin to develop, the more entrepreneurial intelligence becomes public information. This curbs the search for new technology by reducing the possible benefits to those who spend time and money to find new technology. In turn, standards development, and hence technology diffusion, are hindered. Questions of this kind must be addressed before any agreement can be reached to permit the development of standards farther back in the R&D and production processes for C&IT. However, at a minimum the R&D process needs to be used to develop acceptable terminology and measurement techniques to ensure the inter-comparability of research results.

" The key to whether a (C&IT) standard inhibits or helps technology diffusion is in the timing. If the standard is too early, innovation could be inhibited; if it is too late, the market opportunity for the technology may be missed. Developing standards inhibits the innovation process but permits multiplication of the market, and hence technology diffusion."[16]

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[16] Denis Hall, Chairman, Steering Committee on Telecommunications.

2.3 C&IT Standards Organizations in Canada

There are several organizations and committees in Canada that participate in the development and adoption of C&IT-related standards. Some develop standards, some focus on applications, some promote particular standards and others incorporate an interest in standards in a broader work program. Exhibit 2-1, the membership chart of the Telecommunication Standards Advisory Council of Canada, illustrates key participants in the Canadian C&IT standards area.

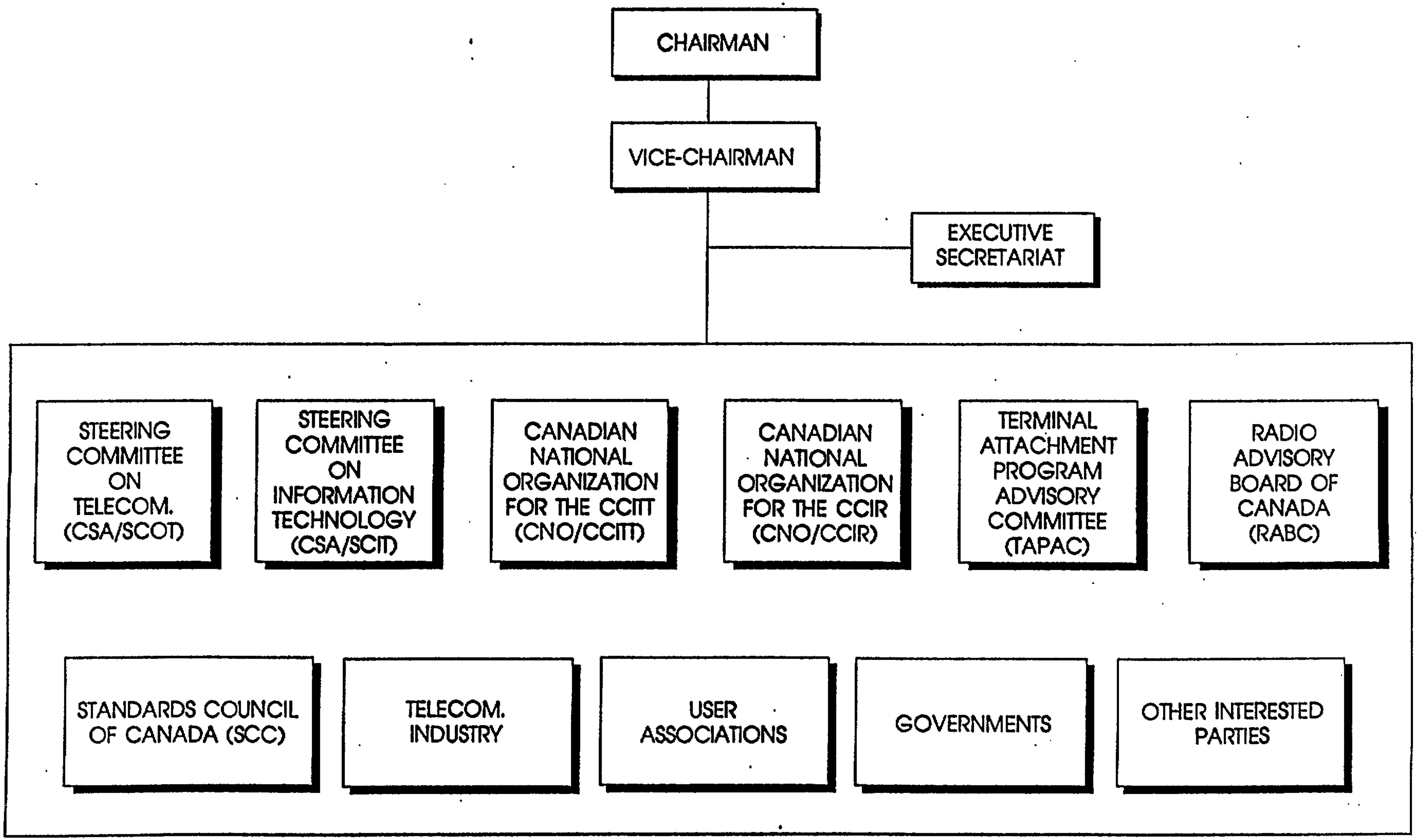
2.3.1 Telecommunication Standards Advisory Council of Canada (TSACC)

TSACC was established to provide a Canadian focus to enhance the effectiveness of the Canadian telecommunications standards infrastructure; to develop and recommend strategies for the development of Canadian standards; and to develop and recommend strategies for Canadian involvement and influence in regional, inter-regional and international telecommunications standardization activities. TSACC membership is open to all organizations which are actively involved in telecommunications standards development in Canada.

TSACC was established because the rapid pace of technology evolution combined with the formation of regional trading blocs is placing unprecedented demands on the standardization process. As such, Canadian industry and government need to ensure continued access to domestic and international markets.

TSACC is intended to address these strategic issues and develop recommendations for their resolution. The strategies required for Canada will include standards development as well as related issues such as accreditation, conformity assessment, mutual recognition, and technology diffusion. The terms of reference for TSACC clearly state that TSACC is not intended to usurp any authority or mandate of the existing telecommunications infrastructure but rather to add value to this structure in providing a forum for consideration or strategic orientation of Canadian interests in the whole spectrum of Canadian, regional, inter-regional and international telecommunications standardization.

Exhibit 2-1
Telecommunications Standards Advisory Council of Canada (TSACC) Membership



2.3.2 Steering Committee on Information Technology (SCIT)

SCIT is a committee of the Canadian Standards Association (CSA), accredited by the Standards Council of Canada (SCC), to deal with information technology. SCIT operates as a harmonized committee, with the mandate to:

- act on behalf of Canada providing upstream contributions to JTC 1; and
- act as Canada's national committee for downstream IT activities.

Its objectives include: streamlining the standards process; harmonizing Canadian standards with those of the U.S. and the world; and addressing issues on priority areas as seen by its members.

SCIT membership is based on expertise and interests, and is by nomination. Members include multinational firms normally associated with data processing manufacturers (e.g. IBM Canada Ltd.) telecommunications (e.g. Unitel, BNR, Bell Canada), user interest representatives (e.g. the CBTA, the banking and steel industries), the federal government (e.g. Treasury Board) and individuals and/or consultants. Representation from the telecommunications sector has been increasing due to the convergence between data processing and data communication products and services.

SCIT's technical committees, on which non-members participate, are fully responsible for the technical content of the standards. The executive committee, on the other hand, is responsible for the co-ordination and liaison, allocation of resources, establishment of new committees and the promotion of information technology standards. SCIT standards are all voluntary, and until recently included as many as 60 standards yearly.

Albeit SCIT is a harmonized committee, its key work is upstream - people participate in SCIT because they want to be involved in the international development of standards. The technical committees prepare Canadian submissions to the ISO/IEC Joint Technical Committee (JTC 1), and only when a JTC 1 decision has been made, does the downstream activity become important. SCIT then recommends the JTC 1 standards, usually without modification, as standards under the National Standards System (NSS) of Canada. At that point, the standards are available for sale by the CSA at an average cost of about $60 per standard.

Some key areas of work for SCIT include:

- information retrieval, transfer and management for open systems interconnection;

- telecommunications and information exchange between systems; and

- interconnection of information technology and equipment.

The open systems work is done in close cooperation with the work of the committees associated with the Canadian National Organization developing standards as part of the International Telecommunication Union (ITU).

2.3.3 Steering Committee on Telecommunication (SCOT)

SCOT is a committee of the CSA, accredited by the SCC to deal with telecommunications downstream activities. While it is committed to international standardization, most members nonetheless deal with market realities which dictate a North American or American strategy.

SCOT's mandate focuses on the definable functional and performance characteristics of terminal equipment attachments to telecommunications networks and network protection issues not dealt with by TAPAC. It does not deal with the design and arrangement of networks, or with issues of electrical safety.

Members of SCOT include representatives from government, manufacturers, telecommunications carriers and general interest groups. At present, there are approximately 40 members, 75 per cent of which require standards but do not themselves have the expertise to participate in their detailed development. The steering committee decides when work on a given standard is required, and then assigns it to a technical committee. As with SCIT, SCOT deals with voluntary standards only.

In a recent assessment of the costs of its standards development, SCOT estimated that the cost of developing a Canadian standard is more than ten times that of adapting a standard. In addition, SCOT estimated that the potential for its sales are relatively low.

These findings placed pressure on SCOT to simply adopt standards developed elsewhere (primarily ANSI T1) as Canadian standards. By doing so, the Committee would make them readily available through the CSA catalogue. This would be ideal given that Canadian industries have difficulty in gaining access to T1 standards. SCOT standards are generally priced in the $10 to $20 range.

SCOT is involved in making Canadian choices for Private Branch Exchange (PBX), switching equipment for voiceband applications, requirements for handset telephones intended for use by the hard of hearing, call waiting, and so on. Products conforming to these standards are being used by millions of Canadians.

SCOT played a leadership role in North America in defining standards for the provisioning of wiring inside buildings for telecommunications applications.

2.3.4 Terminal Attachment Program (TAP), and Terminal Attachment Program Advisory Committee (TAPAC)

The Terminal Attachment Program (TAP) was established 15 years ago by the Department of Communications and a number of telecommunications carriers, manufacturers, provincial authorities, and other interested parties. The objectives included protecting the telephone network from harm, fostering competition within the terminal manufacturing and distribution industry, and providing support to the regulator. TAP facilitates technology diffusion through these efforts.

The Department of Communications (DOC)[17] contribution includes the operation of a Certification Bureau and a laboratory to develop testing methodologies and perform audit testing. In addition, a dozen or so labs in Canada and a similar number in other countries, primarily the U.S., are approved to test equipment.

The Terminal Attachment Program Advisory Committee (TAPAC), which is chaired by a DOC appointed official, was established to make recommendations to the Minister of Communications for mandatory terminal attachment standards.

TAPAC's primary mandate is associated with the CRTC and the mandatory standards pursuant to CRTC decisions. This includes the attachment of equipment to the networks and facilities of the telecommunications carriers. As such, TAPAC was, in reality, the product of the CRTC terminal attachment decision (Decision 82-14) to permit competition in the terminal attachments and of the CRTC's concern that standards, or their absence, not be used to undermine regulatory decisions. The CS-03 standard specifies the minimal conditions for attachment of a wide range of terminals and terminal features including telephones, non-addressing equipment, and ISDN terminals. The CS-03 standard is available from DOC regional offices at no charge (the cost is bundled with the certification prices).

In accordance with its certification mandate, TAPAC is involved in the development of performance standards in association with certification. In addition, given the importance of North American markets for many of its members and the increasing need for harmonization with the United States, the committee pays close attention to FCC activities.

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[17] As of June 25, 1993, the Communications Policy Branch of the Department of Communications is part of the new federal Department of Industry and Science.

2.3.5 Radio Advisory Board of Canada (RABC)

The RABC serves as an advisory and consultative body for DOC in the area of radio communications. The Board mainly deals with matters concerning the radio spectrum, its management and allocation. RABC is not certified under the SCC as a standards-writing organization.

The RABC is an association of associations. Its membership includes industry trade associations, individual firms and government bodies. The activities of the RABC are supported by member fees.

RABC's mandate is to promote the interests of radio-communications groups, as well as insure the orderly diffusion of technology by promoting appropriate standards, both in the broadcasting and telecommunications sectors. At present, RABC also deals with equipment and system matters related to digital radio transmission equipment, as well as with regulatory and policy matters independent of standards. The RABC advised the Minister of Communications on the service features and technology requirements for the CT2 Plus Class 2 standard for public cordless telephone service. Other C&IT-related areas of work include paging standards, spread spectrum radio transmission techniques, and digital radio.

The RABC's work is conducted through its technical committees. These committees prepare submissions to DOC on various concerns including the technical and regulatory protection granted to users, and protection from interference. The Ministry of Communications is mandated to take actions on the RABC's advice including establishing standards where appropriate.

For the most part, RABC's work consists of downstream activities although harmonization of Canadian standards and regulations with those of the Federal Communications Commission (FCC) are also important.

2.3.6 The Canadian National Organization for the Telecommunication Standardization Sector

The Canadian National Organization for the Telecommunication Standardization Sector (previously known as the Canadian National Organization for the Consultative Committee in Telegraphy and Telephony, or CNO/CCITT) is the upstream group responsible for preparing contributions to the Telecommunication Standardization Sector. Its contributions represent formal Canadian positions on telecommunications-related matters. It is chaired by an official of the Department of Communications, but its membership reflects a working combination of industry and government interests.

Given the recent restructuring of the ITU, the present structure of CNO will also undergo some change.

The various subcommittees of the CNO for the Telecommunication Standardization Sector are working on such initiatives as ISDN, data transmission over the telephone network, transmission performance of telephone networks and terminals, terminals for telematics services and so forth.

2.3.7 The Canadian National Organization for the Radiocommunication Sector

The Canadian National Organization for the Radiocommunication Sector (formerly known as the Canadian National Organization for the Consultative Committee in Radio, or CNO/CCIR) is the upstream organization responsible for preparing contributions to the Radiocommunication Sector and its various committees. The CNO has traditionally dealt with radio spectrum, its allocation and management, including standardization of equipment and systems.

With the recent restructuring of ITU, it is anticipated that this CNO will also change its composition and function. Exhibit 2-2 illustrates the proposed new CNO for radiocommunication sector.

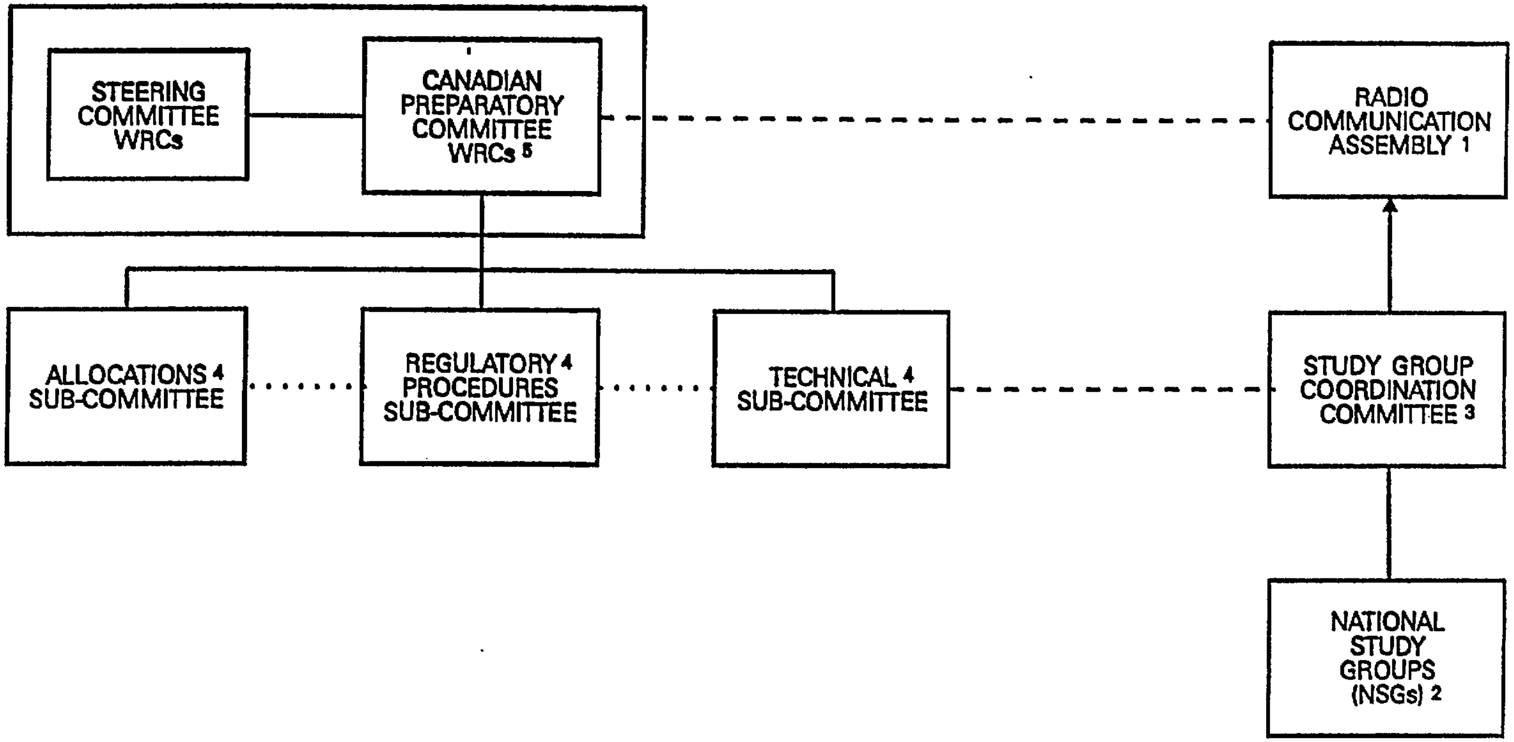
The CNO has been contributing to such areas as geostationary and low earth orbit satellite allocations, Future Public Land Mobile Telephone Services (FPLMTS) and the development of digital audio radio. In this latter area, Canada is taking a lead position developing experimental systems and promoting international interest in digital audio.

2.3.8 Canadian Interconnection Liaison Committee (CILC)

As a result of the CRTC's recent decision on facilities-based long distance competition, the Canadian Interconnection Liaison Committee (CILC) has been established by DOC to address issues associated with network interconnection. The activities of CILC ultimately result in more value-added, more innovation and more technology diffusion.

Members of CILC include Bell Canada, B.C. Tel, Unitel, and BCRL/Lightel.

Exhibit 2-2
Proposed Canadian National Organization for the Radiocommunications Sector



1. Membership includes participation by representatives of the former CNO/CCIR Executive Committee and Advisory Group. Strategic Planning and Study Group restructuring functions, to be undertaken internationally in the Radiocommunication Study Group Advisory Committee (or in specific ad hoc groups) e.g. Res. 106/107 Groups, are included within the mandate of the Radiocommunication Assembly. Canadian Contributions to meetings of the International Radiocommunication Assembly, which is responsible for matters previously undertaken by the CCIR Plenary Assembly, will be approved at the CNO Radiocommunication Assembly level.

2. NSG's perform 2 distinct functions: i) preparation of contributions for Task Groups, Working Parties and Study Groups (non-WRC agenda); and ii) when necessary, preparation for WRC's, including Conference Preparatory Group (CPG) Meetings.

3. Formerly the CNO/CCIR Advisory Group. One of the main functions of the Study Group Coordination Committee will be to ensure that work in support of routine study group activity is identified from work undertaken in support of CPG meetings.

4. The convening of Sub-committee meetings is dependent on the items included on the agenda of future WRCs. In certain circumstances such meetings may not be necessary. The principal function of the Technical Sub-committee will be the coordination of work undertaken by the study groups themselves.

5. Canadian contributions in support of World Radiocommunication Conferences will be directed to 3 specific areas: Conference Preparatory Group meetings; Technical Assemblies; and WRCs themselves.

2.3.9 Canadian Interest Group on Open Systems (CIGOS)

CIGOS is not a standards development or an advisory group. Rather, it was established to promote open systems in Canada. It is one of many groups, internationally and in other countries devoted to promoting open systems, but unlike many of these, CIGOS does not develop profiles. Its activities are limited to the dissemination of information, encouragement of upstream work on the part of its members, lobbying to ensure mechanisms are in place to support OSI adoption, and OSI promotion among Canadian industries. These activities could influence the diffusion of communications and information technology.

Members of CIGOS include government or government-related bodies, consultants, and industries or their organizations (many of which are research rather than production oriented). Most of the industry membership is from individual companies. Approximately half of these companies are multi-national firms headquartered elsewhere.

CIGOS contributed to the development of a Montreal conformance test centre and has been assisting through participation in the development of harmonized standards at the international level. CIGOS eagerly anticipates the completion of national standards for OSI registration services and their implementation in a national registration authority. The Group recently produced Version 2 of the Canadian OSI product guide.

2.3.10 Industry Trade Groups

There are various industry trade groups with a significant interest in C&IT standards development and approval. Among these are:

- Association of Competitive Telecommunication Suppliers (ACTS);
- Information Technology Association of Canada (ITAC);
- Electrical and Electronic Manufacturers Association of Canada (EEMAC);
- Canadian Business Telecommunication Alliance (CBTA); and
- Radiocomm Association of Canada.

These groups, along with some of their individual members, represent segments of the industry on a variety of standards bodies. They are able to influence the development, adoption and adaption of standards, and, as a result, are able to encourage technology diffusion.

2.3.11 The Impact of Canadian C&IT Standards Organization on Technology Diffusion

All of the C&IT organizations impact on the development and/or adoption of C&IT standards which in turn impacts on the diffusion of C&IT technology. However, the relative impact of these organizations on C&IT technology diffusion differs. As shown in Exhibit 2-3, the standards organizations with upstream standards preparation mandates have a high impact on the diffusion of technology because, the standards define the specifications for the technologies that will result from the efforts of the members of these organizations. Exhibit 2-3 also illustrates that TSACC is the only organization with a strategic mandate to address such issues as accreditation, mutual recognition and the dissemination of standards information.

2.4 Findings of Recent Studies

It is useful to review selected studies that have recently been conducted under the sponsorship of the Department of Communications. Among these reports are:

2.4.1 The Olley Report

The thrust of the Olley Report[18], on the national seminar on C&IT standards conducted by the Department of Communications, is that the Department should provide the leadership (i.e. acting as the leader, the promoter, or the facilitator) necessary to develop a standards strategy in C&IT. The framework for this strategy should be the promotion of international standardization and the involvement of Canadian industry as strategic partners.

The report goes on to list nine recommendations.

1. Evaluate the differences between the converging communications and information technologies and their related standards processes.

2. Evaluate the efficiency of C&IT standards development.

3. Support the ITU and ISO/IEC as truly international organizations.

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[18] Dr. R.E. Olley, *Rapporteur's report on Canadian Seminar on Information Technology and Telecommunications Standards* (Ottawa: Department of Communications, 1991).

Exhibit 2-3
Relative Impact of Canadian C&IT Standards Organizations on C&IT Technology Diffusion

Standards Organization	Relative Impact on Technology Diffusion	
Telecommunication Standards Advisory Council of Canada	High	- develops Canadian strategies for standards development, accreditation, mutual recognition and dissemination of information directly influencing technology diffusion
Steering Committee on Information Technology, Canadian Standards Association	High	- members participate in the development of international standards for information technology which directly affect product development and diffusion
Steering Committee on Telecommunication, Canadian Standards Association	Medium	- contributes mainly in adopting international telecommunications standards
Terminal Attachment Program Advisory Committee	Medium	- primarily deals with the CS-03 standard, a prerequisite for attaching terminal equipment to the telephone network (and diffusing such products in the Canadian market)
Radio Advisory Board of Canada	Medium	- while not a certified standards organization, advises the Minister of Communications on standards-related issues
Canadian National Organization for the Telecommunication Standardization Sector	High	- prepares contributions to the Telecommunication Standardization Sector in Geneva. The resulting standards influence the diffusion of a wide range of telecommunications products
Canadian National Organization for the Radiocommunication Sector	High	- prepares contributions to the Radiocommunication Standardization Sector in Geneva. The resulting standards will influence a wide range of radiocommunications products and services
Canadian Interest Group on Open Systems	Medium	- promotes the use (and therefore the diffusion) of inter-operable systems in Canada

4. Promote the use of C&IT standards in all federal government procurement.

5. Develop a series of seminars to assist senior management in understanding the strategic importance of standards in international markets.

6. Improve and increase the dissemination of information about standards.

7. Develop a clearly understood advisory mandate for TSACC.

8. Promote the international acceptance of test results.

9. Without delay, lead the exploration of new ways to obtain financial and human resources in standards development.

2.4.2 The Ho and Kelley Report

The Ho and Kelley Report[19], on regional seminars on C&IT standards, covered a diverse number of issues. Many of these local issues will likely be addressed as the national issues are attended to.

The report lists 11 key common concerns revealed by the regional seminars. Of these, four cover issues not reported by Olley. These include:

1. In general, the bulk of C&IT standards and information on the current activity on these standards is not easily accessible to Canadian industry.

2. Canadian C&IT standardization activity appears to be centred in the Ottawa/Montreal/Toronto triangle (primarily because that is where the SCC and CSA are located).

3. Canada needs to be more involved with strategic issues of standardization bodies in the U.S.A. and Europe.

4. Certification centres should be established regionally across the country.

[19] B. Ho and J.D. Kelley, *Report of the Five Regional IT&T Seminars Organized by Communications Canada SPO and regional Offices - June 1992* (Ottawa: Department of Communications, 1992).

2.4.3 The Hall Report

The Hall Report[20] consolidates issues identified through workshops conducted by DOC. The report indicates that there are, in effect, four major issues, as follows:

1. Can Canada reduce the manpower required to manage C&IT standards? If so, how?

2. How may small companies get better access to early information on developing standards?

3. How can senior management in Canadian industry be influenced to address standards as a strategic issue?

4. What is the appropriate role for government?

The Report goes on to list the following recommendations:

- DOC should recognize that streamlining standards development will be the result of delicate and intricate negotiations.

- DOC should provide a regional focus for C&IT standards information through its regional offices. The Department should encourage regional officers to visit the smaller companies with offers of assistance on standards issues. The Department should also make standards a regular agenda item at its regional management meetings.

- DOC should initiate discussions to determine whether it might be effective to develop a tax-based incentive to company involvement in standards.

- DOC, in conjunction with TSACC and industry associations, should take the lead in developing a centrally organized three year campaign to senior marketing people throughout the C&IT industries in Canada.

[20] C.D. Hall and R.E. Olley, *A Study of the Issues in Canadian Information Technology and Telecommunications Standards* (Ottawa: Department of Communications, 1992).

- DOC should accept responsibility to be the leader in promoting efficiency in the working of the standards system for Canadian C&IT standards. The Department should co-ordinate its own standards work and in particular the work of TAPAC, the Standards Program Office (SPO), the CNO for the Telecommunication Standardization Sector (formerly CNO/CCITT) and TSACC. The Department should also propose and promote improvements to the C&IT standards management. This may require additional full time people of senior positions and strategic capabilities.

- DOC should provide all the support feasible to assist Treasury Board in setting and enforcing C&IT standards within government. The Department should also encourage provincial and municipal governments to follow the lead of the Treasury Board.

2.4.4 Evaluation of the Terminal Attachment Program

The evaluation of the Terminal Attachment Program[21] (TAP/TAPAC) received generally positive comments. However, some senior representatives of organizations expressed strong views that the carriers have had undue influence on TAPAC proceedings and standards. These individuals suggested that TAPAC is not a representative body of the industry because it allegedly allowed carriers to:

- declare essentially their own standards on the industry, for self-serving purposes;

- influence the standards process so as to keep the timing as short as possible; and

- exercise a majority vote at Committee meetings.

As such, it was suggested that the program and TAPAC be concluded and that the standard-setting responsibilities be transferred to SCOT, which is better organized to deal with them. However, the majority of respondents did not support this position.

Given the significant technical and industrial changes currently taking place, the future role of TAP and TAPAC should be carefully re-examined in the context of:

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[21] The Coopers & Lybrand Consulting Group, *Evaluation of the Terminal Attachment Program* (Ottawa: Department of Communications, 1992).

- globalization and potential reciprocal certification arrangements among countries;

- increasing competition among suppliers and carriers;

- the more extensive issues regarding interconnection rather than solely terminal attachment;

- the future needs of the regulator;

- relationships with other standards-setting organizations, particularly in Canada and North America; and

- the membership profile of TAPAC and the development of more formal administrative arrangements to reflect industrial and technological changes.

A number of suggestions were identified during the conduct of the review. These include:

- DOC should continue to strive to harmonize Canadian standards with those in North America and Europe.

- The profile of the certification program should be promoted through reminder circulars and references in Ministerial speeches.

- The mission and mandate of TAP and TAPAC should be revised to reflect the changing needs brought on by new technology and business conditions.

- The Department should develop a broad vision to help it co-ordinate its policy making role for the various types of interconnect devices in a new world of technology, globalization, de-regulation, and increased competition.

- The equipment certification process should be accelerated by immediately giving the required DOC stickers to those companies whose equipment was tested for compliance with TAP standards by DOC approved laboratories.

- DOC should develop basic formal frameworks for the key TAPAC administrative process and ensure that all interested parties are familiar with them.

- The Department should make greater use of C&IT in preparing and disseminating standards/certification related information to the industry.

- A TAPAC meeting should be arranged to develop a longer-term plan that would deal with these potential initiatives.

2.4.5 Implications of these Studies on Technology Diffusion

It is self-evident that there really is no lack of reports which address the subject of C&IT standardization. Interestingly, all these reports identify common issues and lead to a single conclusion: standards development is closely associated to trade (which is imminently linked to technology diffusion). However, none of these studies rationalize government's involvement in the standards process as it relates to technology diffusion. As such, the reports emphasize the following:

- the need to develop awareness among senior officials within government and industry of the strategic importance of C&IT standards to international trade;

- to harmonize Canadian standards with those in North America and the rest of the world, particularly Europe.

The reports imply that by addressing these needs, we will maximize our trade opportunities and therefore the diffusion of Canadian communications technology in the international marketplace.

2.5 Conclusion

The Canadian C&IT industry is a $40 billion industry consisting of 12,000 firms and employing nearly 300,000 people. Standards play such an important role in the development and diffusion of communications and information technologies, and there are several Canadian organizations that participate in the development of such. However, the Telecommunications Standards Advisory Council of Canada is the only Canadian organization with the strategic mandate to address technology diffusion issues such as accreditation, mutual recognition and the dissemination of standards information.

Several reports have been recently issues which address the subject of C&IT standardization in Canada. All of these reports discuss the importance of standards to international trade and identify such issues as the need for more efficient and effective means of disseminating standards information, particularly to the SMEs, the need to streamline the process for developing standards, the need to develop awareness among senior officials in government and industry of the strategic importance of C&IT standards to international trade, and the need to harmonize Canadian standards with those in the U.S. and other parts of the world.

3.0 GOVERNMENT POLICIES AND PROGRAMS RELATED TO C&IT STANDARDS

This chapter identifies some of the key government departments and agencies involved in the C&IT standards process. The chapter presents the rationale for government interest and how participation by the various departments and agencies supports technology diffusion.

3.1 Federal Government Involvement in the Standards Process

Although the majority of public sector standards activities are centred in DOC, Treasury Board, and Consumer and Corporate Affairs Canada (CCAC), virtually every government department and agency has some level of interest. The major players are as follows.

Standards Council of Canada (SCC)

The Standards Council of Canada is a Crown corporation created by an act of Parliament of Canada in 1970. The Council reports to Parliament through the Minister of Consumer and Corporate Affairs Canada (CCAC).

The SCC is responsible for the overall coordination of the National Standards System (NSS) of Canada, a federation of accredited standard-writing, certification and testing organizations. Through the System, the Standards Council works to ensure that Canadian needs for standards and related services are met.

Organizations accredited to the NSS include SCIT and SCOT, committees of the Canadian Standards Association.

Department of Communications (DOC)

The Department of Communications has the widest range of interest and responsibility in the areas of communications and information technologies, and thus is a significant force in the standards environment. The Ministry is imposed with protecting and promoting Canadian telecommunications interests both domestically and abroad.

DOC is accredited by External Affairs and International Trade Canada (EAITC) to act as the official contact between Canada and the ITU. Presently, the Department contributes $5 million per year to the ITU. A portion of this financial contribution is allocated to participation in the standards activities of the CCIR (now contained in the Radiocommunications Sector) and the CCITT (now included in the Telecommunication Standardization Sector).

DOC has in-house technical expertise to participate directly in the work of national and international technical committees in the areas of communication and information technology. In addition, the Department has connections to the Canadian industrial sector which puts it in an ideal position to track international developments for which there is small scope for direct participation by Canada. For example, DOC is an authorized observer at the European Telecommunication Standards Institute (ETSI).

DOC is also the home of the Government Telecommunication Agency (GTA), the agency which manages the "common" internal communications system of the Federal Government and its Architect Program, which develops network and service strategies government-wide.

Treasury Board

The Treasury Board is ultimately responsible for the procurement policies of the Canadian Government, and as such, it is inherent for the Treasury Board to assume the responsibility to develop policy for co-ordinating the government data processing system. Procurement of open systems standards is now government policy and Treasury Board Secretariat (TBS) officials have been among the prominent Canadian participants both in the development of these standards internationally and in their domestic implementation. Several technical experts from the Treasury Board hold prominent places on JTC 1 committees, both at the national and the international level, and the TBS is also a founding member and major player in CIGOS.

The Treasury Board is primarily responsible for the overall management activities within the public service and as such does not have a specific mandate to encourage industrial development directly. However, the Ministry's central position, as the representative of government as a user of information technologies, permits it to substantially influence the national data management environment.

The TBS develops Treasury Board Information Technology Standards (TBITS), which are OSI based profiles for government use. These standards are developed in accordance with the various other government departments and Common Service Organizations (e.g. Supply and Services Canada and GTA).

The Canadian General Standards Board (CGSB)

CGSB is an agency of government which works with the private sector to develop voluntary consensus standards. CGSB, which is operated out of Supply and Services Canada, has its priorities established by a "policy board" including members from all three levels of government, industry, labour and government. The actual standards are developed by consensus within a volunteer committee structure.

The objective of CGSB has been to develop voluntary standards for government procurement purposes and, to a lesser extent, general industrial and consumer interest. Currently, some 50 per cent of all voluntary standards referenced in Canadian legislation are CGSB standards. The primary concern of the CGSB, in the present context, is the development of standards for electronic data interchange. CGSB also actively participates in other standards-setting bodies such as SCIT.

Transport Canada

Transport Canada has a substantial interest in standards development by virtue of its responsibilities in aeronautical and marine communications and navigation. Transport Canada is the official point of contact for the International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO).

The Ministry also has a major interest in certification issues and has chaired a working group on core communications systems for the Advisory Committee on Information Management (ACIM). Regarding certification, Transport Canada believes that the emphasis must be taken from inter-connectivity and placed on inter-operability. The Ministry sees the concept of open distributed processing as a significant step in this direction.

Industry, Science and Technology Canada (ISTC)

ISTC also has an interest in information technology standards, however its actual level of participation has been limited. For example, Canadian participation in the ISO Technical Committee 154 on electronic data inter-change was established by ISTC but was left to industry to develop.

3.2 Rationale for Government Involvement in Standards

There are several compelling reasons for government involvement in standards.

- In the radio communications area, standards are often set by international treaty and are often implemented through national regulations. Thus, in many of the international bodies, Canada is represented by its national government.

- Participation from individual firms in standard-setting in Canada is, for the most part, quite limited to medium and larger organizations that have the resources to take part in standards activities. Government can participate in standards in order to ensure that the interests of small and medium-sized enterprises are addressed. As a major user of standards and through procurement policies, government can play a significant role in ensuring that its needs, as well as the needs of SMEs and the public at large, are met.

- The standards environment is one with many competing organizations and initiatives. Without some co-ordination at the national level, and some collective action to promote harmony among the various organizations operating regionally and internationally, new standards initiatives, like OSI, and other standardization work currently under way, are likely to be disrupted.

- National governments in the industrial countries support educational and other awareness efforts to support standards development and the dissemination of standards within their own jurisdictions. For example, in countries like Britain or France, there is an increasing amount of effort being directed at small and medium sized firms to explain to them the importance of standards development.

Today, standards work helps to create new markets and new competitive opportunities for domestic firms. The smaller firms are where the new jobs are occurring. To grow the sector and economy, these firms need to be supported in the standards-setting area, as they cannot absorb the costs necessary to fully participate in standards-setting activities. There is a great public interest in having a national strategy for standards that ensures that smaller firms participate and have the necessary intelligence to seize the opportunities that will result.

The Canadian federal government, and particularly the Department of Communications, is and will remain a significant force in the C&IT standards environment. This is true even in areas that are presently, or might at some time in the future be, directed by such not-for-profit organizations such as the Canadian Standards Association or by private industry.

In the U.S., the level of government interest in the C&IT standards process has traditionally been diminutive. Only recently, has the U.S. federal government recognized the importance of being involved. Standards help determine the competitiveness of the U.S., and if the U.S. standards process malfunctions, or fails to keep pace with standards development in the rest of the world, American industry will suffer.

As a result, on February 4, 1993, the Clinton/Gore Administration introduced a Bill in the U.S. Congress to amend the Stevenson-Wydler Technology Innovation Act of 1980. One of the highlights of the Bill is to commission the National Institute of Standards and Technology (NIST) to promote and support the dissemination of U.S. technical standards to additional foreign countries, in cooperation with governmental bodies, private organizations including standards-setting organizations and industry, and multinational institutions that promote economic development.

3.3 Conclusion

If the federal government intends to assist Canadian firms to develop, test, adopt/adapt modern and advanced technologies, it cannot ignore the importance of standards. This importance is being acknowledged as indicated by the increasing level of interest by more and more government departments and agencies.

4.0 CORPORATE INVOLVEMENT

This chapter introduces the relati nd the C&IT market. It also discusses the leve and service providers, as well as user groups of the Canadian Network for the Advancemen (CANARIE) initiative.

4.1 The Impact of C&IT Market Ec

Standards and markets are symb en greater significance given the following:

- the globalization of markets;
- the scope of new technologies
- the increasing importance of the regional and international standards environment, and of the various agreements to which Canada is a part;
- the directions set by new telecommunications policy; and
- pressures to increase competitive opportunities and open markets world-wide.

As such, current significant changes in the structure and economics of the markets for communications and information technologies are having a great impact on the standards environment, in general, and on the processes by which standards are created.

C&IT standards consolidate markets, create barriers to entry (or eliminate them), or (especially recently) provoke the creation of new markets. No single standard is likely to achieve all of these objectives, seeing how each standard initiative has a different objective. However, in general, industries participate in the development of C&IT de jure and de facto standards because these are among several possible strategies for developing, consolidating, and protecting the markets for their products.

From the point of view of industry, the choice between de facto and de jure standards is often one based on convenience. Sometimes, it is to the advantage of industry to rely on de facto standards to tie it to single source suppliers. Sometimes, industry advocates de jure standards within a national, regional and international environment. Sometimes, the two are seen as part of an evolving standards strategy. And, at other times, it is to the advantage of one or more of the individual industry participants to participate in standards work in order to prevent the development of a standard.

Nevertheless, standards development and marketing are closely associated with one another from industry's viewpoint. This also directly implies that standards development and technology diffusion are closely associated.

4.2 Participation of C&IT Manufacturers and Service Providers

As Exhibit 4-1 illustrates, vendors believe that both open standards and proprietary standards can be used to exploit competitive advantage.

Standardization, in general, involves a great number of organizations, some with overlapping memberships. The reason for their participation is simply that the interests they represent are diverse. In dealing with C&IT, the development of new technologies, and the development of standards associated with them, responds to the dictates of the market and the wide ranging interests of its participants.

Various Canadian equipment manufacturers and research firms, for example, participate nationally and internationally in standardization work. Among these organizations are:

- Northern Telecom, Canada's largest equipment manufacturer, which participates in all key standards-setting bodies at the national and international levels.

- Bell Northern Research, Canada's largest research and development organization and a world leader in the design and development of advanced telecommunications systems, represents its owners (Bell Canada - 30% and Northern Telecom - 70%) in standards-setting activities at both the national and international levels.

- Mitel Corp., which is a voting member of T1 and participates in Canadian national organizations and in SCOT. Mitel also contributes technical expertise to ETSI via the U.K. committees to that organization. Mitel is not, however, a member of ETSI.

- MPR Teletech, which engages in standards work as part of the systems engineering work which it conducts for BC Tel and Stentor. MPR Teletech has membership in selected ITU committees.

Several industry organizations also play important roles in supporting standards related work. For instance, the Information Technology Association of Canada, the Electronic Equipment Manufacturers Association of Canada, and the Canadian Manufacturers Association all maintain standards committees. In addition, the Canadian Advanced

Exhibit 4-1
Incentives and Disincentives for C&IT Standardization: Vendor Perspective

PERCEIVED INCENTIVES	PERCEIVED DISINCENTIVES
Vendors see that adherence to industry-wide standards can provide them with market advantages due to: • Increased inter-operability It is, of course, easier to sell a telecommunications product that inter-operates with other vendors' equipment, particularly for a new vendor entering the market. This follows from users' general preference for standardized systems. • Expanded markets Adherence to standards can increase the scope of a vendor's market. All users of the standard system are potential customers. In markets without standards a vendor may only be able to sell to customers who have selected their particular version of a technology. This is particularly the case in international markets, in which large vendors perceive adherence to global standards as a key to becoming viable suppliers in other countries. • Market leadership Given users' generally positive perception of standards, a vendor that is an early adherent to a standard can capture early adopters of a new technology as customers. At the same time this enhances the vendor's image as a technological leader. • Stable infrastructure Standardization can create many new market opportunities by providing a viable base for the enhancement of standard products.	Proprietary technologies, as opposed to open standards, may be used to exploit competitive advantage by providing vendors with: • Captive markets IBM established and maintained its domination of the data processing marketplace through a complex set of proprietary systems that locked in users to IBM technology. • Advanced services Standards nearly always lag behind the most advanced technologies. Non-adherence to standards frees vendors to take advantage of the latest developments in its product line, offering more advanced applications and products to users willing to purchase before the establishment of standards in new areas.

Source: M. Jussawalla and D. Lassner, "Global Telecommunication Standardization and Regionalism", p.184.

Technology Association recently decided to concentrate on general standards issues and is setting up an information function in collaboration with the CSA.

Participation by telecommunications carriers in standards work is somewhat more complicated, mainly because of the fragmented nature of the domestic telecommunications environment. There are over a hundred telephone companies in Canada, the majority serving very small geographic areas. Of the larger companies, all but three are privately owned and operated. Among the private firms, Bell Canada dominates the domestic market with a 50 per cent share, followed by BC Tel, with 11 per cent, and Alberta Government Telephones, with nine per cent.

Several Canadian telecommunications carriers have research and development detachments. Among these are Bell Northern Research and MPR Teletech. However, it is the research capability of the larger telecommunications companies which act as the determining factor in the standards process. Thus, it is important not to belittle the importance of the big carriers who, in the final analysis, decide whether the standards are a vehicle for them or not.

Participation by telecommunications carriers includes:

- Stentor, which coordinates the representation of its member telephone companies in the work of ITU. It also participates in JTC 1 and ANSI T1.

- Teleglobe Canada, which provides the interface between the Canadian telecommunications network (as represented by Telecom Canada) and countries other than the U.S.

- Bell Canada, which participates domestically in SCOT, SCIT and TAPAC, and internationally in JTC 1 and ITU.

- Unitel, which, interestingly enough, has positioned standards also at the marketing level and has linked it closely to service planning. This reflects Unitel's perceived importance of standards and their proactive position with respect to standards development that now tends to dominate among major firms.

Yet, even though standards activities require and command the extensive participation of industry, it appears that, in Canada, the level of participation of industry is rather low.

The recently conducted Hall study[22] included interviews with Canadian individuals who participate actively in Canadian C&IT standards activities. These interviews revealed the following:

- The majority of funds provided by the private sector for C&IT standards work is controlled by individuals who have responsibility to their corporations for the eventual commercial success of specific products. Due to the fact that the funding is considered an expense of supporting a specific product or product line, it is difficult to get support for generic standards work or for the administrative functions (i.e. Steering Committees or committee chairmanship).

- Albeit the annual expenditure of time varies considerably, participants from smaller companies indicate that they usually spend one third to half of their time preparing for and attending standards meetings. The remaining time is typically spent internally, with product development and marketing people on standards-related issues.

- In very large organizations, there are few people who are devoted, full time, to standards issues. In these same organizations, there are five times as many people who are involved peripherally in the formulation and analysis of standards positions (usually relative to a particular product).

- The direct participants are highly regarded as very intelligent technologists. They are entrusted to make important decisions on the spot, but, in general do not hold a strong enough position to influence the level of standards activity in their company.

The authors of the Report therefore suggested that industrial organizations attempt to play a larger role in the C&IT standards-setting in Canada. These associations have the required industrial contacts and want to be recognized for doing things in the interest of their members. In addition, the associations might be in a good position to arrange for the sharing of representational duties among members, thereby reducing the overall cost of access to current information.

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22 C.D. Hall and R.E. Olley, *A Study of the Issues in Canadian Information Technology and Telecommunications Standards: A Guide* (Ottawa: Department of Communications, 1992).

4.3 Participation of User Groups

Users of information and telecommunications systems are broadly considered to be major beneficiaries of open standards. Exhibit 4-2 lists some of the key benefits, as well as a few possible negative effects) of standardization for users.

Exhibit 4-2
Incentives and Disincentives for C&IT Standardization: User Perspective

PERCEIVED INCENTIVES	PERCEIVED DISINCENTIVES
• <u>Inter-operability</u> Connectivity with large numbers of compatibility equipped other users provides significant externalities, e.g., for users of telephones, facsimile machines, and dial-up modems. • <u>Decreased costs</u> Standardization permits economies of scale in production, for example, by making mass production of specialized chip sets economical. Furthermore, the presence of multiple vendors of standard products in the marketplace generally leads to more competitive pricing and lower costs than in single-source markets. • <u>Vendor independence</u> Users perceive value in the increased flexibility and decreased risk associated with portable applications; they need not be tied to the fortunes and practices of a single vendor. • <u>Stable infrastructure</u> Standardization creates platforms on which advanced development may take place. For example, the emergence of the IBM PC bus as a standard enabled the development of a wide range of add-in boards with advanced functions that were not available on previous systems with smaller shares of the market.	• <u>Manipulation of standardization</u> Users worry that powerful vendors may use standardization as an anti-competitive tool by legitimizing proprietary technologies, resisting improvements, and switching standards at times that benefit their own competitive position. • <u>Stifling of innovation</u> Adoption of standards may make it difficult or impossible to migrate to superior technologies as they become available. Use of the QWERTY keyboard lay out, even in the face of proven superior alternatives such as the Dvorak keyboard, is an excellent example of this inertia effect.

Source: M. Jussawalla and D. Lassner, "Global Telecommunication Standardization and Regionalism", p.183-184.

Although the users of C&IT technologies are considered to be the most important beneficiaries, it is unusually difficult to find ways for incorporating user groups into the standards process. The exceptions are the industries which are so highly dependent upon the new information technologies, and so well organized, that they are capable of representing their viewpoints in an intelligible way in the standards process. The banking and financial industries are good examples.

The banking and financial industry is, next to the government, the single largest key player in this emerging information economy. It operates a highly information-intensive business, transmitting data and funds world-wide 24 hours a day, and it heavily depends on communications, both nationally and internationally.

Through the Standards Council, the Canadian Bankers' Association (CBA) manages Canada's national organization for ISO's technical committee on banking and financial services. The Association is also a participant in JTC 1 and was one of the founding members of CIGOS.

Given the current separation of telecommunications regulatory power, representatives of the banking and financial industry strongly believe that progress in C&IT standardization will require close co-operation between federal and provincial governments. In fact, one of the more critical problems which needs to be addressed is the harmonization of telecommunications policy across Canada. The lack of clear and uniform standards, such as those regarding interconnection, create problems for business users, as well as the financial industry in its offering of the same innovative services uniformly in every province.

Aside from those "exceptional" industries, most of the other users of technologies are companies. This poses a problem because their interests are not represented to any great degree by consumer organizations. The Canadian Manufacturers Association (CMA) and the Canadian Business Telecommunication Alliance (CBTA) do make representation on standards issues that affect their members but, for the most part, the extensive and continuous participation in standards-setting is beyond their means and capability.

The CBTA represents the interests of hundreds of corporate and individual business users. Traditionally, the responsibility of this organization has been to prepare considerations to the regulators, however, it has also been actively involved in international and domestic standards activities. The Association does not have membership with SCOT but is a member of the ITU Users Group.

Another problem in representing the users of C&IT arises from considerable variations in their level of knowledge and interest. As such, the representation of users would likely have to be in a broadly-based organization and/or through an education program sponsored by government or a private standards organization. The ISDN Users Forum, for example, might turn out to be a model of a user group, organized around an emerging technology that is capable of representing the needs of users at an early enough stage in the process so that the resultant technologies are effective.

4.4 The Canadian Network for the Advancement of Research, Industry and Education (CANARIE)

In 1992, a group of leading organizations from Canada's C&IT research and business communities agreed to co-operatively establish a new initiative, the Canadian Network for the Advancement of Research, Industry and Education (CANARIE) to respond to the challenge that Canada faces.

CANARIE's mission is "to support the development of the communications infrastructure of a knowledge-based Canada and in so doing contribute to Canadian competitiveness in all sectors of the economy, to wealth and job creation and to our quality of life."[23]

The specific objectives of CANARIE are:

- to upgrade the capabilities of our existing R&D and educational national backbone network to progressively higher bandwidths, with the objective of expanding the network to gigabit capabilities;

- to promote the use of the network and CANARIE services in conjunction with the regional networks;

- to establish and operate a high-speed experimental test network;

- to stimulate the development of commercially viable, new networking technologies, products, applications, software and services; and

- to support the migration to operational networks of new networking technologies, products, applications, software and services as developed, tested and used on the high-speed experimental test network, and on the R&D and educational network.

CANARIE will play a significant role in the development of next generation networking technologies, products, applications, software and services for operational high-speed networks in Canada and for export markets. Canadian information technology firms

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[23] The Canadian Network for the Advancement of Research, Industry and Education Business Plan, CANARIE Associates, December, 1992.

require a high-speed test network to undertake a number of standards-related activities including systems integration testing, conformance testing, and network interconnectivity testing.

CANARIE has been supported thus far by the Steering Committee for the federal Prosperity Initiative, which in its report, recommended the following action:

> "link Canada by building a high-speed, broad-band electronic information highway, led by the private sector and funded jointly by the private and public sectors."[24]

CANARIE's implementation plan, proposed as a joint undertaking between the members of CANARIE and the federal government, is expected to commence in 1993.

4.5 Conclusion

Albeit standards activities require and command the extensive participation of industry, it appears that, in Canada, the level of involvement of industry is not significant. It has therefore been suggested that Canadian industrial associations attempt to play a larger role in the C&IT standards process.

Similarly, users of C&IT are not adequately represented. Selected consumer organizations do make representation on standards issues that affect their members but, for the most part, extensive and continuous involvement in standards-setting is beyond their means and capability. Furthermore, the level of knowledge and interest among the users of technologies appears to vary considerably, suggesting the representation of users through a broadly-based organization or government sponsored education program.

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[24] Inventing Our Future, An Action Plan for Canada's Prosperity, Steering Group for Prosperity, October, 1992, pg. 21.

5.0 C&IT STANDARDS IN AN INTERNATIONAL CONTEXT

The international standards environment is complex involving organizations that deal with world standards, more recently organizations that are dealing with standards on a regional basis, and a multitude of technical committees, subcommittees and work groups.

The following sections identify various C&IT world standards organizations, as well as C&IT organizations within Europe, North America and Japan. The chapter concludes with a brief discussion of the importance of international and regional standards-setting bodies and the need to adopt or adapt their standards.

5.1 C&IT World Standards Organizations

At the international level, the principal world standards organizations are the ISO (the International Organization for Standardization), the IEC (the International Electrotechnical Commission), and the ITU (the International Telecommunication Union).

5.1.1 The ISO/IEC Joint Technical Committee (JTC 1)

The ISO covers all fields of standardization with the exception of electrical and electronic engineering standards which are the responsibility of the IEC. Both of these administrations are responsible for developing voluntary standards and are thus connected to the voluntary standards community. Work in the field of information technology is carried out through a joint ISO/IEC technical committee, the ISO/IEC JTC 1 on information technology, established in 1987 by the ISO and IEC councils. JTC 1 amalgamated the work of the various ISO and IEC technical committees. The international secretariat for JTC 1 was awarded to the American National Standards Institute (ANSI) in the United States.

Unique to JTC 1, is the existence of a special group on functional profiles. This group is responsible for facilitating open systems applications by encouraging the development of functional profiles, which upon achieving official status are recognized as international standardized profiles.

JTC 1 has also, to an extent, consolidated the operating procedures of ISO and IEC. In ISO, the normal procedure for the passage of a standards project is for it to enter the system as a "new work item". If the project is accepted by a technical committee, it is then given over to a sub-committee which works it into the form of a working draft.

This draft is later voted on by the sub-committee to achieve the status of draft proposal, which is then submitted to the technical committee for its approval. If successful, the draft proposal is first registered as a Draft International Standard (DIS), and then distributed to the member bodies for consideration. At this stage, consensus has been achieved if 75 per cent of the votes received were positive. The standard is declared an international standard following a final review by the ISO Council.

The process in IEC is rather similar with the exception that the committee chairperson is given authority to make the ultimate decision as to whether consensus has been achieved. In IEC, consensus is considered to have been achieved if 80 per cent, or more, of the response is favourable.

JTC 1 has more than 60 active working groups dealing with such areas as information coding, telecommunications, software development and system documentation, interconnection of equipment, text and office systems, identification and credit cards, information retrieval and optical digital data storage. Perhaps the most notable achievement of the ISO in the communications area has been the development of the seven layer open systems interconnection reference model which was approved as an international standard in 1983.

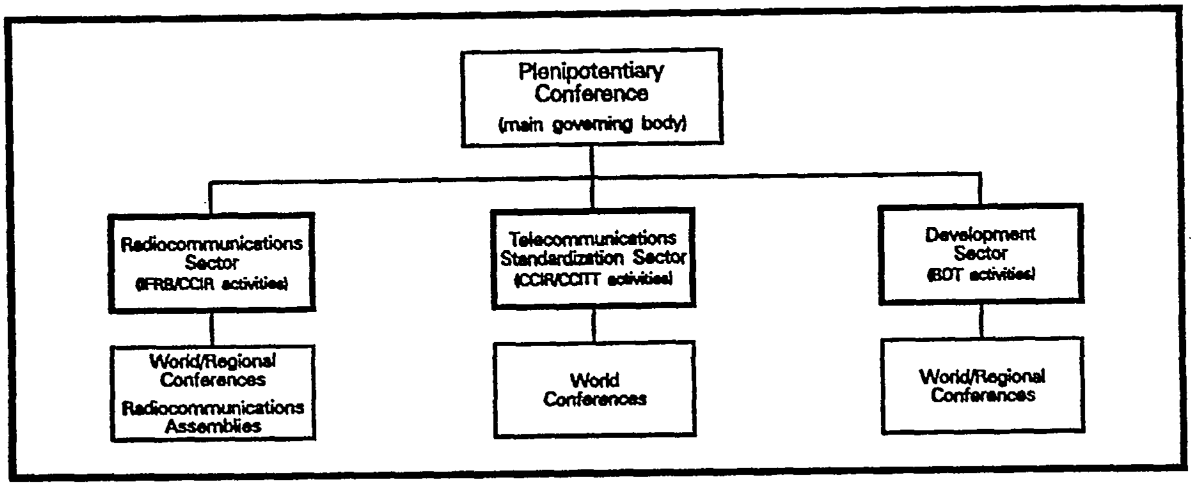
5.1.2 The International Telecommunication Union (ITU)

Responsibility for international standards in the area of communications is maintained by the ITU. Originating in 1865, the ITU has been a specialized agency of the United Nations since 1947. Membership in the ITU is basically at the level of national governments. As such, the point of contact in each member country's national organization is the foreign affairs department. In Canada, this responsibility has been delegated to DOC.

Canada has been a long-standing member of the ITU. The country recognizes that there are a limited number of council seats, and that regardless of their equitable distribution on a regional basis, it must behave in a certain manner to be assured long-term membership. As such, Canada contributes more than just the minimum.

Until recently, ITU was comprised of four main divisions: Telecommunication Development Bureau; International Frequency Registration Board; International Telegraph and Telephone Consultative Committee; and International Radio Consultative Committee. On March 1, 1993, those divisions were replaced by the Radiocommunications Sector (responsible for the allocation and use of the radio spectrum), the Telecommunication Standardization Sector (develops communications-related standards), and the Development Sector. Exhibit 5-1 illustrates the new structure of the ITU relative to its previous structure.

Exhibit 5-1
New Structure of ITU



The Radiocommunications Sector of the ITU has the mandate to ensure the compatible use of radio-frequency spectrum by all radiocommunication services including those using the geostationary-satellite orbit. It will work through world and regional radiocommunications conferences and assemblies (now every two years), its Radio Regulations Board, and the radiocommunication study groups. In short, the Radiocommunication Sector now has full responsibility for conference preparation and the study groups can now deal with regulations in addition to technical and operational matters.

Exhibit 5-2 illustrates the increasing number of ITU telecommunications recommendations and pages produced over four year intervals since the late 1960s. A similar curve exists for the Radiocommunications Sector workload, and in general with telecommunications standards at the international, regional, and national levels. The increase in standards recommendations demonstrates the increasing importance of standards in the development and diffusion of telecommunications and radiocommunications services and technologies.

Conferences for the Standardization Sector will now be scheduled every four years, but they can be held at two-year intervals if necessary. There will also be a new accelerated approval process for dealing with more critical issues. In addition, the Development Sector will hold annual regional conferences and a world conference every four years.

Recommendations include vocabulary, quality of service, tariffs, analogue and digital switching, signalling and transmission, terminal equipment, construction and installation of cable systems and so on.

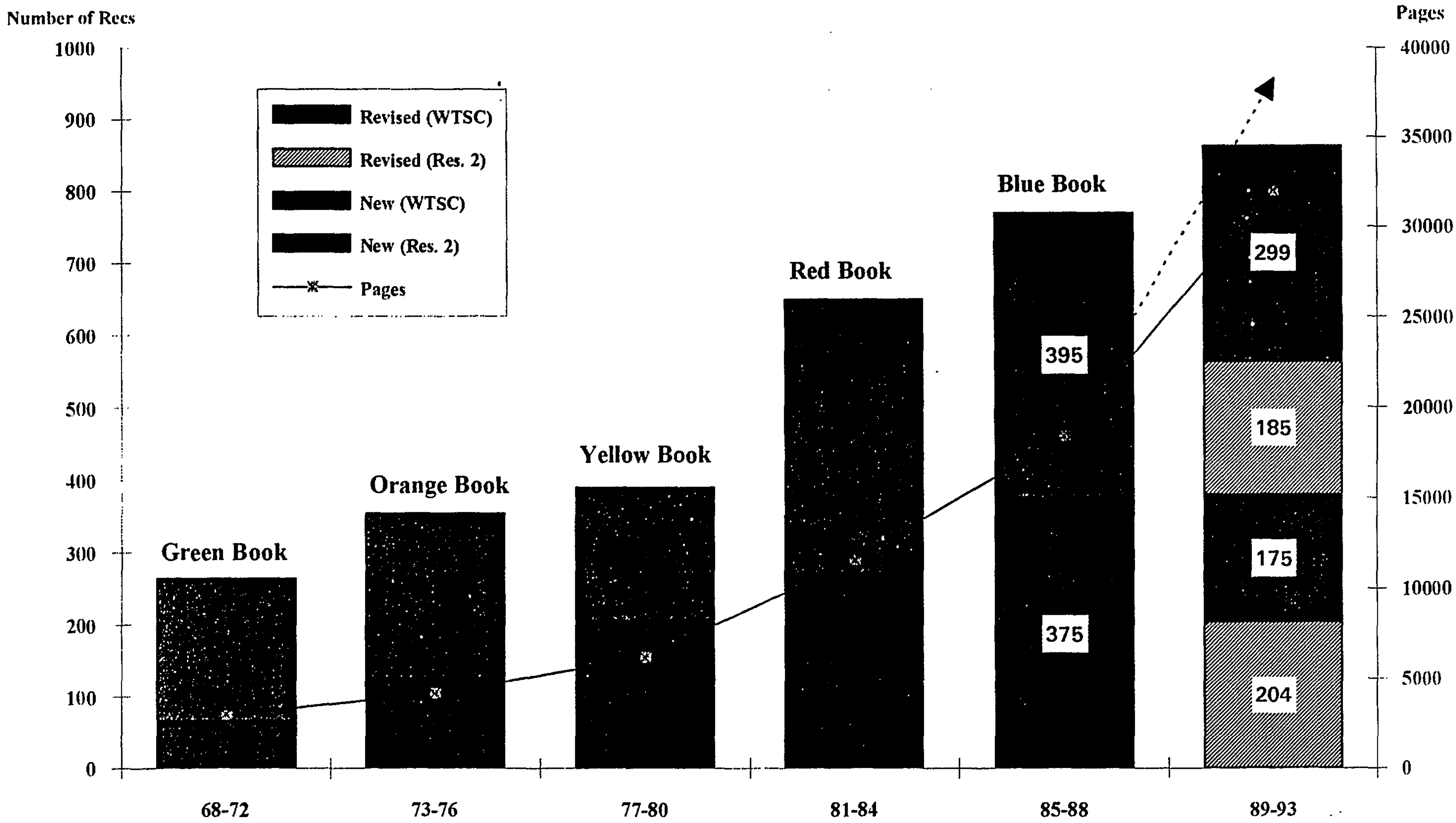
5.2 The European Region and Telecommunication Standards Organizations

5.2.1 Conference of European Post and Telecommunication (CEPT) and European Telecommunication Standards Institute (ETSI)

The potential strength of the European Community in international telecommunications has traditionally been weakened by strong national PTTs organized collectively in the inter-governmental Conference of European Post and Telecommunication (CEPT).

CEPT is an association of 26 member PTTs, formed to rationalize and harmonize the administrative structure of European postal and telecommunications services. The standards program established by the CEPT members was very ambitious. Although numerous recommendations were produced, it took nearly three years for the first NET (Norme Européenne de Télécommunications) compliance certificate to be issued.

Exhibit 5-2
Evolution of ITU-T Recommendations



Source: Radio Standardization Sector, International Telecommunication Union

The CEPT standards process was soon viewed, by many Member States, as being too loose and not relevant to the needs of the European Free Trade Alliance (EFTA). In addition, it was noted that even if the working structure of CEPT enabled it to co-operate with industry and users, the responsibility for the program rested entirely on public administrators and operators. Therefore, in 1988, at the insistence of the Commission of European Communities (CEC), CEPT formed a new standards organization, the European Telecommunication Standard Institute (ETSI). ETSI, which now undertakes the standards-writing activities of CEPT, has three primary fields of interest:

- telecommunications;
- the overlap between information technologies and telecommunications, and thus in the standards relevant to these technologies; and
- the overlap between broadcasting/radio technologies and telecommunications technologies.

Membership in ETSI is open to any European organization concerned with telecommunications, including national administrators, public network operators, manufacturers, users, and research bodies. As of 1990, the Institute had 137 members, from 20 countries, representing the leading European telecommunications interests. Some countries which were represented in CEPT have not yet joined ETSI.

The working structure of ETSI consists of technical committees and project teams. The technical committees, which are composed of experts, and involve non-members of ETSI, provide a forum for consensus building on draft standards to be submitted to the technical assembly. The project teams are groups of specialists who carry out studies and prepare draft standards to be examined by the technical committees.

CEPT and ETSI have been responsible for the development of standards such as the Group Standards Mobile (GSM) standards for digital mobile communications.

5.2.2 Terminal Equipment Type Approval Procedures

Approximately 15 years ago, the Canadian Terminal Attachment Program was initiated in a co-operative manner by DOC and a number of telecommunications carriers, manufacturers, provincial authorities, and other interested parties. The specific objectives of the Program included protecting the communications network from harm, promoting competition within the terminal manufacturing and distribution industry, and providing technical support to the regulator.

The terminal attachment program within the European Community, however, is somewhat different. This is primarily due to the fact that EC telecommunications policy is based on significant government intervention in commissioning technical standards in order to ensure a single market for terminals and services across the Community. This is quite evident from EC legislation, which establishes:

- open competitive supply markets for terminals and most services;
- a common administration and harmonized standards for terminal attachment approvals; and
- harmonized specifications, availability, and access terms for public networks (referred to as the Open Network Provision, or ONP).

This legislation is essentially in the form of directives, which have legal status within the Member States. However, it is the responsibility of the telecommunications authority within each Member State to command the extent to which each standard must be met within that state.

By 1986, both EC vendors and users of telecommunications products and services had become completely intolerant of the delays, costs and irritation of submitting the same product for approval for attachment to the public telephone network in each EC Member State. As a result, the CEC issued Directive 86/361/EEC, in July of the same year. The Directive recognized the initial stage of the mutual recognition of equipment type approval within the EC for telecommunications equipment.

This Directive required the Commission to initiate relevant common conformance specifications, mainly in the form of harmonized European standards for terminal attachment, or NETs. The NETs were to be defined by the European standards body for telecommunications, which initially was CEPT.

Subsequently, on June 28, 1990, Council Directive 90/387/EEC was adopted to establish an internal market for telecommunications services through the implementation of ONP. The objective of the ONP approach is to encourage the development of value-added and other telecommunications services within the EC through:

- ensuring that telecommunications organizations make available appropriate leased lines and basic public services in a timely and consistent fashion on a Community-wide basis;
- requiring that technical interfaces and service features for attached terminals are subject to European standards; and

- proscribing anti-competitive conditions which might restrict, in particular, the use of these services in the private provision of enhanced services to third parties.

Definition of ONP conditions for specific public networks and services is expected to occur through a planned series of subsequent directives and recommendations. These will include leased lines and voice telephony service (via directives), plus packet-switched data services and ISDN conditions (initially via recommendations).

This framework directive also establishes the characteristics of the ONP Consultation and Co-ordination Platform. Membership is completely open, but represents designated interest groups such as public operators, other service providers, equipment manufacturers, business users, and residential users. The Platform's goals include providing a medium for discussion of views and issues, identifying common positions, and presenting views and positions to the Commission and its ONP Committee. Working groups may be established to cover particular technical or other topics.

In April 1991, Council Directive 91/263/EEC initiated Community-wide procedures for conformance testing of telecommunications terminals to harmonized specifications. The Directive would require Member States to ensure that terminals for use with public networks could be marketed or put into service only if compliant with such requirements. Appropriate national authorities for type approval would be required to acknowledge a certificate of conformity to relevant specifications issued by a notarized testing body of another Member State. The implementation of this Directive was required by the end of 1992, and would effectively replace the provisions of the first-stage Directive on type approval.

Essential requirements to be satisfied by terminals include:

- safety and radio interference aspects;
- protection of the public network;
- interworking of the terminal with the network for connection control; and
- interworking between terminals, in certain cases.

The Directive sets a procedure and consultation process to be followed in designating and publishing relevant harmonized standards and technical regulations for compliance (Common Technical Regulations, or CTRs, which would replace the NETs of the first phase scheme). The Approval Committee for Telecommunication Equipment (ACTE) would assist in this process.

ACTE advises the EC Commission on standards required in the Euro terminal attachment approvals process. Members of ACTE include representatives from Member States, particularly of national approvals bodies. The Committee is chaired by the Commission. By May 1992, ACTE had called for 18 required CTRs to cover interfaces for various leased line types, including: network access for public data networks; ISDN; digital mobile networks; and digital telephony over ISDN. The schedule for development of relevant technical specifications by ETSI Technical Committees runs to mid-1994.

5.3 The United States and North American Telecommunications Standards Organizations

In the U.S., the American National Standards Institute (ANSI), acts as a powerful industry grouping, as do other U.S. organizations such as the Institute of Electrical and Electronic Engineers (IEEE).

5.3.1 American National Standards Institute

ANSI has several committees and subcommittees assigned to the C&IT area including subcommittees dealing with data communications planning, transmission formats, signalling speeds, public data networks and so on.

ANSI coordinates the U.S. voluntary consensus standards system by accrediting and monitoring independent standards development bodies, certification organizations and testing organizations. In addition, it establishes procedural rules based on the concepts of due process and consensus agreement. The main U.S. forum for telecommunications standards development is ANSI Accredited Standards Committee on Telecommunication or T1. The T1 Committee is open to a variety of interests including manufacturers, vendors, exchange and inter-exchange carriers, users and general interest. The mandate of T1 is to develop and maintain technical standards relating to the interconnection and inter-operability of telecommunications networks. T1 is considered to be North American in scope and includes participation from all of the principal Canadian telecommunications carriers.

5.3.2 The National Institute for Standards and Technology (NIST)

NIST is an agency of the U.S. Department of Commerce which maintains all U.S. standards in matters relating to basic metrology - weights and measures.[25]

NIST supplies information both to government for procurement purposes, and generally to industry and the voluntary consensus standards organizations. A prime concern of NIST has been testing and the development of certification programs linked to government procurement needs.

NIST has obtained a potentially expanded role in U.S. standards development following from the 1988 Omnibus Trade and Competitiveness Act. Under this Act, NIST has been given a role in assisting research consortia, along with small and medium sized companies in technology transfer programs.

NIST has particular significance in the communications and information technologies, through the National Computer and Telecommunication Laboratory.

5.3.3 Other U.S. Organizations

The IEEE, established in 1884, also establishes standards for the data communications industry. Its most well-known activity resulted in the IEEE 802 recommendations which defined a set of standards for local and metropolitan area networking that deal with the physical and link layers of the ISO Reference Model for Open Systems Interconnection (OSI). Other organizations in the U.S. involved in standards-writing include the Electronic Industries Association (EIA) which works in liaison with the ITU Telecommunication Standardization Sector and with ANSI. The EIA was responsible for the development of the RS-232 interface standard. In addition, the Federal Telecommunication Standards Committee (FTSC), a federal government advisory body adapts standards developed by the CCITT, ANSI, ISO, and EIA for purposes of achieving inter-operability among federal telecommunications networks.

The weight of the U.S. industry and technology at the global level has established that country as a regional force for standards definition in the international arena.

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[25] **In Canada, the Institute for National Measurement Standards, National Research Council, maintains Canadian standards relating to basic metrology.**

5.4 Standards Organizations in Japan

Japan, with its rapidly increasing global technological reach, is also considered as a regional force in the international standards arena.

Under Japan's Ministry of Posts and Telecommunication, the Telegraph and Telephone Technology Commission has created a C&IT-related standards group, the Telecommunication Technology Council (TTC), that includes Nippon Telegraph and Telephone (NTT), value-added network vendors, manufacturers, and key users of large-scale networks. Key activities include interconnecting dissimilar computer systems and networks as well as establishing connectivity standards for ISDN terminals. TTC is the rough equivalent of T1 and it was set up to an extent in deference to the expanded range of interests to emerge in Japan following privatization.

The Japan Industrial Standards Committee (JISC) is the official Japanese member of ISO and IEC and, hence, it forms the link with JTC 1. Important Japanese initiatives in the information technology standards area have included setting up the Asian Forum for Standardization of Information Technology in 1987. Of great significance to the international OSI environment is the Japanese-based Promoting Conference for OSI (POSI) which performs conformance testing and has mutual agreements with other regions for recognition of certification marks.

5.5 Conclusion

As noted in the report entitled Technology Diffusion and the International Standards Setting Environment: Implications for Canada,[26] North America, Europe and Japan/Pacific Rim have emerged as regional forces on the standards front. Regional organizations, and new potential alliances between the regions, are becoming more important along with international standards-setting in general.

In Europe, many of the national organizations have lost most of their reasons for existence. National standards have simply become adoptions of regional or international ones. However, regional standards will not necessarily be adopted in every case by the European Community.

The basis for European regional presence has been to ensure a European industrial participation in the information technology sector, which has been threatened and

[26] Technology Diffusion and the International Standards Setting Environment: Implications for Canada, NGL Nordicity Group Ltd., April 16, 1993.

dominated by large American firms. In the communications sector, the rationale for regional participation has been to somewhat protect the public telephone and telecommunications structures from the forces of liberalization and competition with respect to some of their services.[27]

Like the work of the regional standards bodies, the activities of international standards organizations are also becoming increasingly relevant. Where standards were once used to protect national markets from foreign competitors, they are now being used by the major competitors as tools to gain competitive advantage over each other in major regional or world markets. National standards now need to be consistent with international standards in order for users to obtain the full benefits of current technology.[28]

Thus, if Canada expects to be successful and competitive in international trade, particularly with new technologies now on the drawing board, the nation must have input into and knowledge of, international and regional standardization activities. Furthermore, Canada must be willing to readily accept these standards, in particular international standards, for certain products and services. For example, of the 192 National Standards of Canada, approved during the 1991-92 year, 65 were adoptions of international standards, which included several joint ISO/IEC standards on OSI.[29]

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[27] L. Salter and R. Hawkins, *The Standards Environment for Communications and Information Technologies*, Simon Fraser University, March 1990.

[28] Industry, Science and Technology Canada, *Telecommunications Equipment Industry Profile*, Ottawa, 1991.

[29] Standards Council of Canada, *Annual Report*, Ottawa, 1992, p.9.

6.0 DISCUSSION OF ISSUES

Standards and regulations significantly influence the diffusion of C&IT technologies. Their importance to this sector, as well as all sectors that use C&IT products and services, is increasing. Even though products will still continue to be developed and diffused where standards have not been formalized, it is becoming more and more necessary for manufacturers, service providers and users to be familiar with standards, both existing and under development, in order to optimize their strategies and business decisions pertaining to the development, introduction and use of C&IT.

From our research and interviews, we have identified several issues associated with standards and regulations as they pertain to technology diffusion.

6.1 Dissemination of Standards Information

Issue: Are the current means of disseminating standards and standards-related information efficient and cost-effective? Would enhancements improve the ability of non-participants to make the decisions regarding the development and diffusion of communications and information technologies and services? Would such information also assist users in planning for C&IT deployment in their organizations?

Various types of standards information are available to Canadian C&IT organizations. These types of information, their sources, means of access and cost are illustrated in Exhibit 6-1.

The exhibit indicates that standards material appears to be readily accessible. The information is available in both electronic and hard copy forms, and can range in cost from almost nothing to hundreds or thousands of dollars.

Nonetheless, Canadian C&IT organizations still face difficulties when it comes to gathering standards intelligence. In most cases, the information collected is either very general or much too technical. When the information is generalized, the ability of the user or organization to realize benefits from standardization may be undermined. Yet, when the intelligence is highly technical, it is often not understood by senior management. Today, the vast majority of standards material is structured for the technical standards community. Senior management has neither the time nor the interest to deal with such a level of technical interest.

Exhibit 6-1
Sources and Types of Standards Information

SOURCE	TYPE OF INFORMATION AVAILABLE	MEANS OF ACCESS	COST
Canadian Standards Association (CSA)	Standards of the Steering Committee on Telecommunication (SCOT) and Steering Committee on Information Technology (SCIT)	Hard copy	A standards document may range in price from $10 to $120.
Standards Council of Canada (SCC)	Offers 4 bilingual databases, available 24 hours a day (information is not full text). • Canadian Standards Database • Reference Standards (Federal) Database • GATT TBT Notifications/Draft European Standards Database • International Standards Database	Electronic	$60 per hour (strictly for connect time)
Department of Communications (DOC)	Standards of the Terminal Attachment Program	Regional Offices	Included in DOC's certification charges
International Telecommunication Union (ITU)	Telecom Information Exchange Services (TIES), which provides a set of computer based services (information is not full text). • ITU databases (videotex-like access or customized user interface access) • External Information Services • Internet Services • Document Exchange • Electronic Mail	Electronic	There is no cost for the use of most TIES services. Normal E-mail or Internet costs for access to TIES are applicable.
International Organization for Standardization (ISO)	ISO Information Network (ISONET) ISO Catalogue ISO Memento Activities Report ISO Bulletin ISO Kwik Index	Electronic Hard copy Hard copy Hard copy Hard copy Hard copy	ISONET can be accessed through Internet. ISO publications are available for a fee.

There is also a requirement to improve the efficiency and timeliness of distributing standards information. Often, when hard copy information is obtained, it is already out-of-date and new development may have already occurred. The electronic distribution and dissemination of standards information could improve the current situation faced by many C&IT organizations seeking to gather standards material. Electronic information would certainly be more timely than hard copy material. For example, the ITU offers its TIES service which supports remote electronic retrieval of ITU documents, as well as remote electronic submission of documents to the ITU. As a result, telecommunications standards-making and dissemination is improved by facilitating the exchange of information and reprocessable working documents between internationally dispersed bodies.

Standards intelligence distributed through electronic means could also be reworked and presented in a more understandable or plain language. The information would be neither too general (as to lose any of its content), nor too technical (such that it is incomprehensible). However, there is a cost issue involved in making full-text available.

The need for such an electronic information system is apparent in Canada. Presently, TSACC, in collaboration with the Standards Council of Canada, have initiated the development of a TSACC C&IT standards database. The database is being designed from a market-based perspective to provide vital C&IT standards information to Canadian industry, governments and users. It will contain tombstone data on standards, summaries of committee meetings, contact information on members of the committees, and a gateway to other databases.

It is also recognized that the Internet is a valuable means of accessing numerous databases pertaining to the standards area. As part of the TSACC process, it has been suggested that the information available on the Internet be fully evaluated to determine how it can be made most effective in meeting industry needs.

Canadian C&IT organizations could also attempt to overcome the problems mentioned by becoming directly involved in or increasing their level of participation in standards-related activities. This would permit Canadian C&IT organizations to gather the standards material firsthand. They do not have to be key participants but active enough to be aware of developments.

Unfortunately, the level of manpower required, as well as the costs associated with continuous and direct participation in standards-related activities are frequently too high for many organizations to bear. As a result, most small and medium-sized manufacturing companies or user groups are not capable of such participation, and therefore miss out on discussions and developments that may directly influence their business.

In conclusion, it is self-evident that intelligence on standards related issues is required if Canada intends to promote an orderly deployment of standards, and hence, further technology diffusion. However, whether this information should be available at some cost remains unclear. On one hand, the information should be available at virtually no cost; if the cost is too high, those who need the intelligence the most will not be able to afford it. Yet, there should be an adequate cost attached to such information given that the actual participatory process required to compile it is time consuming and costly.

6.2 Performance Testing and Certification

Issue: How can Canada improve the efficiency and effectiveness of performance testing and certification?

Presently, in Canada, there are two areas where testing and certification processes have been established.

1. the DOC certifies terminal equipment, on a mandatory basis to prevent network and third party harm, under the Terminal Attachment Program for attachment to telephone networks. In addition, about a dozen centres in Canada have been approved by DOC to test equipment; and

2. a performance test centre, operated by HP/IDACOM, has been established to test and certify open systems products.

The HP/IDACOM initiative, although a welcome private sector move, has been operating with a rigorous "for profit" motive. This has raised various concerns related to, for example, the timing of the introduction of the testing service, the establishment of publicly accessible registers of conformance tested products, inter-operable products, etc., and the development of criteria (accreditation and testing).

Clearly, Canada does not have satisfactory testing and certification processes. In fact, industry has many concerns about Canadian performance testing and certification. Industry is of the opinion that the time required to certify a product - which is between four to six weeks - is too lengthy, both in absolute terms as it hinders getting the product to the market, and in relative terms when compared to the FCC whom many see as processing applications in one week, on average. While the perception of FCC procedural time is correct, it should be recognized the FCC excludes from its calculation the two to seven days required to process the funds which accompany the application. It should also be noted that the FCC, unlike Canada, does not conduct in-depth verifications of supporting attestations.

Given the North American free trade agreement, industry requests that Canada move towards harmonized standards and mutual recognition of certification procedures with the United States, and eventually Mexico. These efforts have already been initiated through the FTA and the NAFTA, respectively.

In the latter portion of 1992, the Canadian and United States governments signed a Memorandum of Understanding (MOU) to promote co-operation in developing common information technology standards for government use. According to the MOU, the Canadian Treasury Board Secretariat and the United States National Institute of Standards and Technology (NIST) will work together. Both organizations intend to promote standardization and share expertise that will: support competition in procurement; increase compatibility in computer and telecommunications networks; improve transportability of software and protect government software investments; and foster the development of computer systems using components from different suppliers.

At about the same time, the Canadian Standards Association and the Underwriters Laboratories Inc. (UL) agreed to accept each other's test data. The process for the reciprocal acceptance of each other's test results is based on a jointly developed test report, for a wide variety of product categories. This process falls within the framework of the MOU signed by CSA/UL in 1989.

As a result of these initiatives towards harmonized standards and mutually accepted conformance tests, the question has been raised as to whether Canada should establish the procedures and facilities to test C&IT products for inter-operability in Canada so that testing does not have to be done elsewhere. Currently, the larger manufacturers have established facilities for testing, and several other firms test products in other countries, particularly the U.S.

A Canadian process and facility for certifying inter-operability could increase the timeliness of the certification process for Canadian companies and facilitate the diffusion of technologies and products on a worldwide basis by testing and registering products that meet inter-operability standards. Furthermore, such an initiative could be used to lure those countries/regions with significantly higher certification costs to conduct their testing in Canada.

6.3 Involvement of Smaller Companies

Issue: How can smaller companies, where the majority of new jobs are created, be involved in the standards-setting process in order to maximize the potential for diffusion of Canadian C&IT technologies?

It has already been recognized that smaller Canadian companies find it difficult to become involved in the standards-setting process on an on-going basis. Two key points raised in the Hall Report are:

1) Smaller companies cannot afford the financial disbursements involved, or to have qualified personnel away from their operational activities for the time required to make important contributions and thus to effectively gather the intelligence available.

2) Smaller companies have a wide range of standards-related requirements, much greater than the degree of involvement which they would find to be cost effective. For example, some smaller companies want only to receive advance warnings about changes to relevant standards while others want to influence the standards so that their particular products will qualify as compliant. Today, there is little room or tolerance for smaller companies with "partial" involvement in the standards process.

Most smaller Canadian companies accept standards as positive factors in their evolution and growth. While these companies may have developed products and technologies that fill specific niches, they are often missing relevant standards information necessary to make the modifications or enhancements necessary to diffuse their products on a much wider scale internationally. However, their larger and more developed competitors can afford the time and money to comply with, and sometimes establish, standards.

While time is money for any organization, it usually means more money for a smaller company, in relative terms. For example, a large multinational firm will usually obtain blanket approval for all of its manufacturing plants around the world, costing several of hundreds of thousands of dollars. A small firm, however, usually starts out by getting approval from the various electrical utilities (e.g. Ontario Hydro) in Canada, but as soon as it begins to export the product, it must get both CSA and the Canadian UL approval. This process, which must be repeated for each new product, is time consuming, costly, and never routine.

There is a recognized need for more Canadian small and medium-sized enterprises, where the majority of new jobs are being created, to become more involved in the C&IT standards process. This will result in increased development, adoption, or adaption of standards, leading to increased technology diffusion and greater overall competitiveness on the part of the Canadian C&IT industry.

6.4 The Role of Government and DOC

Issue: How can the Department of Communications expand on its leadership role in C&IT standards-setting? How can DOC play a more strategic role in the standards-setting process? How should other government departments become involved in C&IT standards-setting in order to maximize the potential of the C&IT sector?

The role of government is a potentially very broad question, because there are several federal departments beyond the Department of Communications, as well as several provincial governments, which currently have (or should have) interests in C&IT standards. Yet, DOC remains to be the main government department involved.

It is identified, in both the Hall and Salter reports, that there is a need for DOC to further expand on its leadership role in the area of C&IT standards. Specifically, the reports recommend that the Department undertake the following actions:

- Assume within the bounds of its mandate, a proactive and leadership role in promoting the resolution of C&IT issues in Canada. This does not imply that the Department should take over tasks already performed in other governments or the private sector, but rather that DOC co-ordinate the role of the SCC, the responsibilities of other federal government departments, and the interests of the provincial governments.

- Coordinate its own standards work, and in particular the work of TAPAC, TSACC, SPO, as well as that of its Canadian National Organizations to the ITU. It is crucial that the department's efforts and strategies on C&IT standardization be perceived as strong and coordinated.

- Become visible and clearly active in proposing and promoting improvements to C&IT standards management processes. DOC would both originate proposals and promote those proposals originating with other groups which it considers to be worthwhile. The Department would also meet with interested and affected stakeholders on a continuous basis.

- Add two or three individuals of senior positions and strategic capabilities. These individuals would consult with groups in the area of C&IT standards in order to determine ways to improve the C&IT standards process.

- Promote improvements to C&IT standards management procedures. For instance, DOC should promote the greater use of electronic media and telecommunications facilities to speed up the dissemination process and perhaps even reduce the paper burden costs.

Our research indicates that the Department of Communications is, through TSACC, exercising more of a leadership role in C&IT standards. To start, TSACC has assumed responsibility for the following:

- designing and developing a database of C&IT standards; and

- establishing a working group to take action on the recommendations in the Hall and Salter Reports.

The need has been identified to have strategic experts in the Department of Communications who can interpret which aspects of standards-settings are important (and which are not). These experts can act as a source of intelligence and advice for industry, particularly the small and medium-sized enterprises. In addition, these experts would be given a functional role to train and orient regional office staff so that they, in turn, can more effectively address C&IT standards issues.

It is also recognized that DOC's main role in standards lies in the areas of radio and telecommunications. Although it has some role in the standards-setting process associated with other information technologies, there appears to be a need for further strengthening of standards activities associated with these other information technologies.

For example, SCIT may cease to exist because the committee is lacking the resources necessary to its operations. Some of the larger contributors to SCIT are reducing their level of funds and resources because they have representation in other countries' committees, such as the U.S. T1.

In this regard, it has been suggested that SCIT's operations could be streamlined into other secretariats where its costs and resources are covered, or it could seek funding assistance and participation from other government sources. It has been suggested that this involvement could perhaps come from ISTC, which promotes Canadian industrial development in advanced technologies including the information technology sector.

In conclusion, the federal and provincial government departments and agencies cannot ignore the importance of standards if they intend to assist Canadian firms in developing, testing, and adopting advanced communications and information technologies. This importance is being acknowledged as indicated by the increasing level of interest by more and more government departments and agencies.

6.5 The Need to Rationalize and Streamline the Canadian Standards Process and Harmonize the Regulatory Process

Issue: How should Canada's standards-setting bodies be organized in order to continue to participate effectively in an environment of financial constraint? How can the telecommunications policy and regulatory process in Canada be further harmonized amongst the Provinces?

In Canada, financial resources for standards development are critically scarce. Successive cutbacks at the Standards Council has brought Canada to a point where document distribution has been dramatically curtailed by the Council and delegate travel support has been cut back. In addition, internal cut backs by participating members on standards committees are having a significant impact on the level of participation in standards activities. In addition to reducing the participation on standards working groups, some of the larger firms are reducing their funding levels for secretariat activities. This reduces the ability of secretariats to provide the core services on behalf of members; let alone provide information dissemination services on behalf of non-members such as smaller businesses.

It has been suggested that Canada should look at other countries as models for streamlining the standards-setting process. Sweden, for example, has consolidated all of its ISO and ITU standards-setting activities for C&IT under the Information Technology Sector of its national standards institute. In addition, Sweden has a "one ballot" process where it can adopt a standard as an ISO or ITU standard, an ETSI standard and a national standard. It was also noted that once Sweden adopts an ISO standard as a national standard, it can in effect "rubber stamp" the ISO standard and sell it as a Swedish standard. In addition, by consolidating the standards-setting secretariats and activities, the Swedes have established a central source for the dissemination of standards-related information (and run it on a semi-privatized basis), thereby optimizing the information available to government, manufacturers, service providers and users for strategically planning the development, deployment, and diffusion of communications and information technologies. This and additional models could be further studied.

There is also the requirement to harmonize telecommunications policy across Canada. The differing policies and regulations between some provinces, such as those regarding interconnection, limit the ability of all sectors to use C&IT technologies in a consistent manner across the country, thereby limiting the introduction and diffusion of new and innovative services.

6.6 User Representation in the Standards-setting Processes

Issue: How can we ensure that all types of users are adequately represented in the standards-setting process?

At the present time, only the large users are adequately represented in the standards-setting process. The federal government, through policies and participation of the Treasury Board Secretariat and Supply and Services Canada, is the most active proponent of open system standards in Canada. In addition, some provincial governments and industry sectors (e.g. banking, steel and utilities industries) actively participate in committees such as SCIT and SCOT. Larger business users are also represented by the Canadian Business Telecommunication Alliance (CBTA). However, smaller business users and consumers are not adequately represented in the standards-setting process.

In light of the importance of standards to users, it was recommended in the Hall Report that the Department of Communications provide all the support feasible to assist Treasury Board in setting and enforcing C&IT standards within government. In addition, it was suggested that the Department should see what it can do to encourage provincial and municipal levels of government to follow the lead of the Treasury Board.

In our research, it was also suggested that representative groups (ad hoc groups, forums and associations) of the smaller users such as the Consumers Association of Canada (CAC) be encouraged to more actively participate in the standards arena. While the CAC participates on SCOT, it does not participate on SCIT. The CAC could play a greater role in ensuring that equipment and software diffused to the consumer market is developed in accordance with appropriate standards for connectivity, inter-operability, and user friendliness. This issue can also be addressed through dissemination of standards information in plain language as well as appropriate campaigns to emphasize the importance of standards to all types of users.

6.7 Development of C&IT Standards Awareness and Human Resources

Issue: How should awareness of the importance of C&IT in the development, diffusion and adoption of technology be promoted? Should Canada take the lead in developing post-secondary education programs to train human resources in the standards area?

The correct decision to develop and establish a de facto standard can result in significant business opportunities at the national and international level. Consider Newbridge

Networks and MPR Teletech's decision to take a lead position in the development and commercialization of ATM technology.

There is clearly a lack of awareness of the importance standards play in developing and diffusing technology. This was recognized in the Hall Report which recommended that "DOC, working with bodies such as TSACC and industry associations, should take the lead in developing a centrally organized three year campaign to senior marketing people throughout the (C&IT) industries in Canada to sensitize senior management to the importance of standards management and to portray the standards infrastructure as a key long term need for the successful national and worldwide marketing of their products."

There is also a lack of awareness of the significant opportunities to utilize Canada's highly regarded standards expertise to assist other parts of this world such as South America in developing their own standards practices. By assisting and influencing other countries in the standards area, Canadians will increase the likelihood that our technology can be exported or diffused to those parts of the world.

This general lack of awareness also exists in post-secondary institutions in Canada and abroad where there are currently only a limited number of courses offered to educate students about the importance of standards, their relative importance in the C&IT research and development cycle, as well as their importance in the commercialization and diffusion of C&IT products and services. By increasing the level of awareness and developing an appropriate education program, Canada is in a position to take the lead in the development of human resources with the necessary skills to address C&IT standards in all facets of business and government.

It has also been suggested that as part of an overall awareness campaign, government and industry should recognize and reward excellence in the contribution to the standards-setting process.

6.8 The Rapid Development of C&IT and its Impact on Standards Development Processes

Issue: How should the activities and results of ad hoc groups and forums be integrated into the formal standards-setting processes?

An increasing number of ad hoc groups and forums (such as the ATM Forum and the Frame Relay Forum) are becoming involved in the C&IT standards arena. Their involvement stems basically from the fact that standards have become increasingly important given the integrated and inter-related nature of new and emerging technologies within the international environment. These groups and forums are means for achieving industry agreement on the standards associated with these new technologies. Agreements are reached quickly and by simple majority vote, as opposed to the vigorous processes used by regular standards bodies. Although these bodies have no official standards status, they are gaining popularity simply because regular standards bodies are not moving quickly enough.

The question arises as to how the progress of these groups should be monitored and whether or not these groups should relate to the formal standards development processes.

6.9 Conclusion

The issues identified in this report are mostly of a process nature. These issues relate principally to increasing the role of the federal government as a strategic partner in the standards-setting process; rationalizing and streamlining the Canadian standards process; harmonizing the policy and regulatory environment in Canada; improving the efficiency and effectiveness of performance testing and certification; and addressing the requirements for improved communications and information disseminated on C&IT standards, particularly to the small and medium-sized enterprises across Canada.

7.0 RECOMMENDATIONS

Based on the analysis and synthesis of issues identified in the course of this study, it is recommended that:

- A comprehensive awareness/education program be developed and implemented to enhance awareness within government, industry and the educational community, of the importance of C&IT standards and their relationship to technology development and diffusion.

- The federal government place a high priority on supporting the development of international C&IT standards that will enable a higher degree of inter-operability between networks, terminal equipment and systems.

- Federal and provincial governments promote a greater role for sector campaigns and peer groups in the development of international C&IT standards.

- The federal government play a key role in establishing the state-of-the-art facilities and associated procedures to test and certify C&IT products for inter-operability in Canada.

The above recommendations, which are intended to supplement those which have already been made in previous studies such as the Hall and Salter reports, are discussed below in more detail.

7.1 C&IT Standards Awareness/Education Program

Our research shows that standards activities in all areas are largely restricted to the standards development community and this is particularly true in the C&IT area. There is a need to raise awareness and educate a wider segment of the population on the importance of C&IT standards and their relationship to technology development, diffusion and to Canada's overall competitiveness. The target audience for this program should particularly include senior management in government and industry, small and medium sized enterprises (SMEs) who are not currently involved in the C&IT standards-setting process, and students in universities and community colleges, especially in engineering and business programs. The program should also include initiatives aimed at raising the overall profile of standards-related work, such as increased exposure to the media and awards for excellence in C&IT standards work.

Initiatives under way to increase the efficiency and effectiveness of the dissemination of standards information, should ensure that the needs of target groups mentioned above, particularly the SMEs, will also be met on a cost-effective basis.

7.2 High Priority on Inter-operability Standards

In the present environment of limited financial and human resources, the federal and provincial governments should ensure that resources are directed towards the areas where greatest benefits to industry will occur. In the C&IT area, the greatest benefits to Canada's competitiveness will occur in those programs which encourage the development of international standards which ensure inter-operability of networks, services, systems, and equipment.

In the C&IT standards area, this means establishing the policies and environment to ensure that there will be collaboration between telecommunications, wireless, broadcast and information technology sectors to develop or adopt the common standards that will facilitate the integration of the various networks into one overall network of networks referred to as the Canadian Electronic Highway.

7.3 A Greater Role for Sector Campaigns and Peer Groups in the Development of C&IT Standards

Federal and provincial governments should encourage a greater role for sector campaigns and peer groups in the development of international C&IT standards. Given the limited financial and human resources available to firms involved in the C&IT standards-setting process, the governments should ensure that resources are directed towards the appropriate programs, services and groups. These efforts must emphasize inter-operability standards in order to provide the greatest benefits to Canada's competitiveness.

Sector campaign resources (e.g. from ISTC and DOC) should be directed towards the establishment of international C&IT standards. Such programs would permit governments and industry to address the various barriers to growth, and provide targeted support, advocacy initiatives and visibility to help the C&IT sectors improve their competitiveness and growth prospects in the global marketplace.

Peer groups, like Vision 2000 and CANARIE, should also be used to drive the standards-setting process towards developing and adopting standards that will facilitate inter-operability between the various networks. These groups play a significant role in the development of next generation C&IT technologies, products, applications, software and services, and as such are able to contribute to Canadian competitiveness.

Furthermore, TSACC, in conjunction with Advanced Broadcasting Systems of Canada (ABSOC), should play a lead role in providing strategic direction to the various standards-setting bodies to support the Electronic Highway Initiative.

7.4 Testing and Certification Program

Canada requires a comprehensive testing program. That is, a fully fledged testing program policy, guidelines, information and coherent approach to test service accessibility for the widest practical range of standards. Such a program will: create a stable environment for SMEs; support users acquiring open systems; promote inter-operability and seamless interconnection; and ensure that appropriate agreements are in place with other countries or regions to mutually recognize international standards resulting in improved efficiency and competitiveness of the Canadian C&IT industry. Canada needs this program now or it will become seriously disadvantaged as other regions forge ahead with their coherent testing programs. This is an initiative that should be developed, financed, and operated by government in partnership with industry.

8.0 CONCLUSION

Standards and regulations significantly influence the diffusion of C&IT technologies. Their importance to this sector, as well as all sectors that use C&IT products and services, is increasing. Even though products will still continue to be developed and diffused where standards have not been formalized, it is becoming more and more necessary for manufacturers, service providers and users to be familiar with standards, both existing and under development, in order to optimize their strategies and business decisions pertaining to the development, introduction and use of C&IT.

APPENDIX A

COMMON ACRONYMS

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COMMON ACRONYMS

ACIM	Advisory Committee on Information Management
ACTE	Approval Committee for Telecommunication Equipment
ACTS	Association of Competitive Telecommunications Suppliers
AIT	Advanced Information Technologies Corp.
ANSI	American National Standards Institute
AT&T	American Telephone and Telegraph
ATM	Asynchronous Transfer Mode
B-ISDN	Broadband ISDN
C&IT	Communications and Information Technologies
CAC	Consumer Association of Canada
CANARIE	Canadian Network for the Advancement of Research, Industry and Education
CBA	Canadian Bankers' Association
CBTA	Canadian Business Telecommunication Alliance
CCAC	Consumer and Corporate Affairs Canada
CCIR	International Radio Consultative Committee (now the Radiocommunications Sector)
CCITT	International Telephone and Telegraph Consultative Committee (now the Telecommunication Standardization Sector)
CEC	Commission on European Communities
CEPT	Conference of European Post and Telecommunication
CGSB	Canadian General Standards Board
CIGOS	Canadian Interest Group on Open Systems
CILC	Canadian Interconnection Liaison Committee
CMA	Canadian Manufacturers Association
CNO	Canadian National Organization
CO	Central Office
COS	Corporation for Open Systems
CPE	Customer Premises Equipment
CPG	Conference Preparatory Group
CRTC	Canadian Radio-television and Telecommunications Commission
CSA	Canadian Standards Association
CS-03	Standard for Terminal Attachment to Telephone Networks
CTRs	Common Technical Regulations
DIS	Draft International Standard
DOC	Department of Communications
EAITC	External Affairs and International Trade Canada
EIA	Electronic Industries Association
EC	European Community
EDI	Electronic Data Interchange

EEMAC	Electrical and Electronic Manufacturers Association of Canada
EFTA	European Free Trade Alliance
ETSI	European Telecommunication Standards Institute
FCC	Federal Communications Commission
FDDI	Fibre Distributed Data Interface
FTA	(Canada-U.S.) Free Trade Agreement
FTAM	File Transfer Access and Management
FPLMTS	Future Public Land Mobile Telephone Services
FTSC	Federal Telecommunication Standards Committee
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GNP	Gross National Product
GSM	Group Standards Mobile
GTA	Government Telecommunication Agency
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IMO	International Maritime Organization
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISONET	ISO Information Network
ISTC	Industry, Science and Technology Canada
IT	Information Technology
ITAC	Information Technology Association of Canada
ITU	International Telecommunication Union
JISC	Japan Industry Standards Committee
JTC 1	(ISO/IEC) Joint Technical Committee
LAN	Local Area Network
Mb/s	Megabits per second
MOU	Memorandum of Understanding
N-ISDN	Narrowband ISDN
NET	Norme Européenne de Télécommunications
NFTA	(Canada-U.S.-Mexico) North American Free Trade Agreement
NIST	National Institute for Standards and Technology
NIU-F	North American ISDN Users Forum
NSS	National Standards System (of Canada)
NTSC	National Television Systems Committee
NTT	Nippon Telegraph and Telephone
OECD	Organization for Economic Cooperation and Development
ONP	Open Network Provision
OSI	Open Systems Interconnection
PAL	Phase Alteration Line
PBX	Private Branch Exchange

POSI	Promoting Conference for OSI
PSTN	Public Switched Telephone Network
PTT	Postal Telephone and Telegraph
R&D	Research and Development
RABC	Radio Advisory Board of Canada
RBOCs	Regional Bell Operating Companies
SS#7	Signalling System Number Seven
SCC	Standards Council of Canada
SCIT	Steering Committee on Information Technology, Canadian Standards Association
SCOT	Steering Committee on Telecommunication, Canadian Standards Association
SECAM	Sequential-and-memory (French and Soviet television system)
SNA	System Network Architecture
SNMP	Simple Network Management Protocol
SONET	Synchronous Optical Network
SPO	Standards Program Office
T1	Accredited Standards Committee on Telecommunication
TAP	Terminal Attachment Program
TAPAC	Terminal Attachment Program Advisory Committee
TBITS	Treasury Board Information Technology Standards
TBS	Treasury Board Secretariat
TCP/IP	Transmission Control Protocol/Internet Protocol
TIES	Telecom Information Exchange Services
TSACC	Telecommunication Standards Advisory Council of Canada
TTC	Telecommunication Technology Council
UL	Underwriters Laboratory Inc.

APPENDIX B

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DOCUMENTS REVIEWED

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APPENDIX C

INTERVIEWEES

APPENDIX C
INTERVIEWEES

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Mitel Corp.

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7

Nordicity Group Ltd.
Le Groupe Nordicité ltée

THE EFFECTS OF STANDARDS ON TECHNOLOGY DIFFUSION IN THE BUILDING CONSTRUCTION INDUSTRY

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SUMMARY

This report describes the Canadian national standardization and regulatory system as it relates to residential and non-residential building construction. It reviews the role of Canadian standards and regulatory organizations, and it identifies and discusses issues related to how standardization impacts on technology diffusion in building construction.[1]

Several substantive and process issues are identified in this report. The substantive issues centre around some of the major characteristics that are driving technological change in building construction. For example, the increasing competitiveness of the industry; the expanding base of innovative technology in building products and materials; and the heightened concern for the environment and for energy efficiency are key factors which have a direct bearing on the role of standards and regulations.

Process issues relate principally to maintaining a uniform standards and regulations infrastructure across Canada; responding to the globalization of markets and the increasing interaction of the international industrial base; and addressing the requirements for improved communications and information flow on developments in building technology.

Industry Sector Situation

The building industry is a mature sector comprised of a wide variety of players. Broadly defined, the industry includes not only firms directly involved in the construction and renovation of buildings, but also the manufacturers and the engineering and other professionals who provide the goods and services used in these activities.

The application of new technology in the building industry has long-term impacts on building construction. Any major new development has lasting effects because of the nature of the residential or non-residential building product. The erection of a home or an office building is a long-term investment.

The pressures for introducing changes in building construction technology have increased considerably over the past decade. Owners and building practitioners in

[1] This is the third report in a series of five which comprise a comprehensive study of the impacts of standards on technology diffusion in Canada. The first report provides an overview of the standards process in Canada and reviews issues regarding the role and effectiveness of the Canadian standardization infrastructure; the second report is a sector analysis of the communications and information technologies industry; the third report is this one on the building construction industry; the fourth report reviews issues related to Canada's participation in international standards setting activities; and the fifth report is a synthesis of the results of the overall study.

Canada, including designers, contractors and inspectors, face many challenges today. Among the key factors that are impacting on the building industry, and are driving technology development in this sector, are:

- *the growing base of innovative technology in products and materials;*
- *growing concern for the environment and for energy conservation;*
- *globalization of markets and production, and increasing interaction of the international industrial base;*
- *the specialized nature of the sectors within the industry and the increasingly competitive environment;*
- *the diversity of interpretations of government building regulations and enforcement processes.*

Technology Context

Leading-edge building construction technologies are accessible globally, but developing competitive advantages depends on the capability to select, add value to and accelerate the diffusion of these technologies within the appropriate national context. The pace by which new technology is standardized, and the manner in which these standards become incorporated into the building and other regulatory codes, is thus an important issue for the diffusion of new products and processes in the building industry.

While the building industry in Canada has a strong domestic orientation, and while many innovations have been developed in Canada, still most of the building technology used is adopted or adapted from foreign sources. With increased globalization and international competition, amongst manufacturers in particular, Canada needs to be active in the international arena -- to monitor technological developments as they occur, particularly within our major industrial partners.

The introduction of advanced technology into the building construction industry has been helped significantly during the post-war years, through the activities of government organizations such as National Research Council, Canada Mortgage and Housing Corporation, and Energy Mines and Resources.

Public laboratories and research institutions such as the Institute for Research in Construction (NRC) and CANMET (EMR) are involved in building technology development and are active on standards development committees. The development and dissemination of standards is an important means of promoting the use of results of research carried out in these institutions.

Assessment of Impacts/Issues

The Canadian building construction standards institutions are well established, and Canadian procedures for standardization in this sector are the envy of many industrialized countries.

Yet change is slow. The multiplicity of public bodies (federal, provincial and municipal), regulating and inspecting building construction projects, could be a factor in delays, conflicts, uncertainties and unnecessary costs. In addition, there is a multitude of zoning, planning, environmental, and civic regulatory requirements that often take lengthy periods (sometimes years) to comply with before a construction project can proceed. These delays and associated additional costs in the building process could have detrimental impacts on technology diffusion.

On the positive side, industry participation on standards committees is a catalyst for the diffusion of technology. Manufacturers and consumers regularly adopt new technologies or products through standards. It is, therefore, very important to be closely associated with standards development committees, nationally and internationally. However, the building construction industry is made up of many small and medium-sized firms, who may be unable to participate, especially in times of recession. Many of those who do participate are typically representatives of larger enterprises with their own vested interests.

The requirements for standardization increasingly focus on the early stage of the research and development process. Including standardization concerns at an early stage of R&D can have an accelerating effect on the diffusion of new technologies. This report provides some examples of this approach (e.g., Institute for Research in Construction (IRC), NRC; and the Buildings Group, CANMET, EMR).

One way of influencing policy formation about new technologies is to link the R&D environment to the standards development process. In this way research organizations can promote and disseminate the results of their work through involvement in standards setting activities.

Through the IRC, the NRC contributes in many ways to building technology development, standardization and regulation. NRC has had a strong presence in the building regulations area ever since it developed the National Building Code in 1941.

With a staff of over 200 engineers, scientists, architects, technical experts and administrative staff, IRC operates construction program activities through its own research and technology development activities and through its strong affiliation with field advisors of NRC's Industrial Research Assistance Program (IRAP).

The strategic objectives of IRC are:

- *to undertake research of significance to the Canadian construction industry and its users;*
- *to develop appropriate technology and information and promote their adoption by the industry;*
- *to support the national construction codes, standards and evaluation system.*[1]

By combining these three strategic areas of activity into one organizational structure, the IRC contributes at the different stages of R&D and technology development to the standardization process and to technology diffusion.

In performing its mandate for research in new technology, the Buildings Group (CANMET) includes in its approach the investigation of requirements for new and revised building standards. This activity is embodied in all stages of the innovation/technology development cycle. The aim is to accelerate the diffusion of proven technologies and to increase support for emerging technologies. This energy efficient technology strategy is an integrated approach involving: research and technology development; lab testing and field trials; standards and guidelines; technology transfer; and quality assurance.

These complementary activities are depicted in Exhibit A, which summarizes the Buildings Group approach.

Implications for Competitiveness

There is growing international pressure (particularly from our major trading partners) on the building construction industry to introduce new, more effective mechanisms for technology diffusion. For example, the harmonization of standards under the FTA and NAFTA is currently receiving considerable attention by the building industry. Many players, particularly those in the building products manufacturing industry, are concerned with the potentially negative implications of competition with American firms. In the area of manufactured housing, for example, two years ago the Department of External Affairs and International Trade and the Canadian Manufactured Housing Institute (CMHI) compared the Canadian and U.S. standards on manufactured housing. It was concluded that the Canadian standards were superior and that those in the U.S.A. should be strengthened in any harmonization program, rather than vice versa.

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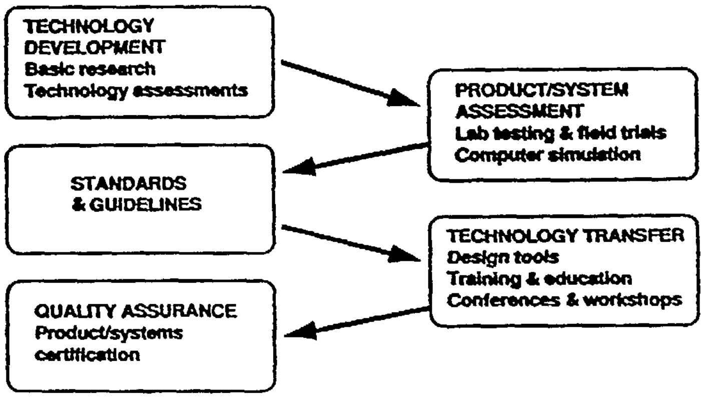
[1] *NRC – Working with the Construction Industry*, National Research Council, Institute for Research in Construction, Ottawa, 1992.

Exhibit A: EMR Buildings Group Approach: Integrated Program for Technology Development

COMPLEMENTARY ACTIVITIES



Activities include:

- For "proven" technologies:
  - Technical information & advice
  - Product/services certification
- For "market-ready" technologies:
  - Training and education
  - Standards and guidelines
- For "emerging" technologies:
  - Lab testing, field trials, research
  - Technology assessments

Source: Buildings Group, CANMET, Energy Mines and Resources.

The creation, use and communication of information is now playing a central role in the development and diffusion of technology. In the building industry, there is an explosion of information provided by a complex network of organizations. Quick and effective access to building information is extremely important in constructing high quality buildings. It is also needed to minimize the risk of legal actions and unexpected delays and costs during construction. Adapting to the new technological realities of the 1990s will depend very much on the progress of the state of information and standards on many of the new building systems and technologies.

Faster response time will help the industry to introduce new mechanisms for technology diffusion. Following the CANMET and IRC models, where implications of standardization are built into the R&D stage of technology development, could also increase the competitive position of the Canadian building industry.

Summary of Findings

This report on the building construction industry forms part of the research for the broader study on the impacts of standards on technology diffusion (see reference on page 1 of this Summary). The results confirm the general findings of the overall analysis, namely:

- *that standards and regulations have a major impact on technology diffusion;*
- *that there is a need to improve the dissemination of standards information;*
- *that the federal government should promote awareness of the standardization process, particularly as to how it impacts on the competitive position of Canadian industries; and*
- *that it is vital that government and private sector participation in the standardization process be increased, particularly at the international level.*

This report has demonstrated that standards and standardization form an important component of the technology development process in the building construction industry. Standards can both help and hinder technology diffusion. As the base of technological knowledge continues to grow worldwide, maintaining and increasing Canada's competitive advantages will depend on this country's capability to select, add value to and accelerate the diffusion of new technologies, as they apply to the Canadian situation.

1.0 INTRODUCTION

1.1 Objectives

This report describes the Canadian national standardization and regulatory infrastructure as it relates to residential and non-residential building construction. It reviews the role of Canadian standards institutions, and it identifies and discusses issues related to how standardization impacts on technology diffusion in building construction.[1]

This study has been initiated by Industry Science and Technology Canada as part of a broader project for examining "...the role that standards and regulations play in the technological innovation process and how they impact the international competitiveness of Canadian firms."[2]

A series of reports are being prepared as part of this work. In addition to this report on the building industry, the other reports are: an overview of the effects of standards and regulations on technology diffusion; a sector report on the communications and information technologies industry; a report on the international standards development environment and Canada's role in it; and, finally, a synthesis report which summarizes the findings and conclusions of the overall study and provides recommendations for the future.

The main objective of the overall initiative is to identify how the standards development process may help or hinder technology diffusion; to determine the implications of standardization for competitiveness of Canadian firms; to establish priorities for future action regarding standards development activities in Canada; and to determine how appropriate actions could be initiated and the scope of these actions.

This report on building construction should be viewed as a Discussion Paper to stimulate discussion of the issues identified. No recommendations on priorities for future actions are made in this document -- this is reserved for the synthesis report.

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1 For the rest of this report, the "residential and non-residential building construction sector" will simply be referred to as "building construction" or "the building industry". In addition, a "regulation" is defined as a sub-category of standards -- see Section 1.7 for definitions.

2 Request For Proposals, *Impact Study on the Analysis of Effects of Standards and Regulations on Technology Diffusions*, DSS File, 1992, Appendix A, p.2.

1.2 Context for the Study

1.2.1 Global Competition

During the 1990s, world markets are expected to become intensely competitive, with fewer nationalistic bastions in most industrial sectors. This competitive environment, over the next few years, is likely to be characterized by increased economic globalization, rapid technological change, further expansion of multinational enterprises, and greater liberalization of trade practices. Regionalized GATT-compatible agreements have emerged as a new factor in international trade between major industrialized countries. Further strengthening of some of the European economies and of Japan and other Pacific Rim countries will likely continue, despite occasional setbacks. Along with these trends is the increasing interdependence of financial markets across the globe.

In Canada, economic prosperity and competitiveness will continue to be a high priority in the national political agenda, throughout the 1990s. It is reasonable to assume, however, that government jurisdiction over industrial programs and policies will remain a shared federal-provincial responsibility.

On the technology side, greater amounts of R&D funds will need to be spent externally on private sector research in Canada. Intensified industrial competition will drive innovation and the need for rapid technology diffusion. Co-ordination of government research and development with industry and non-government organizations will become even more necessary.

Within this broad context, Canada needs to ensure that our consumer and industry standards and regulations are amongst the best in the world, to enhance the country's competitiveness in the new global economy while protecting the health and safety of our citizens -- and providing for an appropriate level of quality (including service life). There will be some tradeoffs to be made: between new, value-added products versus conventional Canadian commodities; between modern, technologically-driven ventures and traditional businesses; between globalization of commercial activities and domestic markets. More importance will be placed on the quality of life and on a cleaner, healthier environment. Politicians will continue to face many difficult questions regarding industrial policy options. For example, do we target the most promising Canadian technologies, as a government industrial strategy? If so, how do we determine which are the most promising innovations?

For Canada, as for other countries, economic growth depends on trade. Nearly fifty per cent of all Canadian manufactured goods are exported. To the extent that an international sale (or purchase) of goods involves a transfer or diffusion of technology, Canadian firms, to remain internationally competitive, must be assured of timely access to the best foreign and domestic technology and that the national standards infrastructure act as a stimulant rather than a hindrance to this country's competitive position.

1.2.2 Focus on Building Construction

Even a minor construction project requires the use of many different products, services and technological know-how. This aspect of the residential and non-residential building construction industry makes it an appealing choice to examine, within the broad context of this study, the impacts of standards and regulations on technology diffusion. The levels of construction costs and technology have a direct bearing on the capital and operating costs of other industries, and indeed of all sectors in the Canadian economy -- and therefore also on our competitiveness as a nation.

Efficiency, effectiveness and cost of construction within this multi-billion dollar industry is of vital concern to Canadian enterprise. One way to improve the performance of the construction sector is to accelerate the development and acquisition, adoption and adaptation of new building technologies. Another way is to improve the application of existing technologies.

The importance of construction technology was demonstrated by a study prepared for the National Research Council.[1] A poll of leaders in a cross-section of the construction industry and allied fields was conducted. Two-thirds of the issues important to those surveyed had vital or significant technology components. Technology is thus very important to the operations of the industry, yet the investment in many construction research and development programs is at a relatively low level in Canada, particularly in comparison to other industrial countries such as Japan. However, in general, the level of construction R&D compared to those of other industries is relatively low everywhere. Thus studying effective technology diffusion in building construction is all the more important.

Building construction is subject to a wide range of standards, legislation and regulations administered by all levels of government -- federal, provincial and municipal. Hundreds of standards are used by the building industry. For example, the National Building Code of Canada (NBC) references about 210

[1] Don Chutter, Revay and Associates, "Technological Implications of Major Issues Facing the Canadian Construction Industry During the Next Decade", *The Construction Industry and the Issues Facing It: An Overview*, National Research Council, September 1986.

documents directly and many more indirectly. Generally, these are standards prepared by the standards development organizations (SDOs)[1] accredited by the Standards Council of Canada (i.e., Canadian Standards Association, Canadian General Standards Board, Underwriters' Laboratories of Canada, the Canadian Gas Association, and the Bureau de normalisation du Québec). Standards from American organizations such as the American Society for Testing and Materials (ASTM) and the National Fire Protection Association (NFPA) are also referenced. Other primary regulatory documents adopted by provinces and municipalities, such as codes pertaining to fire safety, plumbing, electrical products, elevators, and so on, also reference many standards used in building construction. This practice of regulation by reference to standards makes the standards development organizations major contributors to the regulation of construction and helps to ensure that the National Building Code in Canada and other primary codes reflect the latest in accepted technology.[2]

In addition to standards and building codes, "specifications" play a key role in determining building construction requirements. Specifications are the detailed requirements for a specific building or project, most frequently in the form of a project manual. "The specifications for a project may be based on model or standard specifications, may be custom requirements for a particular project or may be requirements of the law."[3]

A special feature of the building construction industry, within the context of this study on technology diffusion, is the wide scope and ubiquitous nature of the products. This industry has major links with all other sectors in the economy. It represents a major component of Gross Domestic Product (about 10 percent) and, as an industry, is considered to be a leading economic indicator (with over $65 billion in annual business -- 1992).[4] Government involvement in this industry is spread over several jurisdictions -- with fragmented federal, provincial and municipal responsibilities.

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1 "Standards Development Organizations" until recently were referred to as "Standards Writing Organizations" (SWOs). The Standards Council of Canada has changed the reference to more accurately reflect all of what these organizations do.

2 Robert A.Hewett, "Building Regulation and The National Codes", *The Construction Industry and the Issues Facing It: An Overview*, National Research Council, September 1986.

3 Robert A. Hewett and Gordon L. Walt, *Canada's Framework for the Regulation and Design of Buildings*, National Research Council, Institute for Research in Construction, Ottawa, June 1992.

4 In 1992, the total values of construction work purchased (for new and repair activities) were over $41 billion for residential buildings and over $24 billion for non-residential buildings. See Exhibit 1-2.

Generally, the building industry can be characterized as a "traditional" economic sector, but with high-technology products and applications. The use of standards and regulations within building construction serves various purposes. These primarily range from socially relevant aspects such as public health and fire safety, to ensuring sufficiency and appropriateness of structural design and effectiveness of building processes, materials and systems.

1.3 Definition of the Building Industry

For the purpose of this report, the building industry includes construction activities involving both residential and non-residential buildings. Exhibit 1-1 shows the breakdown of these two components of the construction industry.

Exhibit 1-1
Components of the Building Industry

```
RESIDENTIAL BUILDINGS

      Single detached
      Semi-detached, including duplexes
      Apartments, including row housing
      Other (e.g., mobile homes, cottages)

NON-RESIDENTIAL BUILDINGS

      Commercial
            (e.g.: office buildings, warehouses,
                   hotels)
      Institutional
            (e.g.: schools, churches, hospitals)

      Industrial
            (e.g.: factories, petrochemical and
                   other plants)
      Other
            (e.g.: farm building, radio stations,
                   airports)
```

The building industry, as characterized in Exhibit 1-2, is comprised of a wide variety of stakeholders. Broadly defined, the industry includes not only firms directly involved in the construction and renovation of residential and non-residential buildings, but also the manufacturers and the engineering and other professionals who provide the goods and services used in these activities. These latter groups are of particular interest in terms of export potential, including building products, technology and expertise.

Builders themselves are the focal point of the network of firms involved in the industry: they bring together the necessary products, labour and information, navigate the web of regulatory requirements, organize the various inputs into a smooth and efficient production schedule and package the results into attractive, saleable products for consumers.

1.4 Participants in the Building Industry

The home and the workplace of Canadians is the broad market area of the building industry. This encompasses the whole population of Canada. Many participants (shown in Exhibit 1-2) are more directly involved in this industry.

Exhibit 1-2: Stakeholders of the Building Industry

Regulatory Authorities	- governments (federal, provincial, municipal)
Codes and Standards Organizations	- codes and standards development bodies - evaluation, testing and certification
Developers, Builders, Contractors	- (including sub-contractors)
Manufacturers and Suppliers	- manufacturers - suppliers (retail/wholesale)
Specialized Consultants	- inspection and testing - costing experts - project managers - other building science practitioners
Owners	- public sector - private sector
Users of Buildings	- tenants - the public

Designers	- architects
	- engineers
	  - electrical
	  - mechanical
	  - structural

Research Organizations	- industry - government - institutions (e.g., universities)
Related Businesses and Professions	- mortgage and finance - real estate - law - insurance
Associations	- manufacturers - professions - building trades

1.5 Characteristics of the Industry

1.5.1 Building Construction is Very Important to the Economy

The building construction industry plays a major role in contributing to the economic success of Canada, by providing the physical capital and infrastructure required to build a prosperous and competitive nation. Exhibit 1-3 shows the total value of the building industry in Canada. These figures include all direct construction labour content and the cost of materials used. In addition, included is related construction costs such as preconstruction planning and design, management, legal and real estate fees, interest during construction, materials purchased for contractors, etc.

Exhibit 1-3
Total Value of Building Construction Work Purchased
-- by Type of Structure, Canada

	TYPE OF STRUCTURE		
YEAR	RESIDENTIAL	NON-RESIDENTIAL	TOTAL
	($000)	($000)	($000)
1989	$42,729,632	$28,508,639	$71,238,271
1990	$41,012,053	$29,034,886	$70,046,939
1991	$36,776,088	$25,605,646	$62,381,734
1992	$41,114,580	$24,192,690	$65,307,270

Source: Construction in Canada -- 1990-1992, Statistics Canada Catalogue, 64-201, May 1992.

Building activity generates over a million jobs a year in Canada, in a variety of different industries across the country. Almost half of these jobs represent direct employment in building construction itself.

The total value of output from all construction activity (including bridges and roads and heavy engineering projects) in 1992 was $99 billion (about 15 percent of GDP), of which 42 percent was residential and 24 percent was non-residential building construction (for a total building construction value of $65 billion).

Building products have historically represented approximately 40 percent of total construction value (i.e., about $40 billion in 1992). Of these $40 billion, approximately $31 billion are for the value-added manufactured building products market.

1.5.2 Many Small Firms

It is typical, among many industries and businesses in Canada, for a relatively small number of firms to be responsible in the aggregate for 75% or more of the total volume. The building industry, however, is more akin to agriculture - it is not concentrated in a few areas but is spread throughout the country and is operated mainly by family firms. It is true that there are a number of developers, merchant house builders, general contractors and specialty contractors in Canada whose individual annual volume of business is valued in the hundreds of millions of dollars. Yet -- even in the aggregate -- they carry out a minority share of the building program. The great majority of the firms in the industry are small businesses. Typically they operate in one market area. Small municipalities ordinarily can only support relatively small firms.

In recent times, the value of housing repair and renovation work in Canada has exceeded that of new house building. This trend has opened up increased opportunities for the single artisan or sole proprietor with one or two or a few employees to obtain work.

A similar situation exists with regard to the allied professions of architecture and engineering. A few Canadian design firms have obtained world ranking and maintain large staff and branch offices. The great majority, however, operate as relatively small professional practices. It is only in the building materials manufacturing sector that large industrial organizations - often international - with large market shares are to be found.

1.5.3 A Highly Competitive Business

The building construction industry operates in an atmosphere of easy entry and keen competition. With a few exceptions, no special qualifications or sizeable capital investments are required to establish a business as a builder, general contractor or specialty contractor. Established firms accordingly always face new competition. Sizeable projects or lack of work will attract competition from other areas. Firms which compete for contracts or sub-contracts typically have low overheads.

Building has traditionally experienced cyclical instability. In "boom" times the high demand for building construction and accompanying potential for profits leads to the formation of many new enterprises. In the "bust" period the industry's capacity far exceeds the demand for its services. Competition often becomes uneconomic and many firms fail or quietly close down. At the same time, there is a greatly increased incentive to become more innovative and cost-effective in order to survive. In contract construction, the general contractors and sub-contractors must build in accordance with the specifications, so they can only compete on cost. Developers and builders who have control over the design standards for their projects compete in terms of both cost and quality in their competition for buyers or tenants in the market.

1.5.4 Standards and Regulations

The building industry is regulated by all three levels of government. However, under Canada's constitution the provinces and municipalities are responsible for administration and enforcement of regulations. Areas that are regulated include building materials, plumbing, fire prevention, electrical systems, structural sufficiency, heating systems, ventilation and elevators.

Major Canadian model codes and standards directly referenced in provincial, territorial and municipal building laws and regulations are listed in Exhibit 1-4. Generally, there is a large measure of uniformity of regulations between jurisdictions. This provides many benefits to the Canadian public and the building industry (including manufacturers). Consistency of procedures, complementarity and interchangeability of building components and materials, contribute to a more efficient business and an effective delivery of industry products to the consumer.[1]

In 1995, there will also be a Canadian Energy Code and a Canadian Housing Code published by the National Research Council.

1.5.5 Specialization in the Industry - Benefits and Co-ordination Problems

The principal source of efficiency in the building industry is the high degree of specialization among the design professions; among builders and contractors, sub-contractors and sub-subcontractors; and among the building tradesmen. Many projects are highly complex and may themselves be only units in larger developments. No one organization can have expertise in the whole operation.

This specialization operates at all levels. For example, for electrical work the on-site employee first goes through apprenticeship training in the electrical trade and must qualify as a licensed electrician. Electrical contractors must have qualified personnel and (with a few exceptions) they only compete for

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[1] Section 2.0 describes the building standards and regulation system in more detail.

Exhibit 1-4
Canadian Model Codes and Standards Adopted in Building Laws and Regulations by the Provinces

NATIONAL RESEARCH COUNCIL

NBC	National Building Code of Canada
CPC	Canadian Plumbing Code
NFC	National Fire Code of Canada
CFBC	Canadian Farm Building Code

BUREAU DE NORMALISATION DU QUEBEC

Code d'installation des appareils sous pression

CANADIAN GAS ASSOCIATION

Natural Gas Installation Code
Propane Installation Code
Code for the Field Approval of Fuel-Related Components on Appliances and Equipment

CANADIAN STANDARDS ASSOCIATION

Canadian Electrical Code (CEC), Part 1
Safety Code for Elevators
Safety Code for Manlifts
Elevating Devices for the Handicapped
Elevating Devices for the Handicapped in Private Residences
Safety Code for Personnel Hoists
Boiler, Pressure Vessel and Pressure Piping
Mechanical Refrigeration Code
Nonflammable Medical Gas Piping Systems
Installation Code for Oil Burning Equipment
Installation Code for Solid-Fuel Burning Appliances and Equipment

electrical work. The contractors are supplied by electrical distributors, who act as sales agents for the manufacturers of electrical materials (some manufacturers maintain their own sales outlets). The electrical element of building projects is designed by licensed electrical engineers. Their designs must conform to the Canadian Electrical Code. Installations are checked by electrical inspectors (often employees of the electrical utility). Within the specialized electrical trade, there are further specialized sub-trades, e.g. electronic controls - with their own cadres of specialist technicians, contractors, suppliers, designers, etc.

And serving the electrical construction component is a host of national societies, associations and unions, many of which have provincial and local branches, affiliates and locals. These include the Canadian Society for Electrical Engineering, the Canadian Electrical Association, Canadian Electrical Code committees within the Canadian Standards Association, the Electrical and Electronic Manufacturers Association of Canada, the Canadian Electrical Distributors Association, the Canadian Electrical Contractors' Association, and the International Brotherhood of Electrical Workers and other unions representing construction electricians.

Similar structures exist in the other specialized sectors of the building industry. This has led to it being described by some as a "fragmented" industry. Certainly, the development of specialized sub-industries within the building industry does cause problems in the event of a lack of adequate co-ordination.

In order to produce the completed building efficiently and economically, the architect must co-ordinate the work of the various design disciplines; the general contractor/builder/construction manager must co-ordinate the work of the various specialty contractors; the mechanical sub-contractors must co-ordinate the work of the mechanical sub-subcontractors; etc.

Innovation and new technologies have increasingly become an important driving force within the Canadian building industry. The rapid increase in the introduction of new materials, components, assemblies and systems is such that technology transfer and participation in the standards development process in Canada and abroad have become major functions of the specialty associations – e.g., the Canadian Wood Council, the Canadian Portland Cement Association, the Canadian Institute of Steel Construction, the Canadian Home Builders' Association, the Society of the Plastics Industry of Canada, the Council of Forest Industries of B.C., the Clay Brick Association of Canada, and many others.

Public bodies such as the NRC Institute for Research in Construction, Canada Mortgage and Housing Corporation, and Energy, Mines and Resources Canada have materially increased their technology transfer activities during the past decade through publications and videos, seminars, workshops, expert advisors, demonstrations and networking services to the industry. Moreover, there has been a growing recognition that each technical specialty within the building process cannot operate effectively in technical isolation. Increasingly, the specialized units must take into consideration how their innovations may impact on the other elements in the overall building system. For example, "Building Envelope Councils" have been established in most major centres across Canada to foster greater understanding of the interplay of the various components in the walls, roofs, etc., that envelope a building. For instance, the improved insulation and sealants introduced in the interest of energy efficiency require in turn an improved ventilation system within the building in the interest of health.

1.5.6 Research and Development

The productivity and competitiveness of the industry is enhanced by the application of new technologies in the building process. As compared to its major competitors, however, Canada's construction industry itself invests very little in research and development for new technology, with most privately financed R&D being carried out by the manufacturers of construction materials, associations, owners, and public bodies -- and not industry practitioners such as engineering firms, builders or contractors.

Although the process of innovation and technology diffusion could be more effective if the industry itself engaged in its own R&D activities, building construction in Canada has benefited from a government/industry partnership arrangement under which government assists with both the research and development activity and the transfer of new technologies to the private sector.

There are a number of public players involved in the process of development and diffusion of new building technologies to the private sector. The key government players are the Institute for Research in Construction (IRC) (including the Canadian Construction Materials Centre) at the National Research Council (NRC), Canada Mortgage and Housing Corporation (CMHC), Energy, Mines and Resources Canada (EMR), Public Works Canada, as well as several provincial government bodies.[1]

1.5.7 Risks of Liability

Architects, engineers, builders and contractors can all be subject to lawsuits if new building materials and processes, etc., do not work as expected in practice -- i.e., to minimum health and safety standards. The dangers which those directly involved in building construction face by initiating new materials is demonstrated, for example, by the experience of introducing Urea Formaldehyde Foam Insulation(UFFI) into Canadian housing during the 1970s. The risks of lawsuits as a result of innovative practices, however, can be offset by maintaining an appropriate standards, evaluation and testing infrastructure for new building products and materials. The activities of

[1] The institutional environment will be described in more detail in Section 2.0.

NRC's CCMC in this respect will be described in Section 2.0. The CCMC offers a national evaluation service for innovative materials, products, systems and services in all types of construction.

While the threat of litigation could discourage the introduction of technological innovations into building construction, the maintenance of appropriate evaluation and testing facilities and procedures in Canada generally serves as an offsetting factor which facilitates innovation.

1.5.8 Technology in Construction

The introduction of advanced technology into the industry has been helped significantly during the post-war years, through the activities of government organizations such as CMHC, NRC, and EMR. Since the sector is highly fragmented and characterized by many small, specialized firms, linkages between the sector and technology centres, such as government research institutions and university engineering researchers, is vital to promote the development and use of advanced technology.

In Canada, building construction is an industry generally with a rather domestic orientation, where technology is a means for individual companies to ensure their competitiveness in the domestic market. In the past, building had been an activity of high labour content. Increased competition in the industry, rising costs of labour and major advances of technology have all contributed to the reduction of the labour content of the construction industry -- particularly in high-rise building. The industry has gradually increased its interests in technological change and innovation, as a means for maintaining growth and prosperity.

1.5.9 Renovation Has Increased in Importance

In the residential sector in particular, spending on repairs and improvements to existing buildings is now slightly higher than on new residential structures. An estimated $21 billion in 1991 was spent on repairs and improvements to existing housing. Moreover, renovation spending is relatively more stable than new construction, which tends to be more volatile and reactive to general economic trends. The importance of renovation has increased progressively over the postwar period in response to the aging and growing housing stock, and changing consumer preferences and occupant needs.[1]

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[1] *Competitiveness of the Housing Industry: A Response to the Federal Government Prosperity Initiative*, from the Canadian Home Builders' Association (CHBA), March 1992.

1.5.10 International Trade

International competition for large, non-residential construction projects in particular is intense and complex. It is commonplace for Canadian firms to compete with foreign firms many times their size which have as their base huge domestic markets. In most cases the export networks of these firms have been developed over a significant period of time and are closely tied to political links. The Canadian contractor, in contrast, is often new to export markets and cannot match the multinational financial strengths of his competitors.[1]

With the exception of manufactured housing, the residential industry is generally not involved directly in international trade.[2] However, indirectly, in terms of its use and refinement of leading-edge building technologies and products, the industry has a significant influence on the competitiveness of Canadian building products and services in external markets.[3] In this sense, the innovations that are taking place in Canada which are promoting more energy-efficient and environmentally-friendly practices and products should give Canadian manufacturing companies an edge in marketing their proven building products and services in export markets.[4]

1.5.11 Examples of Significant Innovations

Innovations and improvements in existing technologies create a need for standards writers to consider changes to their standards and/or testing and evaluation methods and procedures. Innovation in building construction technology can take many shapes. Small changes often have major impacts on cost reduction and effectiveness of the building process. Two examples of this nature are as follows.

A major technological breakthrough occurred in the woodframe industry, where an entire component has been renewed under the influence of new technology. The metal braces introduced to hold woodframe beams together

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1 *Response to the Consultation Paper "Prosperity Through Competitiveness*, from the Canadian Construction Association (CCA), March 1992.

2 During the 1980s, big Canadian developers such as Olympia and York, Campeau and Bramalea, were active in the U.S., with the backing of and access to financing from Canadian Banks. However, with the recession, foreign activities of these big developers have waned.

3 See CHBA report, op.cit.

4 This does not always happen, though. It seems, for example, that heat recovery ventilator technology is now being exploited by U.S. firms (e.g., Carrier and Broan). Keeprite was a leading Canadian company in air conditioning technology -- but has moved its R&D operations to the U.S.!

changed the way trusses are formed and transported in home building construction. This seemingly minor innovation has had a major impact on the woodframe construction industry.

A somewhat different example of technological progress to reduce production costs is provided by the glass industry. A new process for the manufacture of flat glass (called the "float process") was developed. This resulted in significant reduction of production costs, and has had a strong effect on the profitability of the windows industry.

Diffusion of the new glass and woodframe braces was relatively quick, mainly because the economic benefits to the industry and to the consumer were significant and almost immediate. The role of standardization in this context is fairly straightforward: to test the new products and consider whether they conform to existing standards, or whether new standards for the products are required. New products and materials can now gain recognition in the marketplace through the use of NRC's materials evaluation program (CCMC). This does not necessarily require the development of a "standard". CCMC produces evaluation criteria which are used for the assessement of these new technologies. These evaluation criteria quite often form the basis of a standard, if and when industry activity in a particular area warrants such development.

1.6 Definition of Technology Diffusion

"Technology diffusion" can be defined as "the spread of a technology already put to use by at least one firm or public institution, either in Canada or elsewhere in the world."[1] This definition serves to distinguish technology diffusion from technology transfer, which is seen as the transfer from the idea stage to initial use, either for commercial or public purposes.

Technology diffusion in building construction occurs within a broad context of government-industry interrelationships involving consultation and collaboration, and public financing and investment in R&D activities. The factors contributing to the success or failure of technology diffusion are varied, including legal and cultural practices, economic forces, competitive resource allocation and development of know-how. The ultimate purpose of technology diffusion, to a large measure, is increased economic benefits through sales of products and services to domestic and international markets.

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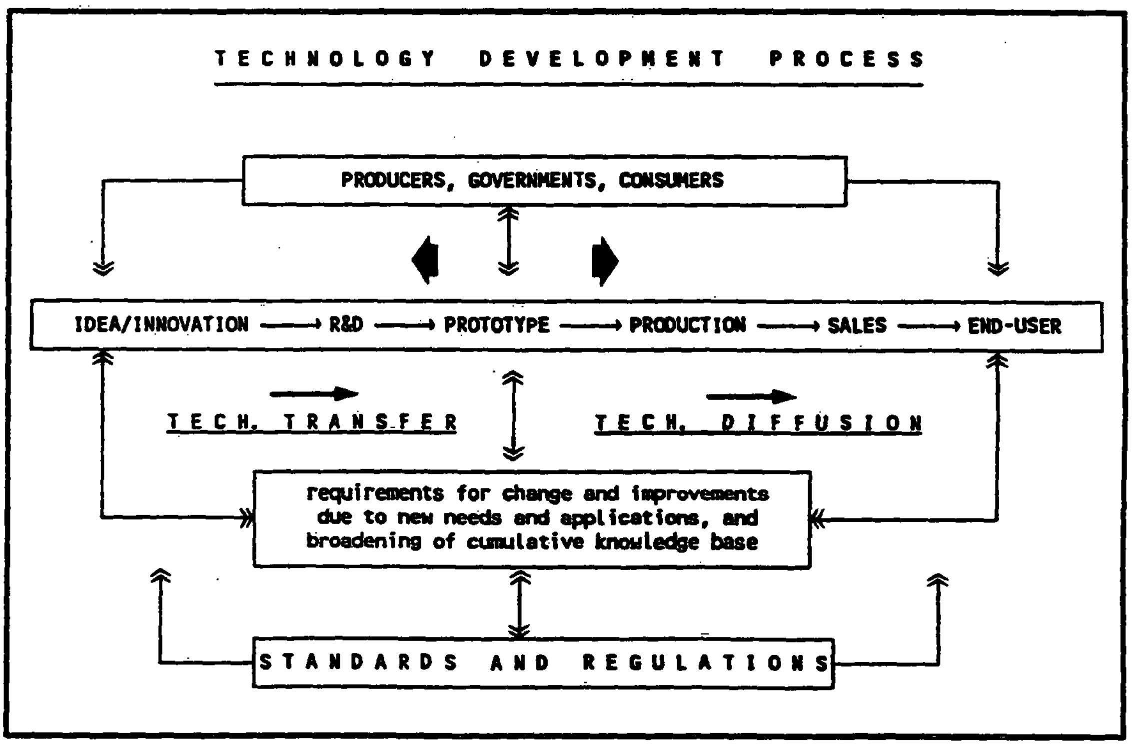
1 *Technology Diffusion in Canada: Myths and Realities*, A. Millington and Y.Van Ruskenveld, MOSST, Sept. 1986.

Since Canada develops only a very small proportion of all technological innovations, the acquisition of foreign technologies and their diffusion throughout Canadian industry is critical to maintaining our competitiveness. There are a number of routes to technology acquisition, including adopting standards, licensing, parent-subsidiary transfers, direct investment by foreign firms, the import of capital goods, and the exchange of technologies through joint technology development ventures.

During the past 25 years, there have been unprecedented changes in the nature of the technological development process. This process, once viewed as a linear sequence of events from scientific discovery to applied research and development – then production and marketing (see Exhibit 1-4), must now be seen as a series of concurrent interactive processes with heavy dependence on basic science and scientific engineering at every step.

Exhibit 1-4
Diffusion as Part of the
Technology Development Process



1.7 Definition of Standards

The use of standards is an accepted fact in society which, to a large extent, defines the quality of life. Some standards act as preventive measures against injury or death, such as those for medical gas, structural design and hockey helmets; some are concerned with the physical or performance characteristics of products, like plywood, flooring and concrete reinforcing.

When properly applied, standards and regulations assist our manufacturing and service sectors to be competitive both at home and in foreign markets. According to the definition accepted by the International Organization for Standardization (ISO) and the Standards Council of Canada, a standard is a: "Document, established by *consensus* and approved by a recognized *body*, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context".[1]

Measurement Standards:
Standards can be written (normative) or they can be standards of physical measurement. This report is concerned mainly with written standards as defined by ISO (above). However, one of the major components of Canada's standards activities involves metrology. Metrology is the science of measurement. It is the means by which base and derived units are given a basis of operation in the fields of science. Base units such as the kilogram, metre, or second, in addition to their derived and supplementary units, are component parts of the International System of Units, adopted by the Conférence des Poids et Mesures (CGPM). These units represent the physical standards of mass, length, and time. They are calibrated and certified by the Institute for National Measurement Standards (INMS) of the National Research Council (NRC).

The INMS of NRC serves as Canada's national measurement laboratory and as such is the focal point for Canada's activities in developing, maintaining, and improving physical standards of measurement so that they remain internationally compatible. In the terminology of metrology, the INMS provides 'traceability' for Canada's national measurement system. Traceability can be defined as a documented chain of measurements connecting the accuracy of a means of measurement to one of a higher accuracy which in turn is ultimately connected to a primary measurement standard.

Physical standards function as the foundation upon which normative standards are built and maintained. NRC provides nationally and internationally recognized measurement and calibration capabilities necessary to support the development of normative standards and the testing and certification of products and services to those standards.

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[1] See *ISO Guide 2: General terms and their definitions concerning standardization and related activities*, International Organization for Standardization, Geneva, Sixth Edition, 1991.
See also *National Standards System: A Glossary of Common Administrative Terms Used in Standardization Activities*, Standards Council of Canada, June 1985.

Normative Standards:
In the *Overview Report*,[1] normative standards were typified on the basis of their purpose, by the development process through which they are achieved, and by the way they are applied.

Purpose: Standards can be classified on the basis of what they define and for what purpose. Three generic types of standards were identified in the *Overview Report*. The first is the *product design standard* which specifies the characteristics of a product or a group of products in order to ensure their fitness for purpose (e.g., baby walkers, traffic lights). Product design standards such as those for baby walkers could also be called safety standards, which are standards aimed at the safety of people and goods.

The second generic type of standard is the *performance standard* which is a product standard specifying requirements for one or more performance characteristics. They deal with operating or testing and evaluating characteristics of a product. A performance standard stipulates that the characteristics with which a product must comply are based on tests that simulate as nearly as possible the performance that a product is required to give under actual service conditions. An example of a performance standard would be a certain mechanical strength specifying a minimum value of load on a physical structure which must be resisted. Another example is R2000 housing specifying minimum energy conservation requirements.

Thirdly, a *process standard* defines socioeconomic roles and relationships and establishes rules for interpreting behaviour. It facilitates interactions between people. Examples of this type of standard include driving on public streets on the right side of the road, or management practices as defined by the ISO 9000 series. This type of standard is a functional, "how to" standard.

Development: Standards may also be classified on the basis of how or by which organizations they are developed. For example, a standard can be developed through a "de facto" process. This means the standard was developed by industry within the context of market forces. They evolve from the marketplace and are subject to supply and demand mechanisms of competition.

A standard could also be developed through an accredited standards development organization (SDO). SDOs are accredited by the Standards

[1] *The Effects of Standards and Regulations on Technology Diffusion: Overview Report*, prepared by NGL Nordicity Group Ltd., September, 1993.

Council of Canada.[1] SDO standards are prepared on a consensus basis and are in the form of published documents which contain requirements, procedures or definitions which apply to specific products or activities. "Consensus" means that the standard was obtained by agreement of those concerned, at the best and highest level of thought. Consensus standards are negotiated by a representative group of stakeholders (in North American standardization, "consensus" means substantial but not necessarily unanimous agreement).

In addition, all three levels of government in Canada write and/or use standards for regulation and procurement. Regulatory standards arise from political choices and are mandated by government authorities from the top down. These types of standards are usually driven by public concerns (for example, to deal with environmental, safety or other social issues). They are also introduced to regulate market structures which may be uncompetitive or economically inefficient.

Application: Finally, the way a standard is applied can be used to describe the standard. A standard can be "mandatory" or "voluntary" in its application. A "mandatory" standard is one for which the application has been made obligatory by a regulation. A "regulation" is a binding document which contains legislative, regulatory or administrative rules and which is adopted and published by an authority legally vested with the necessary power. A standard which has been legislated is often referred to as a "de jure" standard. Not all mandatory standards are legislated. Some non-legislated standards, guidelines promulgated or underwritten by the government, may in effect be mandatory by virtue of the threat of law behind them.

A "voluntary" standard is one which is developed through consensus. Sometimes these are referred to as "voluntary consensus" standards. The word "voluntary" applies to both the preparation of the standard and its use. In the preparation it means that "those concerned, freely and without coercion, gave of their time, money, and effort to achieve a given objective". In use, it means that the standard is either applied or not applied at the discretion of those individuals or organizations involved. Voluntary standards are subject to judgement of both the marketplace and possibly even in court. In effect, many voluntary standards become mandatory in application if the force of legislation, or threat of government enforcement by legislation exists.

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[1] SDOs and their role as part of the Canadian National Standards System are described in the *Overview Report*, op.cit.

1.8 Interface of Standards With Technology Diffusion

One of the general purposes of standardization and related activities is to *facilitate* technology diffusion and the exchange of goods and services, at the national, regional and international levels, and to promote cooperation in the sphere of intellectual, scientific, technological, and economic activities[1], and not, at least in theory, to act as an obstruction for any purpose (e.g., as a protectionist trade barrier). In practice, however, standards do often act as impediments, either through overburdensome bureaucratic processes or due to necessary requirements for technical details and rigour.

As the given body of scientific knowledge grows and forms a perpetually higher base, the process of discovery and technological change progresses geometrically. This has had a profound impact on industries in several ways:

- dramatic progress in material and process characterization;
- increasing power of analytical instrumentation, and its transformation into tools for process control in production;
- global computer communication allowing codified engineering practice for design, production and control to be accurately disciplined, and at the same time geographically dispersed;
- intelligent production tools permitting greatly enhanced product diversity (personalization) without loss of scale economies;
- wide-scale use of information systems controlling distribution and providing end-user support to integrate products with the services required for their beneficial use.[2]

Together these factors are changing the pace of diffusion and the role of standardization. Emerging global industrial sectors characterized by more rapid technological development and diffusion have created an intensified need for global standardization.

Standards impact on all the different stages of the technology development process shown in Exhibit 1-4 -- i.e., innovation, production, distribution, and use. All players in this process are involved in or are affected by standardization. Therefore, for the purpose of this study, technology diffusion will be defined broadly, because the techno-economic contexts in which it takes place, including the preconditions related to technology development, influence and are also influenced by the setting of standards.

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[1] Albert L. Batik, *A Guide to Standards*, Serendal Research Institute, Inc., Parker Colorado, 1989, p.33.

[2] See discussion on fundamental changes in the process of technological innovation in *A Vision for the Future*, joint publication of ISO and IEC, printed in Switzerland, 1990.

2.0 THE CANADIAN BUILDING STANDARDS AND REGULATIONS SYSTEM

2.1 Major Features

The elements of the system that determine building requirements are summarized in Exhibit 2-1. These elements have evolved over many years in Canada. The various facets of building standards and regulations are interrelated, sometimes in complex ways. Despite this complexity, and the fact that there is still some confusion about how the system works, even among professionals in the business, Canadian buildings and building construction are among the best in the world.

The primary focus of this report is on "codes", "standards", and "regulations" as defined generically in Section 1.0, and as further identified in the context of building construction in Exhibit 2-1.

The requirements of codes, standards and regulations can be altered, from time to time, to reflect the results of research and development into new products, materials, and building systems and procedures. Most codes are indeed periodically updated and improved. Changes in technology and innovations, and feedback from practitioners, can lead to significant amendments of codes.

An important feature of the building standards and regulation system in Canada is the extent of public involvement. The model Code-writing process in this country now has one of the most extensive public review procedures in the world. Twice during every five-year National Building Code revision cycle, all the technical changes that the standing committees have agreed to are circulated for a three-month public comment period. This allows for feedback from those most affected by a proposed change and increases the range of expertise available on any subject. For example, during the review period prior to publication of the 1990 edition, over 8000 packages of proposed changes were sent out. More than 900 persons and organizations sent in over 4400 individual comments and each comment was reviewed by the appropriate technical committee.[1]

To assist in the understanding of these changes, the Institute for Research in Construction conducts Code Change Forums across Canada. Staff explain the changes and the background behind them and as a result, comments

[1] *How the National Codes Work*, National Research Council, Canadian Commission on Building and Fire Codes, Ottawa.

Exhibit 2-1
Summary of Building Standards and Regulations System

STANDARDS

Standards are documents that normally contain a set of technical requirements used as a basis for producing, designing or testing goods and services, for regulating activity or products, or for purchasing. Standards are the source of most technical building criteria. They establish the ground rules for building construction, and for trade in building products and materials.

CODES

Codes are a diverse group of documents used in building construction. In general, a document is referred to as a code if its title proclaims it as such. The code most frequently referred to is the building code.

A "code" can be voluntary or mandatory. Its content can cover a very wide range, such as a building code, or be narrow in scope like the Mechanical Refrigeration Code.

The terms "codes" and "standards" are sometimes used interchangeably in the building industry. The refrigeration, concrete design, glulam and lightning protection "codes" are all standards produced by the Canadian Standards Association (CSA).

REGULATIONS

Regulations are commonly proclaimed under an Act to set out in more detail the methods for achieving the objectives established by the Act. The regulation provides procedures and rules for implementing the legislation. An Act may be quite concise, while its regulations may be voluminous and detailed. Regulations have the force of law, i.e., they are mandatory.

LAWS

Laws are sometimes called legislation, Acts or bylaws. Laws applicable to buildings and building construction determine where and when legally binding requirements apply. Legislation enacted by a provincial or federal government is known as a law or Act.

Laws adopted by municipal governments are known as bylaws. Municipal bylaws that affect building construction can only be adopted to the extent permitted by the laws of the province or territory. There are significant differences in what the various provinces permit or require their municipalities to do.

In almost half the provinces and territories, a municipal bylaw is still required for adoption and/or implementation of a building code by the municipality. Provincial laws might include a Building Standards Act or Elevators Act. Municipal bylaws might appoint a chief building official or establish a schedule of permit fees.

Source: Adapted from Robert A. Hewett and Gordon L. Walt, Canada's Framework for the Regulation and Design of Buildings, National Research Council, Institute for Research in Construction, Ottawa, June 1992.

received are more informed. The appropriate technical committee reviews each comment and changes are made as appropriate.

2.2 The Institutional Framework

2.2.1 Federal Government Agencies

The main Canadian government departments/agencies involved in the process of building technology innovation, research and development, standardization and regulatory systems are NRC, CMHC and EMR.[1]

National Research Council

NRC has had a strong presence in the building regulations area ever since it developed the National Building Code in 1941. Through the Institute for Research in Construction (IRC), the NRC contributes in many ways to building technology development, standardization and regulation. With a staff of over 200 engineers, scientists, architects, technical experts and administrative staff, IRC operates construction program activities through its own research and technology development activities and through its strong affiliation with field advisors of NRC's Industrial Research Assistance Program (IRAP).

The strategic objectives of IRC are:

- to undertake research of significance to the Canadian construction industry and its users;
- to develop appropriate technology and information and promote their adoption by the industry;
- to support the national construction codes, standards and evaluation systems.[2]

Among current activities of IRC, the Institute provides technical support to the Canadian Commission on Building and Fire Codes (CCBFC). CCBFC is in the process of developing a new energy code. IRC also assists the building

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[1] Information contained in government promotional materials, federal program descriptions, and various annual reports and newsletters provide the basis for some of the material contained in this section.

[2] *NRC – Working with the Construction Industry*, National Research Council, Institute for Research in Construction, Ottawa, 1992.

industry to address code requirements for structural and fire safety in building rehabilitation.

The IRC organization is made up of the following groups: Research Branch, Codes and Evaluation Branch, and Industry Liaison Branch. This model organizational framework is particularly suited for the interface of all the vital components of the technology development process. Research and development, standardization and regulations, and technology diffusion are unified under one appropriate organizational envelope.

Through partnerships with industry and other research organizations, IRC's Research Branch assists the building construction industry to develop and apply new technologies. This branch is a national resource for solving major engineering problems. Current areas of research activity include energy conservation and environmental protection. Specifically, some of the areas being pursued are the development of high-strength concrete, superior windows, energy-efficient lighting, fire resistance, effective noise control for home and office, and more durable pavement and buried works.

The Research Branch also provides significant research support in the development of knowledge necessary for model code development. Activities include support of development of product standards, performance of the building envelope and indoor environment, fire performance, rehabilitation of structures and so on.

The Industry Liaison Branch is the technology transfer centre of the IRC. It provides high-quality technical information, from IRC and international sources, to the construction industry through technology networks, seminars, publications, and its literature collection.

Clients include the design and construction services communities, manufacturers and suppliers, and contractors and builders. The Branch also encourages interface with the Industrial Research Assistance Program (IRAP) of NRC. One of the activities carried out by this Branch has been the delivery of cross-Canada seminars on codes, standards and evaluation.

The Codes and Evaluation Branch is made up of the Canadian Codes Centre (CCC) and the Canadian Construction Materials Centre (CCMC). The CCC assists the Canadian Commission on Building and Fire Codes (CCBFC) to develop model codes to encourage the efficient construction of safe and durable buildings. The Centre also serves as the technical interface between research organizations and the committees developing the codes. These codes are published under the authority of the NRC and include the National Building Code. The CCC promotes the use of model building codes as the basis for uniform regulation throughout Canada.

The CCMC offers a national evaluation service for innovative materials, products, systems and services in all types of construction. CCMC's objective is to help the construction industry meet the challenge of competition in the marketplace at home and abroad.

CCMC publishes listings and reports on its evaluations. These listings and reports are recognized nationally by regulatory agencies as a basis for determining the suitability of products.

Through the evaluations of materials CCMC is facilitating innovation in construction. Manufacturers now realize they can get a new product into use quickly when it has been shown, through evaluation, to meet the intent of the National Building Code. Evaluation gives building officials the basis to approve a product and designers the confidence to use it.

The CCMC is guided by the Canadian Commission on Construction Materials and Evaluation (CCCME), an advisory group from a cross-section of participants and experts in building construction.

The CCMC is prepared to evaluate (on a fee-for-service basis) all building products or systems that are not covered by a standard and also publishes listings of products that meet a standard. The listings are provided on the basis of independent laboratory testing results. For products or systems for which no standards exist, CCMC develops tests and evaluation criteria with the aid of a network of scientific and engineering experts, both from the IRC and from other research organizations across Canada.

To help ensure that the national model codes continue to meet the needs of the regulators of public safety, the provinces and territories established an interprovincial committee for coordination of the development and application of building codes. The Provincial/Territorial Committee on Building Standards (PTCBS) is made up of senior representatives of the 12 major jurisdictions responsible for building regulations. The PTCBS meets periodically to discuss issues of mutual concern and is supported by a secretariat operated by the IRC. The IRC has two *ex officio* members on the PTCBS -- the heads of the CCC and the CCMC.

Canada Mortgage and Housing Corporation

CMHC meets its housing research and industry support goals through:

- technical and economic research activities;

- social and market housing analyses;
- technology transfer;
- regulatory reform research;
- land management;
- sharing vital statistics and other information;
- assisting in the development of standards;
- supporting housing research and training at universities and other educational institutions and in the private sector.

CMHC's traditional mandate has been generally to promote the construction of residential buildings and particularly to improve the quality of housing. It has played a major role in establishing good building practices in Canada, and in improving the quality of building materials and components.

In partnerships with the building industry and other government organizations, CMHC contributes in research of new construction technologies, to develop new products and standards and to transfer construction know-how throughout the sector. Through vehicles such as the National Housing Research Committee (set up by CMHC with wide representation of industry and governments) and the Technical Research Committee of the Canadian Home Builders Association, the Corporation works with other government,provincial and municipal organizations and the private sector toward improved housing standards. In fact, many housing norms and building practices developed by CMHC over the years have been incorporated into the National Building Code, as well as into some provincial building codes and municipal by-laws. CMHC is an active member of key standards bodies such as the Canadian Standards Association, and the Canadian General Standards Board.

CMHC also maintains a number of design and durability standards under the National Housing Act that are above and beyond the Code. These standards are listed in the Technical Builders Bulletin, and are available free of charge to architects, builders, provincial/municipal authorities and other interested parties.

The Housing Innovation Division of CMHC is responsible for promoting industry innovation and development by facilitating new housing technologies and building systems, and by improving information/knowledge transfer to the industry. The Canadian Housing Information Centre (CHIC) is part of the Innovation Division and is active in disseminating building information and the results of research and development activities to the residential construction industry.

CMHC as part of its mandate develops documentation about the technical, social and economic aspects of housing, from woodframe to high-rise housing. CHIC has a collection of documentation on housing and is the clearinghouse for literature produced by CMHC. CHIC publishes quarterly progress reports on CMHC research and publications. It also provides a literature search service for the public.

The National Housing Research Committee, created and chaired by CMHC, discusses the national research agenda for housing. The Committee members, comprised of representatives of public and private organizations, devote both time and expertise to identify priority research areas to address the requirements of the housing industry and of the Canadian consumer.

CMHC also provides documentation on standards as they apply to federal housing assistance programs. For example, the Standards for the Rehabilitation of Residential Buildings is a document addressing the requirements of the Residential Rehabilitation Assistance Program (RRAP), and is intended for use when determining the eligibility of work proposed for funding under the RRAP program for homeowners and renters.

Much of CMHC's current technological research is devoted to improving the indoor environment in Canadian homes. In fact, Canada is the first country in the world to have guidelines (Health and Welfare Canada) for acceptable levels of air pollutants and humidity in houses.

CMHC is also mandated to run programs such as the Job-Site Innovator Awards Program, and the Housing Technology Incentives Program. These programs reward and encourage the development of new ideas, products or methods which improve new construction or rehabilitation of existing residential dwellings, and which make house construction easier, faster or more cost-effective.

CMHC also encourages partnership activities to focus on stimulating existing relationships, while at the same time creating new ones, to promote innovative means of erecting housing for low- to moderate- income households. For example, through the Canadian Centre for Public-Private Partnerships in Housing, CMHC is reaffirming its lead role in promoting affordable housing for Canadians.

Energy, Mines and Resources

The energy crisis and the UFFI problem[1] profoundly affected the institutional environment. EMR, as a result of its mandate in the energy conservation field, became a significant player during the 1980s through its R-2000 program. The R-2000 program was the first to focus on performance for energy efficiency requirements. It was also innovative in its system approach to buildings and in the type of relationships that it developed with the industry associations and building trades. In 1991, Canada through EMR entered into a licensing agreement with Japan to make the now internationally-acclaimed R-2000 home available to that country. The agreement has helped to promote Canadian exports in technology, products and materials.

CANMET: As EMR's science and technology arm, CANMET is a major participant in research and development for Canada's minerals, metals and energy industries. CANMET enhances the competitiveness of its client industries through conducting and supporting R&D and encouraging the commercialization of leading-edge technologies. In keeping with the goals set out in Canada's Green Plan, CANMET emphasizes the development of technologies that are consistent with promoting a cleaner environment.

Within CANMET, the Efficiency and Alternative Energy Technology Branch (EAETB) is concerned with accelerating the development and use of energy efficient, alternative and renewable energy technologies. Technical areas include energy efficiency for the commercial and industrial sectors and for buildings, as well as solar energy, wind, small hydro, bioenergy and alternative transportation fuels.

EMR currently funds standards development work in a number of energy related areas. Staff of EMR participate in committees of standards development organizations such as CGSB and CSA. Some also work with international standards organizations. Through active participation in the standard development community, EMR influences industry by convincing standards committees to include more energy efficient technologies in new standards. EAETB's standards work is very cost efficient and fits well within their technology transfer strategy.

CANMET is now launching its new program called C-2000 to encourage the construction of a small number of highly energy-efficient commercial buildings. The program will provide an opportunity for architects, engineers, contractors and developers with a technological bent to play a major role in

[1] See section 2.10.4 for description of the UFFI affair.

the development of high-performance, energy efficient projects that will influence the next generation of commercial buildings.

Both the R-2000 and C-2000 programs are part of the R&D and technology development activities which the Buildings Group of EAETB get involved in. The Buildings Group's objectives are:

- provide information on the performance, energy savings and benefits of key technologies;

- develop the infrastructure needed for adopting new technologies;

- exploit technology opportunities in Canada and abroad;

- support environment and competitiveness goals;

- advance the scientific basis for energy efficiency and passive solar utilization.

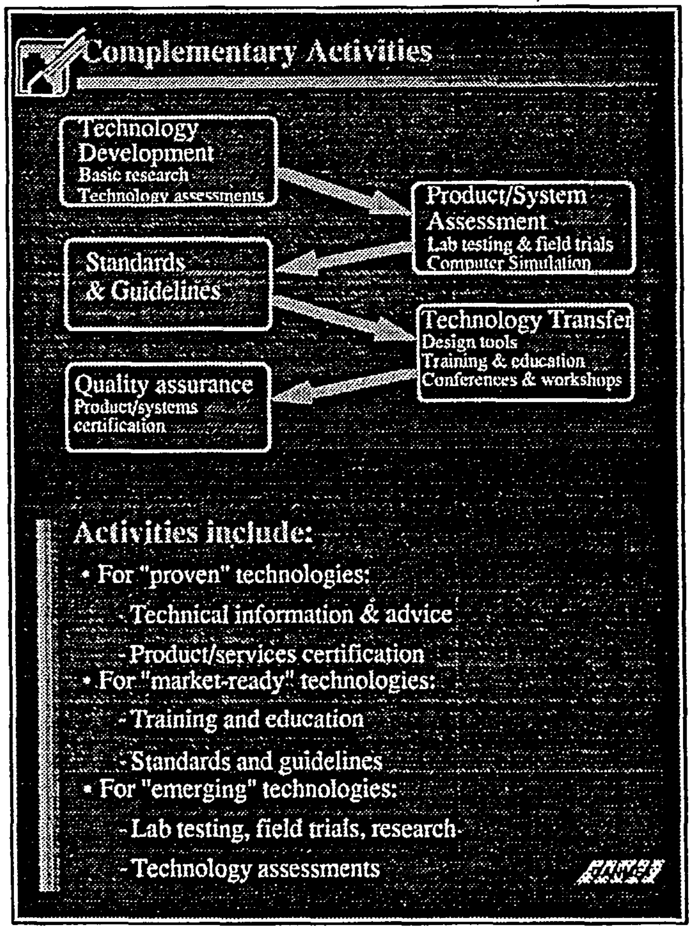
In performing its mandate for research in new technology, the Buildings Group includes in its approach the investigation of requirements for new and revised building standards. This activity is embodied in all stages of the innovation/technology development cycle. The aim is to accelerate the diffusion of proven technologies and to increase support for emerging technologies. This energy efficient technology strategy is an integrated approach involving:

- research and technology development,
- lab testing and field trials,
- standards and guidelines,
- technology transfer, and
- quality assurance.

These complementary activities are depicted in Exhibit 2-2, which summarizes the Buildings Group approach.

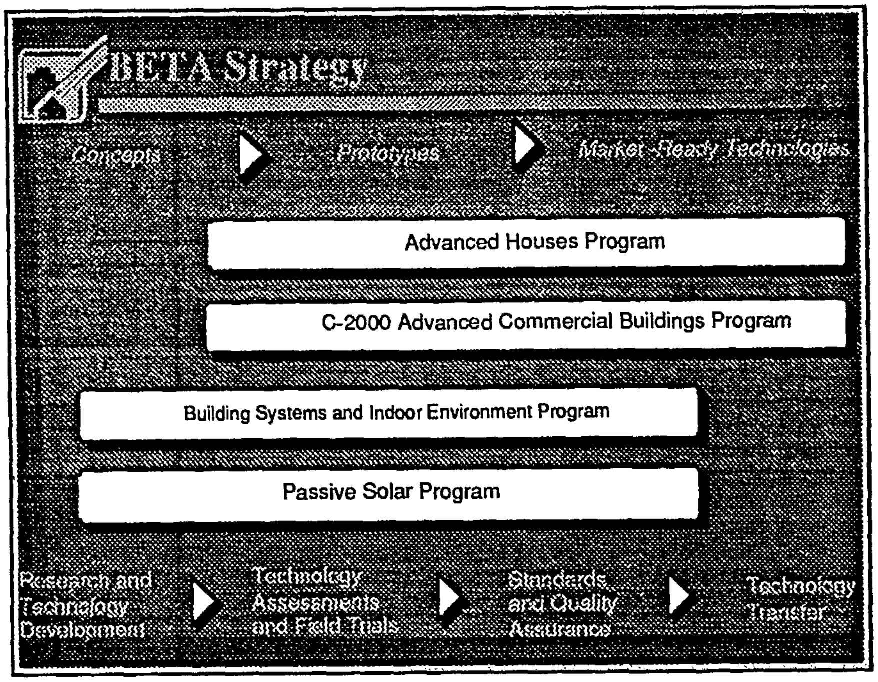
This approach is used to determine the standards requirements of technologies being examined in relation to several of the Buildings Group's programs: including the Advanced Houses Program, C-2000, Building Systems and Indoor Environment Program, and Passive Solar Program (see Exhibit 2-3).

Exhibit 2-2
EMR Buildings Group Approach:
Integrated Program for Technology Development



Source: Buildings Group, CANMET, Energy Mines and Resources

Exhibit 2-3
Application of Buildings Group Approach to EMR Programs



Source: Buildings Group, CANMET, Energy Mines and Resources

The technology advancement strategy of the Buildings Group is thus a coordinated series of activities undertaken at key stages of the technology development and commercialization cycle to meet the challenges of bringing emerging technologies to the point of being market-ready. Each stage features a broad-based cooperation with industry and a variety of stakeholders in both program planning and delivery.

Research and Technology Development: The strategy includes support for basic research and development, chiefly by universities and other research organizations. Over 75 per cent of R&D work is short-to-medium term, while the remaining 25 per cent is long-term and exploratory in nature.

Technology Assessment and Field Trials: Product and system assessment of prototype technologies are conducted in the lab and through field trials and monitoring. These activities provide accurate and credible information on energy savings, reliability, safety, environmental impact, costs and opportunities for improvement. Computer databases, design and simulation tools are also developed to allow analysis of technology opportunities in energy efficiency.

Standards and Quality Assurance: Once a technology has a proven performance record in the field, assistance is provided with the development of standards and regulations needed for adoption in the marketplace. Work is conducted in cooperation with provincial, national and international standards development organizations and regulatory bodies. The approach also assists industry with product quality assurance through the development of certification and labeling procedures, installation standards and durability assessments.

Technology Transfer: Technologies are transferred through the development of computer design tools and training manuals, through workshops and seminars, and the publication of technical reports and factsheets. Information exchanges with private sector associations, universities, provinces, utilities, engineering firms and manufacturers are key activities.[1]

The Buildings Group also provides technical support services and advice to industry and other government departments to accelerate the adoption and application of energy efficiency in buildings. Activities include building performance monitoring, gathering of energy use and environmental impact data for both conventional and innovative buildings, and technical advice in support of other energy and environmental initiatives including a revised energy code for buildings, the R-2000 Homes Program, Canada's new Energy Efficiency Act and utility demand-side management programs.

2.2.2 The National Standards System (NSS)

Standards Council of Canada

In Canada, the National Standards System is a federation of accredited standard development, certification and testing organizations. The Standards Council of Canada (SCC) is responsible for the overall coordination of this federation. Through the System, the Standards Council works to ensure that Canadian needs for standards and related services are met.

The Standards Council of Canada (SCC) is a Crown corporation created by an act of Parliament in 1970. The SCC consists of 57 members, 41 from the private sector, 6 from the federal government and 10 from provincial governments. The objectives of the SCC, as set out in the *Standards Council of Canada Act*, are: to foster and promote voluntary standardization in Canada; to assist and protect consumers; to facilitate domestic and interna-

[1] "Buildings Energy Technology Advancement Plan", Buildings Group Fact Sheet 4/3/93, CANMET, Energy Mines and Resources.

tional trade; and to further international cooperation in the field of standards. During the 1991-1992 period, 192 standards were approved as National Standards of Canada (NSCs), bringing the total number of NSCs to 1,749. Several additional standards have since been approved.

Although the level of funding has been reduced dramatically in the past few years, the Council continues to be funded primarily by government. Other income comes from the sale of standards of the SCC accredited organizations or international standards development bodies.

There are seven main elements of the National Standards System which define its activities. These are: (1) approval of the National Standards of Canada; (2) standards development; (3) certification; (4) product testing; (5) quality system registration; (6) participation in international standardization; and (7) accreditation.

Standards Developmennt Organizations

A **National Standard of Canada (NSC)** is a standard submitted by a Canadian standards development organization for NSC designation by the Standards Council, which must satisfy itself that specified criteria have been met (for example, that the standard is not written to act as a restraint on trade, that there is only one National Standard for Canada for the subject, and that the standard is written in accordance with good standards writing practice).

There are five accredited standards development organizations under the National Standards System. These SDOs are: Canadian General Standards Board (CGSB), Canadian Standards Association (CSA), Underwriters' Laboratories of Canada (ULC), Bureau de normalisation du Québec, and the Canadian Gas Association (CGA). These organizations coordinate the work of standards committees whose members represent a balanced cross-section of interests -- including producers and users. Standards prepared by these committees can be submitted for SCC approval as National Standards.

Information Dissemination

In this era of competitiveness and globalization, an increasingly important role of the SCC is the dissemination of information on national, international and foreign standards, standards-related documents and activities. In this respect, the SCC performs the following activities and services:

- Responds to enquiries on standards, standards-related documents, and standardization activities from publics in Canada and other countries.

- Complies with the mandatory obligations of the GATT Agreement on Technical Barriers to Trade (Standards Code) and the Canada-United States Free Trade Agreement.

- Supports the activities of the Information Division and GATT TBT Enquiry Points by maintaining a comprehensive collection of national, regional and international standards, technical regulations, and certification information.

- Maintains an online interactive information system of standards, specifications, standards referenced in federal legislation and GATT TBT/Notifications to support the activities of the Information Division.

- Acts as the Canadian member of ISO's International Standards Information Network (ISONET).

- Acts as Canadian Information Centre on European and other regional standardization developments.

International Participation

Another main role of SCC is to ensure effective Canadian participation in the work of international organizations engaged in the formulation of voluntary standards. The Standards Council over the years has cultivated an important contribution by Canada in both the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). These two organizations are primarily responsible for voluntary standardization internationally. In all, Canada is involved in approximately 80 per cent of ISO and IEC committees.

In 1972 the Standards Council of Canada became the official Canadian member of ISO and IEC. As such, the SCC is responsible for the organization of relevant Canadian technical committees dealing with ISO and IEC subjects.

Subject Areas

To prevent overlap and duplication of effort, the Standards Council of Canada coordinates the process of rationalization of subject areas and identifies which areas will be covered by which SDO. Where overlaps have occurred in the past, rationalization has helped to amalgamate the standards under one package.[1]

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[1] See Section 2.10.3 for a good example of rationalization.

Exhibit 2-4 provides a summary of the main building-related subject areas that are the domain of each of the five Canadian accredited SDOs. As can be seen from the table, there are still some "grey" areas of overlapping domains. Nonetheless, the general specialization of subject-area responsibilities are clear.

Exhibit 2-4
Building-Related Subject Areas of the Standards Development Organizations

Accredited Standards Writing Organization	Main Building-Related Subject Areas	Directory/Catalogue
Bureau de normalisation du Québec (BNQ)	Paints, road materials, geotechnical test methods, plastic pipes, and ceiling tiles	Catalogue des normes québécoises, 1990
Canadian Gas Association (CGA)	Gas-fired equipment and appliances, installation codes for natural gas and propane	Standards Directory for Gas Fired Appliances and Equipment, 1992
Canadian General Standards Board (CGSB)	Paints, refractories, glass, caulking/sealants, plastic, thermal insulation, roofing, flooring, and hardware	1992 CGSB Catalogue
Canadian Standards Association (CSA)	Electrical/electronic; concrete, wood products, and building materials; energy conservation; structural design; plumbing; materials technology; installation codes for electrical wiring, elevators, heating units, mechanical refrigeration and boilers and pressure vessels	CSA 1992 Catalogue Construction Plus: A Guide to CSA Construction Standards, 1990
Underwriters' Laboratories of Canada (ULC)	Fire-related properties, fire alarm systems, fire extinguishers, space heaters, fireplaces, and chimneys	Standards of Underwriters' Laboratories of Canada, 1992

Source: As reported in *Canada's Framework for the Regulation and Design of Buildings*, op.cit.

2.2.4 Other Organizations

In addition to the five accredited SDOs, other organizations prepare standards-type documents. Of particular importance to building construction is the National Lumber Grades Authority, which publishes the Standard Grading Rules for Canadian Lumber.

Many documents prepared by U.S.-based standards development organizations are also used in Canada. Prominent among these are the standards prepared by the American Society for Testing and Materials (ASTM), National Fire Protection Association (NFPA), and the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE). ASTM, NFPA and ASHRAE standards are "called up", or referenced, only when there are no appropriate or applicable Canadian standards.

2.3 National Model Code Documents

The NRC, under the direction of the Canadian Commission for Building and Fire Codes (CCBFC), is responsible for publishing and updating a number of national code documents which are used in the building construction industry. These codes, summarized in Exhibit 2-5, are considered only "model" documents and therefore must be adopted by an authority having jurisdiction in order to come into effect. The national model codes have generally either been adopted unchanged as the regulations of provinces, territories and municipalities, or in some cases, have been altered somewhat to suit local needs.

Exhibit 2-5
Summary of Building Construction Codes Published by NRC

The National Building Code of Canada (NBC)
This provides minimum requirements for health, life safety and structural sufficiency in new buildings.

The National Fire Code of Canada (NFC)
This provides minimum fire safety requirements for buildings, structures and areas where hazardous materials are used, and ensures an acceptable level of fire protection and fire prevention in the on-going operation of buildings.

The Canadian Plumbing Code
This covers the design and installation of plumbing systems in buildings.

The Canadian Farm Building Code
This deals with the particular needs of farm buildings.

The Canadian Housing Code
This is a compendium of those requirements in the NBC which apply to housing with no horizontal fire separation or shared egress; that is, detached, semi-detached and row houses.

Supplements and Commentary
To assist in the application of certain Code requirements, explanatory material is published in the form of supplements and commentaries.

Source: Adapted from How the National Codes Work, National Research Council, Canadian Commission on Building and Fire Codes, Ottawa, June 1992.

These national model code documents are developed and maintained using a broad-based consensus process. Individuals in all segments of the construction industry have the opportunity to influence changes in the Codes, either directly, through committee memberships, or indirectly, by suggesting changes or commenting on proposed changes.

The model codes do not attempt to cover all aspects of building construction. They make extensive use of standards, usually by calling them up (i.e., referencing them) in the body of the code, thus making the standards officially part of the main document. This practice makes effective use of the specialized expertise represented on the standards writing committees.

2.4 The National Building Code

The National Building Code is the primary text most often referred to within the regulatory and standards system of building construction. The NBC is a very comprehensive document covering many areas of building construction. These include details about the use to which a building is put and its type of occupancy, structural design, heating, ventilation, air conditioning, plumbing services, protection against natural elements such as wind and water, and safety measures at construction and demolition sites. The NBC covers both residential and non-residential buildings. The residential segment is primarily included in Part 9 of the Code, but a separate document called the The Canadian Housing Code is published by NRC as a compendium of those requirements in the NBC which apply to housing -- detached, semi-detached and row houses.

The NBC is essentially a code of minimum regulations for public health, fire safety and structural sufficiency with respect to the public interest. It is prepared by the Canadian Commission on Building and Fire Codes (CCBFC) and is updated every five years following the public consultation procedure described above.

Under the terms of the Constitution Act of Canada, regulation of building is the responsibility of provincial and territorial governments. The Code in itself has no legal status unless adopted by one of the authorities having the power to regulate buildings. Prior to the 1970s, provinces generally delegated the responsibility of regulating buildings to municipalities. Subsequently, however, provincial codes began to replace municipal building bylaws. Most provinces now have acts to regulate building construction, and the regulations under these acts are based in whole or in part on the NBC. Liaison between NRC and provincial and territorial code authorities is maintained through the Provincial/Territorial Committee on Building Standards, established by these authorities to provide policy guidance to the CCBFC. Nine of the provinces and territories have signed a Memorandum of Understanding that the Provincial/Territorial Committee on Building Standards has been struck to provide policy and scope guidance to the Commission.

The Code is developed through the voluntary assistance of many experts across the country. These experts sit on technical and advisory committees, each responsible for specific portions of the Code or its associated documents. Representation on the committees is broadly based, from all major phases of construction in Canada.

The latest edition of the Code was in 1990. Technical problems revealed through the use of the Code are referred to the Institute for Research in Construction for study, to make available to the CCBFC the most up-to-date information on building technology. The process of consultation, review, and updating is now under way for the 1995 edition of the Code.

2.5 Uniform Use of National Building Code

Building codes in Canada are now generally uniform in their application in provinces, territories, and most municipalities. However, there are some variations in the use of the NBC. Exhibit 2-6 displays the variety of approaches adopted across Canada.

Exhibit 2-6
Approaches to the Use of the National Building Code

British Columbia adopts the NBC with a substantial number of changes and publishes it as the B.C. Building Code.

Alberta and Manitoba adopt the NBC by reference, making a few changes and quite a few additions. They publish their own provincial codes as the Alberta Building Code and the Manitoba Building Code.

Saskatchewan, Quebec, Nova Scotia, the Yukon and Northwest Territories all adopt the NBC by reference, most with little or no change, and do not publish a separate code document.

Ontario does not formally adopt the NBC by reference in its Act or Regulations, as do the others, but the Ontario Building Code is copied from the NBC, with a number of provincial changes and additions. A new Part 11 on renovation has been added.

New Brunswick and Newfoundland do not have provincial legislation adopting a province-wide building code. However, New Brunswick requires that any municipal building bylaw must adopt the NBC without change. Both provinces automatically update such municipal bylaws when a new edition of the NBC is published.

Prince Edward Island is the only province with neither a provincial code nor a program to achieve uniformity of municipal action. However, the larger PEI cities voluntarily adopt the NBC, thus effectively achieving uniformity.

Source: Adapted from Robert A. Hewett and Gordon L. Walt, Canada's Framework for the Regulation and Design of Buildings, National Research Council, Institute for Research in Construction, Ottawa, June 1992.

Because of the evolutionary process through which the building code system has developed, it is not identical everywhere. It will differ slightly from region to region, and city to city, because of differences in provincial laws and in the customs of construction. One province may also adopt a new edition of the National Building Code several years sooner than another province, giving rise to a temporary difference in requirements.

2.6 Other Building Standards and Regulations[1]

Federal Acts

While the provinces have most of the responsibility for the regulation of buildings, the federal government becomes involved in a secondary role when an act (such as the National Housing Act) requires that buildings be built to certain standards in order to qualify for the provisions of the Act. Another federal act, the Hazardous Products Act, regulates a number of building products to limit their risk in relation to fire, health or personal injury. These products include cellulose insulation, urea formaldehyde, carpeting, furnishings, smoke alarms and glass used in doors. Regulations under this act take precedence over provincial acts, although provincial requirements can still apply if they are not in conflict.

Zoning Laws

Municipalities are permitted by provincial acts to enact municipal zoning bylaws. Generally administered by planning departments, the bylaws control the appearance, use and character of neighbourhoods within a municipality. They regulate such things as building size, land use (including type of occupancy), front and side yard clearances, population density and sometimes even landscaping and the exterior appearance of buildings.

Other Codes and Standards

While the bulk of requirements that regulate building construction are contained in building and fire codes, buildings may also be subject to other acts targeted for specific building types or occupancies. Other acts may regulate particular services or equipment in buildings that are not directly regulated by provincial building codes.

Provincial liquor licensing acts, for example, may contain certain building requirements that have to be met before a licence is granted. Other acts may be aimed at providing a minimum level of fire safety in certain classes of buildings (such as hospitals, theaters, schools, or apartments), when it is considered that they are not adequately covered under existing provincial-fire prevention acts.

Plumbing may also be regulated by a separate act. The Canadian Plumbing

[1] The material in this section is derived from *Innovation and Building Codes: A Study into Performance Codes*, prepared for Canada Mortgage and Housing Corporation by A.T. Hansen Consulting Services, Ottawa, March 1991.

Code contains model plumbing requirements which are used by a number of provinces and municipalities as the basis for their plumbing regulation or bylaws.

Electrical installations are often administered by a separate department. In some provinces the provincial electrical utilities administer the requirements on behalf of the government.

The Canadian Electrical Code, Part 1, is used by all provinces as the basis for their provincial electrical regulations. Like other model codes, it has no legal status unless adopted by an authority having the power to regulate electrical installations. First published in 1927, the CEC is now in its 14th edition.

Separate provincial acts may control the installation and maintenance of other building services and equipment such as gas installations, elevators, escalators, moving walkways and pressure vessels. The regulations under most of these acts rely on codes and standards published by standards development agencies.

The National Master Specification

In addition to standards, codes and regulations, "specifications" play a major role in determining building construction requirements. Specifications are the detailed requirements for a specific building or project. These specifications could be based on a model or standard specification, such as the National Master Specification of Public Works Canada.

The National Master Specification (NMS) is a resource tool to simplify specification writing, and to minimize duplication, errors and omissions. Jointly produced by the private sector and the federal government, the NMS is the most comprehesnive master specification in Canada. Each of its 600 sections serves as an easy-to-use framework for writing project specifications. The NMS can be adapted for any type and size of construction project, for the government or the private sector. It is reviewed by industry on an ongoing basis, ensuring that it continues to represent current trade practices and meet the needs of the private sector.

NMS is a reliable tool because it:

- conforms to current specification and industry practices;

- references standards such as those of the Canadian Standards Association and Canadian General Standards Board; and

- embraces the expertise of many of Canada's foremost authorities on specifications, contract documents, and construction technology.[1]

2.7 Evaluation, Certification and Product Testing

Evaluation, certification and product testing are different ways of providing assurance that a product conforms to a standard. The evaluation, for conformance to the building codes, of building products, materials, or systems is a difficult and time consuming activity. A number of organizations, such as CSA, CGA and ULC, provide full third-party certification for safety-related products and systems. The NBC does not require such certification, only that the product or system meet certain minimum requirements. Code enforcement officials, however, often rely on certification as a guarantee that such is the case.

The Standards Council operates programs for certification and product testing organizations under the NSS. The certification organizations (COs) have registered trademarks certifying that products or services meet a standard. Testing organizations (TOs) test products or services to determine whether they meet the standard for that product or service and report the results of their tests.

Although they are two distinct processes, certification and testing go hand in hand. The first is a process for determining performance and properties of goods, services or procedures, the second for attesting and periodically verifying that they conform to specific standards, based on test results.

Canada's seven certification organizations include four of the standards development organizations (CGSB, CSA, ULC, and CGA), the British Columbia Council of Forest Industries, Warnock Hersey Professional Services, and Canadian Welding Bureau (CWB).

The April 1992 SCC Directory of Accredited Calibration and Testing Laboratories listed 89 registered testing organizations now operating under the National Standards System, including private research laboratories, government and industry facilities, and five of the six certification organizations (CGSB excluded).

Testing organizations are accredited under the National Standards System by the Standards Council of Canada, based on their ability to perform tests in accordance with recognized standards and procedures and to adequately document their findings.

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[1] Brochure on *The National Master Specification*, Public Works Canada, October 1992.

To provide the construction industry with a national evaluation service for innovative materials, products and systems, NRC created the CCMC.[1] The services of CCMC include the evaluation of new and innovative products for which no standards exist, and of products where standards exist but for which no third-party certification program has been established. Most provinces and territories use the Centre's evaluation reports as a basis for their acceptance of new products.[2]

2.8 Administering the Codes

Provinces give municipalities the authority to administer and enforce building codes. Without this authority municipalities have no legal control over how buildings are constructed.

The effectiveness by which the codes are administered is very much dependent on the competence of the municipal building officials. There is a wide range of technical competence levels in code administration between different municipalities. Larger cities are likely to have specialized administrators. In smaller cities, however, the volume of building construction may not allow this. Unless the building official is exceptionally well trained, he/she will likely have to rely on the seal of professional designers as proof of code compliance.

To ensure that competence in administering the Codes is achieved in all parts of the country, educational programs for code administration are organized by provincial, and to some extent, federal agencies. These ongoing programs are aimed at improving the building official's understanding and applications of code requirements.

2.9 Impacts on Innovation and Technology Diffusion

Some public laboratories and research institutions (e.g., CANMET, IRC), involved in building technology development, are active on standards-writing committees. The development and dissemination of standards can be an important means of promoting the use of results of research carried out in these institutions. In the same fashion, private sector members attempt to promote their commercial interests. As a result, private sector and public interests can be fostered concurrently by the interface of the standardization process with the various phases of technology development.

[1] See description of CCMC in Section 2.2.1.

[2] *How the National Codes Work*, op.cit.

The standards development process, when linked closely to research and development activities, at an early stage, can have an accelerating effect on technology diffusion. The best way to influence policy formation about standards is to introduce standards related activities within the R&D environment, as a routine element of the technology development process.[1] Thus research organizations can promote and disseminate the results of their work by being involved in, and influencing, standards policy within the National Standards System.

2.10 Some Practical Examples of the Interface of Standards With Technology Diffusion

2.10.1 Energy Efficiency

The Efficiency and Alternative Energy Branch (EAETB) of EMR views its activity in standards as a key element in the development of a solid technical and industrial infrastructure that is required to transfer technology to the market.[2] In addition to supporting energy-related objectives, these activities also address health and safety issues. The new Federal Energy Efficiency and Alternative Energy Act will support EAETB involvement in standards. In the Energy Efficiency Division of EAETB standards are also a key component of overall technology transfer strategy. For instance, new products and techniques will not be adopted by industry until their use is covered in a standard.

The practical use of standards is ensured by seeking broad consensus approval within the Canadian standards development process. EAETB also promotes the harmonization of standards between Canada and the United States to ensure that the U.S. market is open to Canadian manufacturers. Finally, standards as also seen by EAETB assist in the exchange of technical information as well as advance product performance.

The Energy Research Laboratories (ERL) of CANMET also treat standards as an integral component of the technology development process.[3] Care is taken to ensure that regulations are encouraged that promote commerciali-zation and minimize environmental risk. Consequently, it seems clear that CANMET's best opportunity to influence standards policy is to work

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[1] A good example of the linkage of standards with R&D activities in building construction related areas is provided by CANMET. See *Normative Standards in Canada: Implications for CANMET*, Canada Centre for Mineral and Energy Technology, Energy Mines and Resources, April 1992.

[2] Ibid.

[3] Ibid.

collaboratively with government agencies and SDOs that set standards policy. Indeed ERL is and has been represented on both the technical and management executive levels of SDOs as well as on the SCC, ASTM and ISO.

ERL is/has been represented in the following standards organizations:

- International Organization for Standardization
- American Society of Mechanical Engineers
- Wood Heating Alliance
- ASTM
- CGSB
- Canadian Gas Association
- Canadian Standards Association.

2.10.2 Air Quality

The developments over the past decade that have advanced the energy efficient house, have also led to the tightly constructed house. The evaluation of new and old products used in tightly constructed houses has now become very important to prevent potential health hazards arising from volatile components. Where ventilation is restricted to conserve energy, and because of the increasing variety of chemicals currently in use, additional controls may have to be imposed on the tight house through building regulations. In this instance, the role of standardization in technology diffusion becomes one of protection of the consumer against the proliferation of potentially hazardous use of technologies. A balance needs to be struck between accelerating diffusion of new technologies with safety and health considerations.[1]

2.10.3 Windows[2]

An excellent example of the response of the Canadian National Standards System to the evolution of technology and industry needs occurred during the preparation of a new general standard as a replacement for several existing standards on windows.

In the early 1980s some 15 Canadian standards dealt with windows -- wood, vinyl, aluminum, and steel. CMHC recommended that a single, performance oriented standard be prepared to replace the existing prescriptive standards.

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[1] See also the UFFI example in Section 2.10.4.

[2] This example is an excerpt from *Canada's Framework for the Regulation and Design of Buildings*, op.cit.

This recommendation was supported by the window industry.

Consultants developed a working draft and CSA organized a Technical Committee to prepare a standard to cover factory-built windows -- wood, metal, and vinyl.

The Technical Committee, comprising members representing producers (including the Canadian Window and Door Manufacturer Association -- CWDMA), users, and general interests, first met in October 1981. They opted for a document combining performance requirements (covering air tightness, water tightness, and wind load resistance) with design or prescriptive requirements (such as for dimensions) to ensure durability.

After some 9 meetings, and a conformity testing/verification program involving commercial testing laboratories, the first edition of CAN/CSA-A440--Windows, was published in 1984 as a National Standard of Canada. It included a classification system providing several levels of performance to enable the purchaser to select a level appropriate to such factors as climatic conditions, height of installation, and type of building.

A second edition of this standard was published in 1990. The new edition included a User Guide which was intended to help make the standard more user friendly, and to explain how to select the level of performance appropriate to the installation.

During the evolution of CSA-A440, the technologies to improve the thermal performance of windows became more readily available and there were no methods for ensuring the performance of these products were as claimed by the manufacturers. This caused the NRC to develop a new laboratory procedure which was the basis for ASTM to develop a new standard for the thermal performance of windows. At the same time, in recognition of the costs of these types of measurements, a joint program under the agreement between the Department of Energy in the U.S. and Energy, Mines and Resources Canada was set up to enable researchers in Canada and the U.S. to jointly develop a methodology which would be recognized in both countries for determining the thermal performance of windows. This has led to a number of models that support the laboratory test measurements which can be used by those specifically trained in their application to reduce the overall costs of testing product lines of a manufacturer.

2.10.4 Urea Formaldehyde Foam Insulation (UFFI)

During the 1970s, urea formaldehyde, an expandable insulation that could easily be injected into walls -- was widely perceived as an inexpensive, quick way to insulate Canadian homes. CMHC introduced UFFI among the products that qualified for the Canadian Home Insulation Program (CHIP), provided that it was applied by a CMHC-approved installer. At the request of CMHC, the Canadian General Standards Board (CGSB) had already begun working on a standard for UFFI in 1973. When the oil crisis hit, CMHC pressed CGSB to complete the UFFI standard. A preliminary UFFI standard was published by CGSB in May 1977, and the final standard was issued six months later.[1]

In December 1980, the federal government halted the grant program when scientists raised concerns that the emission of formaldehyde gas from UFFI posed potential health hazards. Many lawsuits were brought forth against contractors and against CMHC. In one particular court case, *Berthiaume v. Val Royal Lasalle Ltée*, the decision of Justice René Hurtubise of the Superior Court of Quebec showed how the standards-development procedure of the National Standards System helped CMHC weather the liability claims of six Quebec households.

Justice Hurtubise dismissed allegations that UFFI caused the plaintiffs' ailments. He also remarked favourably on the standards development process of the NSS. He noted the balanced procedures required for standards development and the consensus-of-experts approach of the system. As part of his decision, he wrote:

> *The ideal and the real seldom co-exist. Standards are not perfect, but they strive for an appropriate level of quality .... They constitute guides, tools designed to be functional while remaining perfectible as the demands of technology and knowledge evolve. Without binding the interested parties as would a legal text, standards are nonetheless vital because they constitute a rule book for a particular area and this is how they are considered in these proceedings."*

Lloyd Duhaim writes that Hurtubise's judgement "... shows that the consensus standards development process can withstand the tough demands of litigation, perhaps as well or better than the more traditional regulatory process."[2]

This represents a resounding endorsement for the NSS. However, it also underlines the importance of the development of evaluation and testing technologies for building construction. Mechanisms and procedures which measure not only physical building-related attributes, but also other aspects

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[1] See Lloyd Duhaime, "Standards can help protect industry against liability claims", *CONSENSUS*, Standards Council of Canada, Volume 19, No.4., Autumn 1992.

[2] Ibid.

related to health and environmental impacts, need to be developed concurrently with the introduction of innovative building products and processes.

The process of evaluation and testing has perhaps a much greater impact on facilitating or restricting innovations than the form in which a building code or regulation is documented. In addition, the way in which a code is administered (inspections and enforcement) could be conducive or detrimental to the technology diffusion process. These issues will be discussed further in Section 3.0.

2.11 Building Regulations in Other Countries

As in Canada, the building construction sector in each of the world's industrialized countries is one of the largest industries. It can be a major employer and, in most cases, is one of the main contributors to the country's GNP.

Clients in all these countries are demanding increasing performance from the industry. For example, there are increasing demands for healthy buildings and energy conservation. At the same time, there is growing awareness of the limits in natural resources and the need to preserve an ecological equilibrium. Consequently, the world in general is probably entering into a dynamic period of R&D and technological development in building construction products and processes.

The body of existing knowledge on building products and materials has grown geometrically. Many innovative ideas are being researched -- others have already been evaluated and are ready for testing and implementation. New management practices, such as those promoted by ISO 9000 series of standards for quality assurance and management, could also have significant impacts on product quality and production techniques.

Within this broad context, it is important to understand how standards and the regulatory environment impacts on technology development and diffusion within our industrial partners. The scope of this study does not allow an extensive review of experiences in building construction in other countries. The following is only a sample of information regarding three key players in the world industrial arena. The information contained in this section (on the U.S., Japan, and the U.K. standards systems) is comprised of excerpts from material contained in *Innovation and Building Codes* prepared for CMHC by A.T. Hansen Consulting Services.[1]

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[1] *Innovation and Building Codes: A Study into Performance Codes*, prepared for CMHC by A.T. Hansen Consulting Services in association with Scanada Consulting Ltd., Ottawa, March, 1991.

2.11.1 The United States

Under the U.S. constitution, building regulations are the responsibility of state governments. However the states do not exercise their power uniformly. In certain states, for example, only certain specific areas of life safety, accessibility, health or energy conservation are addressed. In many states, local authorities can amend the state code or may be free to adopt their own code. Some states adopt model codes or standards in an unamended state but allow local authorities to tailor the document for local conditions.

The development and adoption of building regulations by state authorities may be done by more than one agency, and in fact may involve a number of codes, all of which contribute to the variety of building regulations. In some cases, all building regulations are under the jurisdiction of one state agency and include building, mechanical, plumbing, fire prevention, life safety, accessibility and energy conservation. Other states have separate codes for each of these areas.

In comparison to Canada, the U.S. seems to have a long way to go to reach the level of uniformity attained in building regulations in this country. The strong tradition of local independence in the U.S., and its resistance to centralized authority would seem to indicate that the road to uniform regulations will be long.

The most significant influence in developing a harmonization in U.S. building regulations is that provided by the three major code writing agencies. The International Conference of Building Officials (ICBO) publishes the Uniform Building Code. First issued in 1927, the UBC is mainly adopted in the Western states, and tends to emphasize the design of earthquake resistant structures. The Southern Building Code Congress International (SBCCI) publishes the Standard Building Code. This is used principally in the Southern states, where it was introduced in 1940. Finally, the Building Officials and Code Administrators (BOCA) issue what is now known as the National Building Code. Formerly known as the Basic Building Code, it originated in 1950. It is used primarily in the Northeast and Midwest states. All three codes are intended to provide minimum acceptable standards for health, safety and public welfare.

In addition to building codes each agency also publishes a variety of other codes such as plumbing, mechanical and fire prevention codes as well as other code related documents. All three model codes are updated on a three year cycle as compared to the five year cycle for the NBC of Canada.

Each of the model code writing agencies provides an evaluation service for new products and systems as well as a variety of other services to assist adopting authorities to administer their respective codes. The three model code agencies also operate a "National Evaluation Service" under the umbrella of the Council of American Building Officials, through a secretariat that revolves from one agency to another at fixed intervals. A proponent using this service can have a product evaluated by each agency and be issued a "National Evaluation Report". This is somewhat less expensive than obtaining a separate report from each agency.

The content of the U.S. model codes is not unlike that of the NBC of Canada in that they are a mixture of both prescriptive and performance requirements. Although they differ from one another in specific requirements as well as in format and arrangement, they nevertheless cover the same general areas familiar to users of the NBC of Canada. Like the NBC of Canada, the U.S. model codes reference numerous standards prepared by other agencies.

2.11.2 Japan

The Japanese Building Standards Law is very detailed and comprehensive. It not only covers typical building code requirements for health, safety and structural sufficiency as found in American and Canadian Codes, but contains comprehensive zoning and administration requirements as well. It also regulates certain buildings after they are constructed, requiring periodic inspection throughout their entire life cycle to ensure continuing compliance with the law.

The Building Standards Law of Japan, initially enacted in 1950 by the Japanese Diet appears to have been influenced by the Uniform Building Code published by the International Conference of Building Officials (ICBO). The Uniform Building Code has traditionally emphasized seismic design requirements, a subject of particular concern to Japan.

The building code type requirements cover essentially the types of requirements covered in most American codes. Like other typical American codes, the Japanese requirements are a mixture of performance and prescriptive requirements with the latter forming the major portion. As a general observation, the Japanese requirements appear to be even more prescriptive in nature than their American counterparts.

The administration of the Building Standards Law rests with the powerful Ministry of Construction, with the final authority on most matters being the Minister. Day to day administration, however, is delegated to the 265 or so local prefectural administrative agencies.

2.11.3 United Kingdom (England and Wales)

A new Building Act was introduced in England and Wales in 1984, amalgamating requirements from 46 other Acts or Instruments, but mainly from the "Public Health Act", the "Health and Safety at Work Act", and the "Housing and Building Control Act".

The new Act (and enabling legislations) introduced a number of new concepts in regulating buildings and provided an opportunity to revamp completely the existing building regulations. Only 20 regulations were introduced in support of the Act. These were made effective throughout England and Wales on January 1, 1986.

Regulation No. 7 simply states that "Any building work shall be carried out with proper materials and in a workmanlike manner." The other regulations, apart from Regulation No. 4, are administrative in nature.

Regulation No. 4 requires buildings to comply with two "schedules". Schedule 1 of the Regulations contains the substantive requirements that regulate building construction for health and safety purposes. Schedule 1, along with Regulation No. 7, forms what in effect is an equivalent to a performance building code.

Under the Building Act, the Secretary of State is empowered to issue "approved documents" to expand on the non-specific terminology in the Regulations. Over a dozen such "approved documents" have been issued to date. These documents are not mandatory requirements. Such documents can be prepared by other agencies if designated by the Secretary of State (including such agencies as the British Standards Institute).[1]

The "approved documents" are issued for each part of Schedule 1 (as well as for Regulation No. 7), and cover subject areas that deal with "materials and workmanship", "structure", "fire spread", "site preparation and resistance to moisture", "conservation of fuel and power", etc.

Schedule 2 of the Regulations, the only other schedule that deals with substantive design and construction requirements, specifies facilities to be provided for disabled persons.

Although the "regulations" of the Act have been reduced to a very meagre size, the associated "approved documents" in effect increase the amount of technical paper a designer has to contend with well beyond that under the previous regulations.

1 See *Overview Report* for details about the British Standards Institute and British standards system in general.

3.0 DISCUSSION OF ISSUES

The application of new technology in the industry has long-term impacts on building construction. Any major new development has lasting effects because of the nature of the residential or non-residential building product. The erection of a home or an office building is a long-term investment. It is no wonder then that the basic instinct of builders and owners has generally been to opt for the conservative choice of using existing, tried-and-tested technology.

The pressures for more rapid change, however, have increased considerably over the past decade. Owners and building practitioners in Canada, including designers, contractors and inspectors, face many challenges today. Among the key factors that are impacting on the building industry, and/or driving technology development in this sector, are:

- the specialized nature of the sectors within the industry and the increasingly competitive environment;
- the diversity of building regulations and enforcement processes;
- the growing base of innovative technology in products and materials;
- increasing use of computer systems;
- growing concern for the environment and for energy conservation;
- higher expectations by the consumer and by building owners (e.g., for improved energy efficiency, quality and appropriateness of the building);
- globalization of markets and increasing interaction of the international industrial base;
- increased emphasis on improved quality assurance and management practices;
- the need to develop new approaches to produce affordable housing for lower and medium income households.

The growing base of technological knowledge worldwide, and the interplay of the above factors, could, over the 1990s, increase the pressures on the construction sector to explore new, more efficient, ways of producing building products (e.g., for energy efficient building systems). Leading-edge technologies are accessible globally, but a long-lasting advantage depends on the capability to select, add value to and accelerate the diffusion of these technologies.

3.1 - The Pace of Standardization and its Impact on Diffusion

Building regulations can have both a positive or a negative effect on technology diffusion. The inclusion of new standards in a building code will require adherence to the new technology embodied in them by designers and builders. For example, many designers may already be following new standards on energy efficiency brought in by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE). If governments adopt the new Canadian Energy Code 1995 (which builds on the ASHRAE standard, incorporates complementing technologies and expands on matters that are important to the Canadian application), then designers and builders in these jurisdictions will have to follow its provisions. In short, the Code will be a most effective vehicle for diffusing the new technology embodied in the new standards.

On the other hand, if the standards development bodies are slow to incorporate technological advances in their standards; if governments are slow to adopt new editions of the model codes; and if the building regulations are fully prescriptive in terms of conformity; then cost-saving innovations and the use of new technology can be inhibited by them.

The responsiveness of the National Standards System to standardization requirements in the building industry appears in general to have been timely and appropriate.[1] However, will this continue to be so if cutbacks are implemented, particularly in light of the apparent increase in the rate of technological change?

It ordinarily takes five or more years to amend the National Building Code, and then the provinces may take several more years to adopt the amendments. The cut-off for proposed amendments in the 1995 Code was in 1992, to permit an opportunity for experts and stakeholders to discuss them, and then to provide sufficient time for translation and publication. However, there is a special provision in the NBC for supplements and revisions urgently required -- i.e., "the equivalency clause".

The concept of the NBC is one of being under continual change. An important element of the Code is the equivalency clause which allows officials to in fact accommodate new products and systems part way through a code cycle, to ensure that the process does not hinder the development of new technologies and designs. In addition, the process allows for interim

[1] Based on the interviews carried out for this study.

changes to the Building Code for various reasons particularly for those concerning health and safety but also where there is undue hardship to a particular industry sector which is being corrected by a code change.

The pace by which new technology is standardized, and the manner in which these standards become incorporated into the building and other regulatory codes, is an important issue for the diffusion of new products and processes in the building industry.

Issue: Can the Canadian National Standards System, and the regulatory infrastructure, continue to be responsive to the pace of technological development in the building construction industry, in spite of funding cut-backs?

3.2 Globalization and International Competition

Multilateral trade arrangements under GATT, the liberalization of international trade, and regional agreements like that of the European Community and the FTA, which could be replaced by NAFTA, reflect the current developments towards globalization.

The pace of internationalization of business is expected to increase, and with this, changes will noticeably affect those who both prepare and administer building codes and standards. Signatories of the GATT Standards Code have agreed to adopt international standards, where they exist. This means that to respond to freer trade, individual nations are having to examine their standards infrastructure and how it impacts on the international competitiveness of their domestic industries.

While the building industry in Canada has a strong domestic orientation, and while many innovations have been developed in Canada, still most of the building technology used is adopted or adapted from foreign sources. With increased globalization and international competition, amongst manufacturers in particular, Canada needs to be active in the international arena -- to monitor technological developments as they occur, particularly within our major industrial partners.

Issues: Should Canada introduce an explicit policy-based strategy which is aimed at facilitating the diffusion of new building technologies from abroad? What role is there for standards and regulations in such a strategy?

3.3 Impacts of Free Trade and Harmonization

The harmonization of standards under the FTA and NAFTA is now receiving considerable attention by the building industry. Many players, particularly those in the building products manufacturing industry, are concerned with the potential negative implications of competition with American firms. In the area of manufactured housing, for example, two years ago the Department of External Affairs and International Trade and the Canadian Manufactured Housing Institute (CMHI) compared the Canadian and U.S. standards on manufactured housing. It was concluded that the Canadian standards were superior and that those in the U.S.A. should be strengthened in any harmonization program, rather than vice versa.

The FTA has brought with it the possibility of increased U.S. imports and a threat of dumping. Standards accordingly will play an increasingly important role. British Columbia, for example, has stated that all manufactured housing erected or moved in the province must bear the CSA label.

Another example involves the cement industry. In general, cement standards in Canada and the U.S.A. are very similar. Design standards and concrete product standards, however, differ. Canadian climatic conditions tend to make Canadian standards more stringent than those established in the U.S.A.

The FTA has reduced or eliminated tariffs on a number of construction products, leading to an apparent increase in the use of imported products in both countries. The task of checking that these incoming products from the U.S. conform to Canadian laws and regulations, and to provincial, territorial and municipal building codes and standards, rests with builders and building officials at the local level. Building inspectors ultimately have the job of ensuring that the codes are complied with. A related problem that is increasing in complexity is that of enforcement of Canadian codes and standards. This is not strictly an FTA issue but has been highlighted since the signing of the FTA.

By all accounts, the pace of harmonization in North America is accelerating. NRC reports on several examples from the construction industry. Major efforts have been under way to develop a North American performance standard for sheathing plywood and to eliminate areas of difference between the Canadian Electrical Code and NFPA's National Electrical Code. Underwriters' Laboratories of Canada and Underwriters' Laboratories Inc. last year organized a joint task force to develop a North American standard for smoke detectors and smoke alarms. The Canadian Gas Association has been participating with the American National Standards Institute in joint working groups developing harmonized standards for outdoor gas grills and food service equipment.

Beyond these examples, Canadians also participate in other selective harmonization standardization activities related to the construction industry, and vice-versa. This technical cooperation, along with market pressures, is expected to accelerate harmonization between the two countries.[1]

Issues: **Should the government of Canada take a more active and direct role in the activities leading to North American harmonization of standards (in general and for the building industry in particular)? If not, should the government then increase its support to the standards development institutions (and the testing and certification infrastructure) that are now having to adjust to new challenges brought about by liberalization of trade and harmonization?**

3.4 Growing Importance of Imparting Knowledge, Communications Networks and Information Flow

"As the economic value of information increases so too will the economic rewards to those who have the greatest access to it."[2] For all industrial sectors, information now serves as a primary resource and therefore an important factor in production. The creation, use and communication of information is now playing a central role in the development and diffusion of technology.

In the building industry, there is an explosion of information provided by a complex network of organizations. A Canadian study of sources of conflict and loss of productivity in building construction found that the most significant problem was difficulty in access to information.[3]

Quick and effective access to building information is extremely important in constructing high quality buildings. It is also needed to minimize the risk of legal actions and unexpected delays and costs during construction. Adapting to the new technological realities of the 1990s will depend very much on the

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1 *Canada's Framework for the Regulation and Design of Buildings*, op. cit.

2 Gordon L. Walt, "The Impact of Globalization on the Development and Enforcement of Building Regulations", Institute for Research in Construction, National Research Council of Canada, 1993 [unpublished paper].

3 Colin H. Davidson and Rashid Mohsini, *Building Procurement -- A Strategic Organization and Management Decision*, Managing Construction Worldwide, Spon, London, Septemeber 1987.

progress of the state of information and standards on many of the new building systems and technologies.

Technical information on building construction is available from both government and private sector sources. NRC and CMHC are the main sources. The Institute for Research in Construction (at NRC), along with its role of providing R&D services for the construction industry and those involved in the building regulatory system, is involved in carrying out the important role of organizing and coordinating the flow of construction-related information. IRC's services include: analysis of specific building problems with recommendations for solutions to industry; testing services of new construction products and materials to ensure adequate performance; and research services for developing new products and construction techniques.[1]

The role of the Canadian Housing Information Centre of CMHC was discussed in Section 2.0 of this report. Briefly, this is a major source of Canadian and international literature on all forms of building research, with particular emphasis on residential construction. Recently, the Centre was reassigned to report to the Innovation Division of CMHC, which is an important recognition of the linkage of information dissemination activities to the technology development process.

For other sources of building information: the Royal Architectural Institute of Canada publishes a directory of construction technology information sources. As for proprietary product information, from the private sector there is: the Buildcore Index (a catalogue of product information) from Southam Publications; and Sweet's Catalogue (a four volume catalogue of proprietary brochures) by McGraw-Hill.

Issues: How adequate is the existing infrastructure for communicating and imparting knowledge and know-how to the building industry? How might the communications networks of information about standardization and regulations in construction be improved, to respond to the explosion of knowledge on existing and new building technologies?

3.5 Use of Reference Standards

There are now approximately 210 individual standards referenced in the National Building Code. Some references are to lengthy standards documents, which could be, in some cases, as comprehensive as the Code

[1] See section 2.2 for details about NRC and IRC.

itself. This trend towards referencing represents a doubling over the past five years or so. If this trend of depending increasingly on other standards, to regulate building construction continues, then as more requirements are removed from the Code, to be replaced with references to other standards, such standards will assume ever increasing importance in the regulatory function.

This could have both positive and negative effects on technology diffusion. While the reference to standards provides a vehicle of simplification in the Code itself, and could encourage innovation by relying more on performance criteria, the central focus of the regulatory system as embodied in the Codes could be threatened by disintegration. While the use of the NBC would continue as an instrument for giving legal status to the standards, it could also become simply a "directory" to the use of these standards.[1]

While the transfer of technical requirements from the building Code to separate stand-alone standards documents relieves the Code from complexity, and reduces the need to maintain expertise in code committees, there are potential disadvantages that should be considered. For example, referenced standards may not have the same objectives as the NBC. The NBC exists to maintain adequate provisions for health and safety of occupants of buildings. This aspect of the Code is stressed within the framework of the regulatory process. The public interest is always represented on the code revision committees. However, unless managed properly, the increased reliance on voluntary consensus mechanisms could have a negative influence on consumer safety and health interests.

With increasing reliance on referenced standards, there is a danger that the inspection and enforcement of building requirements will become more onerous, particularly if the Code is stripped of its regulatory content. Moreover, the Code may become increasingly more difficult to use, particularly for requirements that need field inspections for verification. "There is a potential danger that requirements located in other documents may not be as diligently inspected as if they were in the NBC itself."[2]

<u>Issue</u>: What is the appropriate balance of referencing, regulatory content, and technical detail, for the NBC, which would not compromise safety and health requirements, while at the same time would facilitate innovation and diffusion of technology?

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[1] Hansen, op.cit. p. 20.

[2] Ibid.

This issue is an ongoing concern of the standards system responsible for the development of the National Building Code. As described earlier in this report, this is a comprehensive system, fully funded (and supported by extensive technical resources) that involves all stakeholders, including regulatory authorities.

The continuing challenge for the CCBFC or the PTCBS, for example, is to identify the minimum levels of safety, accessibility and energy conservation that are acceptable to the Canadian "public" (taking costs into account); and to embody this in regulatory clauses that are clear to the industry, relatively easy to administer, and do not inhibit technological choices unnecessarily.

3.6 Multi-level Government Responsibilities

The multiplicity of public bodies (federal, provincial and municipal), regulating and inspecting building construction projects, could be a factor in delays, conflicts, uncertainties and unnecessary costs. In addition, there is a multitude of zoning, planning, environmental, and civic regulatory requirements that often take lengthy periods (sometimes years) to comply with before a construction project can proceed. These delays and associated additional costs in the building process could have detrimental impacts on technology diffusion.

For example, part of the regulatory requirements for building construction is the approval process that developers and builders need to navigate in order to get permission to build. Although much improvement in most locales in Canada has taken place over the past few years, the complexity of the regulatory environment and the delays and costs associated with the approval process still tend to stifle innovation. It also tends to discourage many small developers from undertaking new projects. Streamlining the approval process can lead to significant cost reductions which would benefit the consumer as well as the builder and developer.

The greatest delays probably occur in projects where new materials and products or processes are being introduced. The review, inspection and approval process in these cases could be so lengthy that builders and developers may not be willing to cover carrying costs and overheads during the waiting period. This could discourage innovative applications.

Whereas the National Building Code contains many "equivalency" provisions, which permit the use of innovative technology (not explicitly referenced), in practice many local building inspectors are not technically able to determine if an innovative design meets the Code, and are therefore concerned about potential liabilities. In order to avoid delays, and in order to circumvent the risk of liability, inspectors tend to insist on long-accepted local practice and taking the "easy way out" of using established, familiar methods and materials.

Issues: Is the existing multi-government regulatory environment too restrictive, such that it discourages the introduction of new technologies (e.g., because of delays in the approval process)? If so, how can this situation be improved? Is providing an evaluation facility such as CCMC sufficient to address this issue?

3.7 Performance Requirements Versus Prescriptive Standards

The introduction of performance standards into the NBC provides incentives for innovation, and is likely to result in more cost effective construction. By specifying materials, components and equipment in terms of what they are required to do rather than specifying a particular kind or brand, can provide designers with the opportunity to seek out the most cost-effective design solutions, thereby encouraging innovation.

Many requirements in the NBC are already specified in performance terms. A good example is the use of fire resistance ratings for walls, as opposed to requirements for specific materials and construction assemblies. Any combination of materials can be used provided the overall assembly can provide at least a certain period of protection from the spread of fire.[1]

Other requirements, although they could be phrased in performance terms, are more appropriately expressed in specification language: for example, minimum door widths to accommodate wheelchair access within buildings.[2]

The Canadian Commission on Building and Fire Codes, wherever possible, encourages its technical committees to have the code requirements converted to a performance basis. Still, however, a good number of the Canadian provisions in the National Building Code are essentially prescriptive in nature, in that requirements are mainly defined by describing proven construction and engineering practices for currently used construction systems and mechanical equipment. The advantage of this approach is that it provides designers and builders with a clear picture of what is acceptable.

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1 John Berndt, *Canadian Codes: Their Development and Use*, Institute for Research in Construction, National Research Centre, October 1989, p. 8.

2 Ibid.

The disadvantage is that, because it is oriented towards existing practices, it does not provide a flexible basis for regulating new technology.

At its May 1992 meeting in Montreal, the Conseil international du bâtiment (CIB) approved the establishment of a technical group on performance-based building regulations. This new group, which will be coordinated by IRC, will bring together the world's experts to share knowledge and to develop a common approach to the type of regulation.[1]

The CIB's interest in performance standards and codes has been there for at least 25 years. Performance standards and codes will probably evolve as quickly as the industry (including regulators) can handle them.

Issues: **To what extent should the CCBFC move towards a performance basis for its requirements? What are the implications of greater reliance on performance standards, e.g., encouraging and facilitating innovation and technology diffusion?**

3.8 Technology Provides Significant Opportunities for Change in Building Construction

Construction is a technology-based activity and can therefore be significantly influenced by innovations and improvements in equipment, materials, and systems and methods of building. For example, during the past decade or so, the residential construction industry has been driven to new approaches due to increasing energy costs. These approaches have included changes in insulation techniques, building design, glazing materials, and sub-division layout, all of which have produced more energy efficient housing and apartment buildings.

Another example of technological change in the building industry involves computer automation and the development of computer aided design capabilities. Computers are also widely used in the control of various mechanical and electrical devices, for engineering calculations, project management and scheduling. The effect of computer applications in the building industry is an increase in productivity and efficiency which generally leads to an improved product.

Issues: **What are the main technological developments that are currently**

[1] Gordon L. Walt, "Voluntary standards support Canadian building codes and regulations", *CONSENSUS*, Standards Council of Canada, Volume 19 No. 3, Summer, 1992, p.26.

showing the greatest promise to impact on the building industry (for example, in the areas of energy efficiency, healthy environments, or affordable housing)? Can we assess the impact of standardization on diffusion of these technologies?

3.9 Demand for Quality and Social Relevance

One of the major influences on building regulations is social pressure to improve the quality of life. There is growing national and international concern for the environment leading to more and more requirements in building codes for its protection. Also there is growing social pressure impacting on regulations for the need to improve the indoor climate of buildings and to provide good access for disabled occupants, and appropriate shelter for the aged. Since buildings are a significant investment for the country, it is important to build and maintain them at a high level of quality, but also to make them responsive to social needs. The challenges are great for developing new building approaches which respond to social needs.

Issues: How does the regulatory and standards infrastructure respond to the special needs of occupants (for example, elderly households and the disabled)? Should more effort be put into social requirements, by the National Standards System and by the regulatory institutions administering the codes, to facilitate the diffusion of technology that has social relevance?

3.10 Industry Participation in the Standards Development Process

Industry participation on standards committees is a catalyst for the diffusion of technology. Manufacturers and consumers regularly adopt new technologies or products through standards. It is, therefore, very important to be closely associated with standards development committees, nationally and internationally. However, the building construction industry is made up of many small and medium firms, who may be unable to participate especially in times of recession. Many of those who do participate are typically representatives of larger enterprises with their own vested interests.

Recently, CSA and other standards development organizations have requested that members of technical committees contribute more to the process. Industry is being asked to "foot the bill". This hurts the small and medium-sized firms the most.

Issues: To what extent are cutbacks hurting the standards-development process in the Canadian building construction sector? Will these cutbacks significantly affect industry participation in the process? What are the implications for technology diffusion?

3.11 Interface of Research and Development With Standardization Activities

The requirements for standardization are an important issue even at an early stage in the research and development process. Including standardization concerns at an early stage of R&D can have an accelerating effect on the diffusion of new technologies. This report has provided some examples of this approach (e.g., the Buildings Group at EMR). One way of influencing policy formation about new technologies is to link the R&D environment to the standards development process. In this way research organizations can promote and disseminate the results of their work through involvement in standards setting activities.

Issues: Should the federal government promote closer linkages of R&D initiatives with standardization activities in the building industry?

3.12 Enforcement of Standards

Free trade between Canada and the United States has brought about the increased importance of the enforcement of standards, and the role of evaluation and testing, for assessment of conformity of imported products and materials. As a result of the FTA, Canadian markets are seeing an increase in imported materials, equipment and systems in building projects. It is sometimes difficult to confirm that these products comply with the requirements of provincial building codes.

The need for compatibility of requirements between national markets therefore affects the procedures for conformity assessment in addition to the technical requirements themselves. This means that the international accreditation of testing and certification and the wider recognition of evaluation reports and certification marks are becoming more important to product manufacturers. [1]

Issues: How far should Canada proceed in harmonizing Canadian building standards with those of the U.S.A.? What are the implications of cross-border shopping for building materials, equipment and systems? How can enforcement procedures be improved to ensure full compliance of imports with Canadian standards?

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1 Gordon L.Walt, "The Impact of Globalization on the Development and Enforcement of Building Regulations", Institute for Research in Construction, National Research Council of Canada, 1993 [unpublished paper].

3.13 Balancing Acceleration of Technology Diffusion With Safety and Health of the Consumer: The Importance of Risk-Reduction Measures

The UFFI affair underlined the importance of the development of appropriate, leading-edge evaluation and testing technologies for building construction. Mechanisms and procedures which measure not only physical building-related attributes, but also other aspects related to health and environmental impacts, need to be developed concurrently with the introduction of innovative building products and processes.

The process of evaluation and testing has perhaps a much greater impact on facilitating or restricting innovations than the form in which a building code or regulation is documented. In addition, the way in which a code is administered (inspections and enforcement) could be conducive or detrimental to the technology diffusion process.

If the construction industry is to progress, appropriate mechanisms, such as CCMC, must be maintained to reduce the uncertainty inherent in the use of new technologies.

The possibility of litigation is a real threat for many builders and owners. Protection against potential litigation is thus a significant part of construction costs. Avoidance of litigation is a strong inducement for adopting expensive, defensive design and construction processes which may stifle innovation.

The legal consequences of failure can be reduced by adopting quality control measures throughout the construction process, by improving training of staff and labour, and by implementing a warranty program. Evaluation and testing of new technology, as mentioned, is also a key factor in alleviating the risk of liability. Appropriate use of regulations can also help, by setting quality expectations. Relaxation of regulations may have the opposite effect, possibly increasing the risk of litigation.[1]

Issues: What combination of measures should be encouraged (e.g., quality assurance, warranty programs, evaluation and testing) which would facilitate technology diffusion by reducing the risk of liability in the building construction industry? What should be the role of government in developing or promoting these measures?

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[1] Ferrers R.S. Clark, "Trends and Issues in the Construction Industry", in *The Construction Industry and the Issues Facing It: An Overview*, Institute for Research in Construction, National Research Council, 1986.

APPENDIX A

COMMON ACRONYMS

ACRONYM	ORGANIZATION
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
BNQ	Bureau de normalisation du Québec
CANMET	Canadian Centre for Mineral and Energy Technology
CANSIS	Standards Information System of Canada
CCA	Canadian Construction Association
CCBFC	Canadian Commission on Building and Fire Codes
CCCME	Canadian Commission on Construction Materials and Evaluation
CCMC	Canadian Construction Materials Centre
CEC	Canadian Electrical Code
CGA	Canadian Gas Association
CGSB	Canadian General Standards Board
CHBA	Canadian Home Builders' Association
CHIC	Canadian Housing Information Centre
CISTI	Canada Institute for Scientific and Technical Information
CMHC	Canada Mortgage and Housing Corporation
CMHI	Canadian Manufactured Housing Institute
COFI	Council of Forest Industries of British Columbia
CSA	Canadian Standards Association
EMR	Energy Mines and Resources
FTA	Free Trade Agreement
GATT	General Agreement on Tariffs and Trade
IEC	International Electrotechnical Commission

ACRONYM	ORGANIZATION
IRAP	Industrial Research Assistance Program
IRC	Institute for Research in Construction
ISO	International Organization for Standardization
NAFTA	North American Free Trade Agreement
NBC	National Building Code of Canada
NFC	National Fire Code of Canada
NFPA	National Fire Protection Association
NRC	National Research Council Canada
NSC	National Standard of Canada
NSS	National Standards System
SCC	Standards Council of Canada
PTCBS	Provincial/Territorial Committee on Building Standards
SWO	Standards Writing Organization
ULI	Underwriters Laboratories Incorporated
ULC	Underwriters' Laboratories of Canada

APPENDIX B

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APPENDIX C

LIST OF INDIVIDUALS CONSULTED

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National Research Council Canada

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Nordicity Group Ltd.
Le Groupe Nordicité ltée

LITERATURE REVIEWED (CONSULTATIONS) FOR

STUDY ON THE EFFECTS OF STANDARDS AND REGULATIONS ON TECHNOLOGY DIFFUSION

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