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ROLES OF PUBLIC AND PRIVATE SECTOR RESOURCES
IN A NATIONAL INFORMATION INFRASTRUCTURE

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Introduction

Scientific and technical information is regarded in Canada as a national resource. Although there is no single policy statement that may be taken as "the Canadian scientific and technical information policy" or even "the Canadian information policy", there is an adequate collection of policy statements, procedures and practices to make a coordinated information infrastructure. The public sector, which is mandated to provide for nationwide scientific and technical information services, is an important component of that infrastructure. However, very few public services could be provided without some involvement of the private sector. An information policy statement would include a remark that the strengths of public and private sector institutions should be combined symbiotically to serve Canadians to an extent that neither sector could reach independently. Each should do what it is best equipped to do, and this will be the thesis of the paper. Examples will be taken largely from the field of scientific and technical information. Canada's particular mix of public and private sector activities and responsibilities has evolved to meet Canadian conditions and traditions, and may not obtain anywhere else. However, the thesis is still applicable to most industrialized countries with any sort of mixed economy.

The Canadian Scene

Canada is an extremely large, sparsely populated, bilingual country, with a mix of resource-based, manufacturing and high technology industries. It shares a long border with the most powerful and aggressive economy in the world.

Canada is the second largest country in area in the world, not much smaller than the whole of Europe. It crosses seven time zones. The distance from Vancouver on the West coast to St. John's, Newfoundland on the Eastern extremity is roughly equivalent to the distance from Paris to Alma Ata. The distance from Vancouver, in the Southwest corner of the country, to Yellowknife in the North is further than the distance from Paris to Oslo. Vancouver-Yellowknife is only half the South-North length of Canadian territory at that, although there are very few human settlements North of Yellowknife. An area of
9 million square kilometers is inhabited by a population of 25 million, compared to the 690 million of Europe. The average population density is 2.7 persons per square kilometer, but this figure is somewhat misleading as the population is concentrated in the Quebec City-Windsor corridor and in a few cities in each province. Natural barriers have historically made North-South communications with the United States easier than East-West communications within Canada. As a large part of the Canadian population lives within 200 kilometers of the U.S. border, the heavy influence of U.S. resources and culture on Canada is easy to understand.

Politically, Canada is a federal state, a confederation of ten provinces and two territories, the rights and responsibilities of which are recognized in the constitution. The federal government is responsible for the bibliographic resources of the Canada Institute for Scientific and Technical Information (CISTI) and the National Library, for copyright and legal deposit, and for regulation of the communications industry. The provinces are responsible for health and education, including university libraries. Both levels of government may operate research and development laboratories and may assist private industry.

This combination of a small population, spread unevenly over great distances, with a federal system of government, together with proximity to the USA and its information resources, has had a profound effect on information policies and the way in which scientific and technical information is provided.

Canadian Industry

Traditionally, the Canadian economy has depended very heavily upon primary resource industries such as mining, fisheries, forestry and agriculture. However, there have long been notable exceptions, such as the nuclear energy, automobile and aerospace industries, together with great expertise and investment in communications required by the country's long distances. In recent years, a strong, high technology industry has developed around microelectronics, for such applications as surveying, robotics, instrumentation, telecommunications and data processing.

In theory, Canada has a free-enterprise economy; in practice, the economy is decidedly mixed. This situation has varied little with the political party in power. Private companies vary in size from the very large to the very small. Many are branch companies of parent firms in the USA and elsewhere. Canadian-owned industry has a high component of small companies, which do little of their own research and may not even have a minimal technical information facility. The private sector is encouraged to do whatever it can. Governments, both federal and provincial, however, step in to protect the national interest or to undertake activities that are too large, expensive, complex or long term for the private sector. Canadian governments at both levels carry out research and development, manufacturing, and marketing.
Some of the largest industrial operations are run by what are called crown corporations—government companies with boards of directors reporting to ministers or through them to Parliament. Crown corporations exist in a variety of fields—research and development, e.g., Atomic Energy of Canada Ltd.; services, e.g., Air Canada; aircraft manufacture, e.g., Canadair; communications and culture, e.g., Canadian Broadcasting Corporation; utilities, e.g., Ontario Hydro; marketing, e.g., Canadian Wheat Board; and manufacturing, e.g., Polysar.

The crown corporations, which may be established by both federal and provincial governments, are clear examples of government intervention in the economy. Governments may also be minor or controlling shareholders in private Canadian companies, and in foreign companies operating abroad so that supplies or market openings may be ensured. Government intervention has long been considered necessary because of the geographic and demographic conditions of the country. Canada's very creation as a country depended upon government support for a transnational railway system. Governments may intervene for a variety of reasons such as job creation, control of the balance of payments, preservation of a Canadian identity, provision of essential services, standardisation, and long term planning.

One major principle of the federal government is the removal of regional disparities. This is achieved in a variety of ways, including federal transfer payments from rich provinces to poorer provinces, the placing of government-controlled industries in needy areas, and government charging structures which are independent of location. Another federal policy is that federal services should be provided in both English and French, Canada's two official languages, when the population composition warrants. Both of these policies are applied to scientific and technical information services.

For many years, the federal government has had a "make/buy" policy regarding goods and services. Essentially, the government contracts out to the private sector for services that can be supplied under an arm's length relationship and for goods, the Canadian content of which is an important factor. This policy not only ensures fair competition, as is usual in tendering for government contracts, it also forces an evaluation of government-supplied services at the same time. As a result, the government tends to perform only those activities which the private sector is unwilling to undertake or cannot perform well, though there is obviously scope here for political argument.

In the information industry, governments both federal and provincial are concerned with large libraries and other storehouses of information, with control of the national literature and compilation of databases, and with regulation and standardization. The private sector is particularly strong in telecommunications, data processing and the provision of hardware and software services.
Scientific and Technical Information in Canada

About 97% of the scientific and technical information required in Canada is generated and published externally. Much of the information acquired is in English but there is a growing demand, mainly in the province of Quebec, for French language material. There is rapid communications with the major information producing countries, notably the USA, and no foreign exchange problems. Published information which is needed in Canada can be acquired relatively easily, though not necessarily cheaply. Small industry has limited funds. University libraries are facing serious budget cuts which curtail their acquisitions programs. These problems are compounded at this time by the weaker Canadian dollar. Government, then, has a role to play in the provision of backup services, in the optimum use of total resources, and in the central provision of services that could not be cost-effective from decentralized sources or might be provided only to the large population centres of Ontario and Quebec.

The Canada Institute for Scientific and Technical Information (CISTI) was mandated for this role after several policy studies had been conducted in the late 1960's, when information policy and science policy were in the forefront in several countries. CISTI is a division of the National Research Council of Canada (NRCC), the federal government's principal scientific and industrial research organisation with research projects in a variety of fields, both pure and applied, and with laboratories in several parts of the country. CISTI's collection and services, as they existed in the 1960's formed an excellent basis for a national service.

CISTI is not the only source of scientific and technical information in the country. Good libraries exist in other government departments, both federal and provincial, in universities and in private industry. However, although many of these libraries are tax-supported, none is mandated to serve more than its own mission-oriented clientele, with obvious repercussions on subject coverage and availability of material. Only CISTI has the mandate to provide the national service and the resources to do the job satisfactorily.

The mandate is spelled out in the following objectives (which are actually those of NRCC's scientific and technical information programme of which CISTI is the principal component):

- to promote and provide for the use of scientific and technical information by the people and government of Canada to meet Canadian needs for economic, regional and social development.
- to develop and maintain a national resource in scientific and technical information that can respond to national needs and priorities.
- to provide and maintain services associated with scientific and technical information to meet the needs of the people and government of Canada.
- to coordinate the resources of the National Research Council with those of other information transfer institutions both national and international and participate in the development and maintenance of scientific and technical information networks.
- to provide and maintain a capability and carry out research into the need for and methods of accomplishing the transfer of scientific and technical information in response to user needs.

This mandate clarified CISTI's national role. Information as a resource does not consist only of books, journals and other documents, or only of abstracting, indexing, online search and other services. A citation is worthless if the corresponding document is not available. In a country as far flung as Canada, it is important to be able to obtain scientific and technical information from one source. It is also too expensive for the dispersed population to have much duplication. CISTI therefore has the roles of a national reference library, a national lending library, and an information service provider, which in other countries might be separate. In addition, it continues its historical role of supporting NRC's scientific program.

One major activity is the maintenance of the national collection of scientific and technical literature. The national collection is regarded as a national resource, and its acquisition and maintenance are funded entirely by the federal government. Libraries, research institutions, small companies and individuals draw on CISTI increasingly for loans and document delivery services. The demand for document delivery, one of CISTI's major activities, is increasing by roughly 15% per year.

Use of the national collection varies from one user to another and is considered to be a legitimate cost for the individual, institution or corporation to bear. Consequently costs connected with the use of the collection, such as document delivery, are recovered. This policy is also applied to the services giving access to the collection (and to other collections), notably an automated batch service of selective dissemination of information (CAN/SDI) and a nationwide online information storage and retrieval system (CAN/OLE).

CAN/OLE offers the commercially available databases that are suited to the nation's needs, such as BIOSIS, INSPEC, Chemical Abstracts and NTIS. It also provides a vehicle for Canadian databases, which are relatively small and specialized. Machine-readable databases are regarded no differently from printed journals. They are equally part of the national collection, with the taxpayer funding their acquisition and mounting. Access to
CAN/OLE is via a commercial data network. CISTI pays the telecommunications cost and charges the client a basic connect hour charge independent of the client's location. Service hours in Ottawa are prolonged so that clients at both ends of the country may access CAN/OLE through a major part of their own working days. Other libraries participate with CISTI in CAN/DOC, an automated ordering module of CAN/OLE, which enables clients to place orders with a supplying library of their choice. CAN/DOC is part of a larger interlibrary loan network, in which the National Library has taken the lead in standardization and the development of protocols for the exchange of information. For interlibrary loans and photocopies, CISTI meets 75% of the demand (running at over a thousand requests a day) and is able to report Canadian locations for another 15%.

In addition to its general scientific and technical information services, CISTI also offers specialized services, such as those of the Health Sciences Resource Centre (HSRC). This centre was set up as a result of a directive separate from CISTI's overall mandate. HSRC focusses on the nation's health sciences community, providing information services for which there is no mandate in the libraries of federal or provincial department of health and welfare. In practice, it operates as a national coordinator for Canadian use of the MEDLARS services of the U.S. National Library of Medicine (NLM). Canadian users access NLM's computer, but obtain most of their documents from Canadian sources. HSRC also compiles extremely useful directories of health sciences associations and libraries in Canada.

Another of CISTI's specialized services is the Scientific Numeric Database service (CAN/SND). This service acquires evaluated numerical databases and makes them available to Canadian scientists through online access to CISTI's computer facilities, through lease arrangements for clients who want to mount entire databases, and through reference searches for the occasional user. This very specialized service has a restricted clientele (less than 100 at present), which, even with expected growth, is too small to support a Canadian private sector service.

Clients in both the public or private sectors, are free to use other resources besides the national services. Many U.S. scientific and technical information services, particularly database services, have a broader coverage than their Canadian counterparts. The U.S. services are readily accessible through excellent communications networks. Many information users, including CISTI reference staff, use a variety of online retrieval services in North America and elsewhere. As most U.S. services and non-governmental Canadian services operate on a profit-making rather than a cost-recovery basis, they tend to be considerably more expensive, particularly in view of the devalued Canadian dollar. These services are geographically dispersed, which further complicates matters for the user.
In the area of scientific and technical publications, again a mixture is found of private and public sector activities. The Canadian population is too small to support a large publishing industry. Canadian authors tend to publish scientific papers in the most appropriate or most prestigious journal, wherever that may be located. However, the National Research Council of Canada is mandated to provide a channel for disseminating the results of Canadian research to the world scientific community by means of research journals. A single Canadian Journal of Research was begun in 1929, when Canadian science was in its infancy. The NRCC now publishes a dozen scientific journals in various disciplines, their own reputations attracting foreign as well as Canadian authors. Management and content editing are performed by the NRCC, while all other aspects of publication are contracted out to the private sector. A few specialised journals are published by other federal and provincial government agencies in the same way. In addition, about 30 journals are now also published by various professional bodies.

As in other countries, the more technologically oriented government agencies produce technical reports for internal and public use. Often government reports are not contracted out and many are distributed at the taxpayer's expense.

Trade literature is predominantly in the private sector, where it is supported largely by advertising revenue.

The Canadian generators of published scientific and technical information are, of course, heavy users of scientific and technical information. In addition, however, there are large numbers of people in small industries who make up a significant portion of the user group. Some of these may require sophisticated research information, but many do not. Rather they require information for problem solving and for development of new products. To serve them, the National Research Council and several Provincial Research Councils offer industrial extension services, through offices in headquarters and in the field close to the users. In the National Research Council, a technical information service to small industry, which met a need felt at the end of World War II, is now part of a broader program, which stimulates small industry through financial assistance, joint projects and making national laboratory facilities available for private use. Such technology transfer services are regarded as an important factor in the Canadian economy, and they are therefore funded by the taxpayer, particularly as many small industries could not afford any sort of commercial consulting service.

Communications
As we all realize, information is useless if it is left sitting on a shelf. It must be transmitted to the users. In Canada many users are remote from central sources of information. The challenge of Canada's long distances has resulted in a very strong communications industry. Developed commercially, the Canadian communications
industry has made possible many of the advances achieved in the provision of scientific and technical information services.

The traditional means of transmitting documents is the post office, which is operated by the federal government. Originally dependent on the railway for mail between distant cities, the post office now relies heavily on air mail, especially for first class mail. Both the rail and air systems are government-supported. Total reliance on the post office for two-way communication between libraries is slow, particularly in a country as vast as Canada. When interlibrary loan traffic depended entirely on the post office, the volume was very small. The Canadian post office was recently taken out of the public service proper and has become a crown corporation operating much more along commercial lines. This was partly due to competition from commercial courier services and bulk delivery services.

Telecommunications, from telex to advanced packet-switching networks, have speeded the transmission of messages to libraries though not yet the delivery of documents from them. Canada differs from other countries, in that telecommunications have always been separate from the post office, and have always been predominantly in the private sector. The private sector has raised the huge investment necessary to develop and install a national network, initially by wire, more recently by microwave and satellite links. The companies differ from one province to another, and some are in fact government companies. For telephones, in any one location there is only one company. In data communications, there may be competition between alternative companies. As there is virtually a monopoly situation in both cases, federal regulation limits the rates charged. For telephones, profits on long distance services offset losses on local services, which are not charged per call (although this situation may change). For data, charges are less dependent upon distance, a trend which is continuing as a result of advanced technology. The importance of telecommunications in Canada has led to high technology industries in electronics and other advanced areas. Much research and development has been performed for purely commercial reasons, but some has been promoted by government in the form of contracts, grants or internal research.

About half of the requests for documents received by CISTI now arrive by electronic means, either commercial messaging services or the CAN/DOC facility of CAN/OLE. CISTI also accepts requests by telephone and by telex, as well as by mail. Outgoing photocopies are sent by the traditional means of the post office, but bulk delivery by commercial courier service to a remote distribution point has been used increasingly for speed and convenience. The post office is also introducing new faster services for transporting paper across the country. The electronic transmission of large numbers of documents is still in the future.
Interaction and Cooperation Between Sectors

Because there are different classes of crown corporations, some of which are profit-making, and because government agencies may be substantial share holders in private companies, the distinction between the public and private sectors is somewhat blurred. It will be sufficient, however, to define the private sector as embracing organizations that are profit-making in intent, leaving the public sector performing functions that must be supported from taxes. In the context of Canadian scientific and technical information services, each sector is doing what it is best equipped to do and in addition cooperation between the sectors makes the services more effective than they otherwise would be. The cooperation may be instigated by either side. Canada has some notable examples of such cooperation.

The national collection of scientific and technical literature, together with the services giving access to it, injects funds into the Canadian private sector even though much of the literature has to be purchased abroad. Acquisitions through Canadian agents, purchase or rental of computers, photocopiers and other equipment, use of service bureaux and consultants, and use of communications services would have been significant even without the government make/buy policy. CISTI will develop technology and use new technology as it becomes available externally to enable scientific and technological information to be provided in a cost effective manner.

The national collection would not have been assembled in the private sector. Without it, users would either have expanded their own collections with inevitable duplication, or they would have put pressure on inappropriate sources, such as university libraries, or they would have been forced to use foreign, more expensive sources. The Canadian national collection is matched closely to the changing needs of Canadian users so that CISTI can respond quickly. The services are designed to help the small industrial user who does not necessarily go through a library. Thus unverified references are accepted and a considerable amount of effort goes into tracing difficult requests. The effect on industry in this regard is not quantifiable but is certainly significant.

A national scientific and technical information network would not have been developed without government support, particularly the computer-based services that give access to the national collection. Many of the databases on CAN/OLE are relatively small Canadian databases which might not have been compiled without a national host to make them available. The large foreign database services look for a broad clientele in their own countries and elsewhere and would not have been interested in mounting Canadian databases without subsidy. Canadian private sector services which offer STI databases have required substantial government support to become viable. Services like CAN/SND with an extremely specialized and limited clientele would clearly never have developed in the Canadian private sector.
The access services on the present scale would have been impossible without the private sector data communications services. To provide equal access to CAN/OLE from all parts of the country, CISTI initially leased data lines to the major cities. Now that the data communications network has grown throughout the land, CISTI covers clients' communications costs through a flat connect hour charge. This is similar to the universal practice of post offices charging rates independent of location, but in this case a government agency is equalizing a disparity in a private service.

The private sector services themselves have adapted to the requirements of the public sector. When electronic messaging was first introduced, CISTI approached the telecommunications companies and asked that prompts and formatted screens be incorporated into the software for interlibrary loan purposes. These features have been in place for about three years in one system and negotiations are in progress to incorporate them in a second private sector system. The use of scripted protocols has greatly facilitated the transmission of ILL messages among libraries. The requests to CISTI on the commercial system now number over 75,000 per year; the traffic among all libraries is clearly far larger. The private sector operator has acknowledged that public sector institutions have been instrumental in making the commercial messaging system successful by increasing the utility of the systems offered to the private sector. Experiences gained with libraries have spun off scripts for entirely commercial applications such as order handling, invoicing, inventory control, sales report and projections.

In the past two or three years, the telecommunications companies have been developing a gateway concept. This recognizes that there are a variety of potential users of electronic information services and a variety of information service providers, who operate diverse types of system and equipment. The concept provides clients with single point access to all the providers in the network, plus value-added services such as menus, directories, help messages, and centralized billing. A field trial involving 400 participants from the banking, communications, energy, real estate, legal, travel and bibliographic information communities has been conducted. The bibliographic information participants were all from public sector organizations. The commercial feasibility of the gateway network was established through a series of projects including the testing of systems interfaces, electronic directories, data derivation, electronic messaging and file transfer. The financial contribution of the public sector to the trial is estimated at over $2 million, but public sector expertise also contributed significantly to the trial's success. The development has now moved into a broader market trial involving some 2,000 participants. Results so far, indicate that the gateway concept is extremely beneficial to the many small users of information services, and there seems little doubt that public sector information providers will use gateways of this type as one of their means of providing service.
Easy transfer of data between different computers and operating systems requires standardization. At the international level, some of the standardization is being provided by bodies such as UNESCO and ISO. In Canada, the National Library has made considerable progress in the development of library application protocols, which will facilitate the exchange of files, records and messages among libraries. An important aspect of the protocol is the appropriate acknowledgement of each step in a procedure such as the placing and filling of an interlibrary loan request. One commercial company specializing in the library applications of computers is deeply involved in this protocol testing based on specifications developed by the National Library. In the broader context, library application protocols will allow all computer manufacturers to link their machines into library and information networks. Undoubtedly this particular public sector initiative will be commercially significant for Canadian computer manufacturers.

Similar cooperation has taken place in the field of hardware development. Major contracts have been placed, for example, by public sector organizations, particularly the National Library, for the development of terminals specifically suited to library applications. A similar impetus has come from university libraries which are well advanced in computer processing. Canadian companies have thereby gained considerable national and international opportunities through the sale of their products to the library community, and some of the more specialized companies would not have existed without the public sector initiatives.

Concluding Remarks
The division of responsibility between the public and private sectors that has developed to suit Canadian conditions is clearly different from that found in other countries. History, geography, economics, politics and psychology all have a contribution to the situation, and vary from country to country. There may be an increasing tendency for governments to transfer selected programs to the private sector. This may be a question of mechanism and the channelling of funds, however, as much as profitability. Governments must see that certain things are done, even if they do not do them themselves. The actual divisions between the public and private sectors, being variable, are not that important in the context of scientific and technical information.

What is essential for maximum performance is cooperation between the various parties in the information transfer process. The information system must be developed cooperatively with either side taking the initiative in instigating projects. The current burgeoning of communications systems is likely to remain the predominant feature of the rest of the century. It is up to libraries and information centres not only to adapt but also to ensure that their special requirements are not overlooked.