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Canada's Information Revolution

edited by
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and
Lucie Deschênes

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The Institute for Research on Public Policy

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Foreword

Research conducted to date on the international scene has clearly shown the growing presence of new information technologies in all areas of our lives. Advances in informatics and telecommunications have profoundly affected all economic sectors, whether they involve the manufacturing of goods or the provision of services. The changes are not limited to these areas; the new technologies have altered the internal organization of businesses, relations among the different economic partners and the very foundations of our society.

With the integration of informatics and communications technologies, knowledge and information have become strategic resources and agents for change as our post-industrial society enters a new stage—the information age. The information society is "information intensive", that is to say that information will henceforth be the raw material of the new economy, the prime mover of growth and development.

It is in this context that Communications Canada, through the Canadian Workplace Automation Research Centre (CWARC), decided to organize a conference on the theme "Information Technology: Globalization, Diffusion, Innovation and Retraining". The conference, held jointly with the IRPP, brought together representatives from the private sector, government and the universities, reflecting the government's emphasis on promoting synergy among the different socio-economic partners.

The purpose of the conference was to identify Canadian expertise in this field and to define the major issues facing our societies at the dawn of the 21st century.

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Part A

New Information Technology: Evolution and Issues

The Information Society: Some Questions of Governance

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Institute for Research on Public Policy, Victoria
and
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Institute for Research on Public Policy, Ottawa

My old mentor in economics at MIT, Nobel Laureate Paul Samuelson, once noted that a good economic forecaster, like a good soldier, never looks back—it's too easy to lose your nerve. Similarly no aspiring speaker should ever attend meetings on information and communication. It's too easy to encounter wisdom like that attributed to the famous Spanish philosopher Ortega y Gasset:

> "Between us only a relative and indirect and always dubious communication is possible."

or, alternatively, the observation

> "I know you believe you understand what you think I said. But I am not sure you realize that what you heard is not what I meant."

Information is an elusive commodity. Our capacity to be in contact (i.e., connected through a network) has far outstripped our ability to be in touch (i.e., communicating meaningfully). But it is nevertheless clear that our changing technologies and capacities for creating, processing, and moving information underlie the most fundamental mutations in our economic and social organization. The structures of both enterprise or market, and bureaucracy or hierarchy, are shifting dramatically as information channels multiply and transactions costs decline.

Indeed, Harlan Cleveland's seminal article (1985) on the Information Society is titled "The Twilight of Hierarchy". But it is not clear that all this dramatic development is for the better. In his definitive work on hierarchiology, which appears in his book *Malice in Blunderland*, Thomas Martin, Jr., building on these earlier observations, cites what he calls Martin's Law of Communications.

> "The inevitable result of improved and enlarged communication [between different levels in a hierarchy] is a vastly increased area of misunderstanding."

But it is clear that we are in the midst of a fundamental economic and social transformation whose extent and implications we only partially grasp. This transformation is being driven by:

- an interplay of social and technological dynamics including, in particular, developments in information processing and telecommunications and the increasing links between those technologies;
- the emergence of a more educated and informed population and associated value changes;
- the increasing role of the mass media;
- higher degrees of specialization in a more knowledge-based economy and consequent changes in the structure of work; and,

- a much richer infrastructure of public and private organizations and a stronger degree of interaction amongst those organizations.

Thus, in a freight train of cliches, we see around us a rapidly changing world characterized by:

- globalization
- atomization
- informatization
- dematerialization and (as particularly pointedly and poignantly illustrated in recent weeks)
- democratization.

This transformation and the more richly interconnected, complex and turbulent world, the vast increase in information availability, and the compression of both time and space that result, has been labelled "the information society".

We are here to discuss a relatively small subset of the issues raised by this transformation. In beginning to address those more specific questions, though, I think it is important to try to place them in a broader context: a context which helps to make clear their significance, and to define what questions will need to be addressed if we are to navigate successfully the transformation through which we are living.

Almost since its inception, the IRPP has worked on questions related to the emergence of the information society. In that time we have been driven to the conclusion that it is very difficult to make progress on the specifics, without also putting considerable effort into understanding that broader context. We began our work in this area with a number of individual studies of policies for the information technology sector and of the implications of developments in that sector for individuals and for the workplace. While those studies were worthwhile in themselves, the pervasiveness of the effects of the information revolution on the economy led us more recently to somewhat broader studies of the information economy (Osberg, Baumol, Wolff), and of the important new issues raised by the rapid growth and special requirements of high technology trade (Conklin and St-Hilaire). In addition, a series of tri-national meetings led to the formulation of the Generic Declaration on information policy, subsequently distributed widely in the U.S. and the U.K. as well as Canada. As this work has proceeded, it has become clearer that the effects of the information revolution are pervasive not only for the economy, but for society and for our system of governance.

Let me illustrate this with some ideas we have been discussing recently with senior policy makers and researchers, and which we expect will guide the next phase of our work on the information society; and also (I hope!) can provide some of the context that might be helpful as we begin our discussions here today.

As I mentioned a moment ago, the transformation to an information society is perhaps most evident in the economy, where we have already witnessed 24 hour trading on interconnected stock exchanges, frontierless capital markets, an unprecedented level of takeovers and buy outs, the emergence of regional trading blocs, the globalization of manufacturing, and so on; all of these being effects which flow from the new reality of doing business on the international scale. A main effect of communication has been to collapse time and space so that it not only allows, but makes imperative, the internationalization of enterprise to an extent unheard of in the past. It also is significantly changing the way in which major institutions operate and is calling into question the boundaries that separate them.

The Institute's recent work on international trade in services, for example, was based on the observation that information technologies in particular have made possible an unprecedented degree of intermediation and trade in the delivery of services once considered "non-tradeables".

The process of globalization is accompanied, perhaps paradoxically, by a process of atomization of industry: the shift to services and a knowledge-based economy not only means that knowledge-

intensive approaches and technologies are increasingly the key to competitiveness in virtually all sectors, but also generates a proliferation of smaller companies. Even as mergers lead to greater concentrations of assets, the workforce in the larger organizations is being reduced; and employment is growing in smaller organizations, primarily in the service sector. We are becoming a nation of more, smaller, multicentered organizations. Those smaller firms, freed from locational dependence on an immobile resource base, and no longer constrained within a heavy transportation infrastructure, follow people. Their choice of location depends on factors that used to be secondary: availability of communications, proximity of educational institutions, climate and the general quality of life of a region. They compete with larger firms less by gigantism than by the formation of alliances of small players who join together to behave as if they were big. Hierarchies increasingly give way to alliances, and employment to entrepreneurship.

While the transformation inherent in the emergence of an information society is perhaps clearest at the moment in the private sector, no less fundamental changes are occurring in the public sector, redefining issues on the policy agenda (from competitiveness and trade relations, to labour force adjustment and human resource development to intellectual property and privacy, . . .), and changing fundamentally the very process of governance. There are many examples of this, and I would like to mention a few:

1. First, similar to trends in industry, government is running up against the limitations of the bureaucratic/industrial model of organizing, and is exploring ways to develop more flexible, rapid response mechanisms that can mobilize a wider range of resources; and at the same time seeking to reduce its own size, strip away levels of management, rely more on networks and task forces, and farm out (privatize or contract out) a variety of functions previously done in-house. (The increased demands coming from a more interconnected and turbulent environment were answered, in the post-war period, by an increase in the size and scope of public and private bureaucracies. This has not proved to be sustainable, resulting in a search for more flexible, more economic and more responsive ways to meet those demands.) Increasingly, the boundaries between organizations and departments are being called into question as issues become more interconnected and as the key to success becomes finding ways to pull together resources needed to address a given issue from a variety of departments and organizations. Within organizations that are becoming more knowledge-based, there also are fundamental changes taking place in work structure, in part as a result of greater use of information technology and increasing specialization. Overall, more and more emphasis is being given to the development of less hierarchical and more flexible forms of organizing, both within and amongst organizations.

2. Second, in the public sector, as well as in the private, development of staff (now often called human capital) becomes a central theme, as organizations recognize that in a more complex, rapidly changing environment dominated by information and communication, well-qualified staff (with their ability to manage larger amounts of information, establish effective working relationships within and outside the organization, make judgements and innovate) are their principal asset.

3. Third, in both the public and private sectors (in the face of huge volumes of data and resulting overload) the most important skill increasingly is the strategic use of information: developing the conceptual and other mechanisms needed to translate data into information, and information into knowledge, and ensuring that the most pertinent information is provided to the relevant people to make a given decision. A range of information translation and related intermediary functions are growing up in the public and private sectors to help to meet this increasing demand.

4. Fourth, similar to the trends in industry, government is experiencing both a process of globalization (as more and more issues are handled in supranational fora, networks and organizations) and a process of atomization, decentralization and democratization (as provinces, localities and various non-government groups become increasingly powerful players). Government now finds

itself, as never before, in a context characterized by multiple voices, as a wide range of groups in a more highly educated and informed society organize to assert a role in the governance process. Governance increasingly centres on the discovery of ways to harmonize and mobilize a wide diversity of not-very-compatible interests, to address public policy issues with which government alone cannot expect to cope. An increasing concern, in this context, becomes how to ensure that all relevant interests are brought forward and weighed, so that no one interest can capture the public agenda.

5. Fifth, in this environment the media plays a crucial role in shaping the policy agenda and determining which voices will be heard to the greatest effect. The interaction and mutual reinforcement amongst governments, various interests and the media, and the information or misinformation that results, become an increasingly important part of the process of governance. Government now means not just administration of established functions, but the constant negotiation of coalitions, with regions, with the private sector, with other nations, with special interest (or single issue) groups—all taking place in a noisy, information-rich, increasingly media-centred public forum. A related development, in this environment, is that secrecy is less and less possible, raising major questions for systems of governance that are predicated on a certain degree of confidentiality.

6. The last example I will mention of how the information society is transforming the process of governance in that policy development increasingly requires a process of experimentation involving both action and analysis: the players are becoming too numerous and the issues too complex, interconnected and rapidly changing for pre-planned approaches to work effectively. A key requirement, in that context, is the generation of a shared vision of the overall direction and values to be pursued, to provide the context within which the process of experimentation can proceed on the part of the various players, and its results can be interpreted and consequent action determined.

In sum, the process of governance in the information society more and more involves a process of learning in which government is a central, but not sole, player.

Moreover, these and related changes in the governance process do not appear to be limited to Canada or western societies, but also seem to be occurring in various forms in very different societies around the world. (As one senior official put it not long ago, Gorbachev is riding the information tiger, and from my own observations in China, and from our own experience here, I can tell you he is not alone!) The assumptions, categories and ways of thinking about policy and governance that practitioners have developed and used over the years seem no longer adequate to deal with the new realities, and in some cases may be misleading.

The very distinction between public and private sectors begins to blur as the growth of the service sector and the privatization and contracting out of government functions proceed, and as new organizations are developed to demand a greater voice in the governance process. In the turbulence of the information society, how does one begin to grapple with the issues, and to develop new ways of thinking about the policy process, about the roles of the various players both public and private, and about ways to integrate the wide range of increasingly powerful and articulate special and regional interests so that Canada can better deal with growing global challenges?

These are some of the broader questions, generated by the transformation to an information society, that we increasingly will need to address. And those broader questions may help us to pose some issues which we should keep in mind as our discussions here proceed on the impact of globalization, diffusion and innovation in information technology on Canada's international competitiveness.

Let me close by suggesting a few of those issues that I hope will be recurring themes in our discussions:

- What is the appropriate role for the public sector and for the private sector in addressing the issues we will be discussing?
- Stated somewhat differently, what should be treated as public goods, and what left to market mechanisms?
- To what degree is it feasible and desirable to extend property rights into the information sector in order to foster creativity and innovation, and at what point does such an extension come into conflict with legitimate concerns about public access to information, about equitable distribution of that information and the benefits it can bring, and with long held views (for example in the scientific community) that knowledge should be treated as part of our common heritage?
- And, finally, what new mechanisms and approaches will be required to forge consensus and resolve disputes amongst the public and private sectors and other players, both nationally and globally, to better enable us to address the particular issues we will be discussing here?

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New Information Technologies: Innovation and Diffusion

Lucie Deschênes
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When one speaks of the advent of the information society, one is generally referring to the impact of new information technologies, designed to process, store, reproduce and transmit information in all fields of human endeavour. In order to shed light on the current trends, we will present a brief overview of the innovations in information diffusion, the resultant developments within organizations and factors influencing the degree of computerization.

1. Diffusion of Information

1.1 Traditional means of diffusion

Although information has existed from time immemorial, the means of conveying opinions and information have changed considerably. The printed press gained undeniable supremacy in England in the early 19th century, a period which saw the emergence of the major world news agencies (Associated Press, Reuter, etc.), press distributing services and most of the major newspapers. Advances in newspaper publishing technology such as offset, the invention of the telegraph, and then telecommunications technology making satellite transmission possible have each in turn radically changed the newspaper publishing industry.

The advent of radio broadcasting in the early 20th century marked another important stage in information diffusion. It led to the emergence of mass culture, the sharing of interests, values, ideas and beliefs common to the whole population. Mid-century saw the rise and growth of the news and entertainment media: television, music, film and book publishing. The market for these information industries, now described as traditional, almost tripled in Canada between 1977 and 1985 (Communications Canada, 1987).

1.2 New information technologies

In recent decades there has been an invasion of a whole range of communications technologies into our daily life: cable television, video cassettes, audio cassettes, video disks, video games, compact disk players, new types of telephone, personal computers and so forth. These new information products and services come from new firms that are taking an ever increasing share of the information market.

According to Jacques Perrin, the handling of information accounted in 1984 for 40 to 50% of the value-added produced by the transborder flow of information in the industrialized nations. The industry associated with such new technologies has seen the emergence of new products: text, digital data, sounds and images that can now be recorded, stored and exchanged in electronic form.

The new products take the form of databases that provide information electronically coded in the digital language of computers. The microcomputer has maximized the possibility of immediate access to the information. As a result of developments in electronic telecommunications networks, it has become possible to query sources of electronic information, exchange computerized data and documents, carry out business transactions and so forth. Progressively, the management of information is becoming the modus operandi of world economic activities (Seguin, F., 1989).

It is estimated that at the present time there are more than 3,000 databases that provide information on all sorts of subjects from the stock market to one's horoscope; increasingly they encompass all aspects of human endeavour. Indeed, new information technologies (the software and data processing industries) have grown more quickly than the GDP with revenues increasing sevenfold between 1974 and 1985, from $200 million to $2.1 billion (current dollars) (Communications Canada, 1987).

1.3 The business market

For many firms and organizations, commercial databases have come to supplement, if not replace, printed media such as newspapers, magazines and trade publications. The United States plays a central role in telereference in Canada, for example, a high proportion of data produced by American-owned enterprises (Visa, Household Finance, etc.) are stocked in data banks located in the United States.

In parallel, electronic data interchange (EDI) related to business transactions is an electronic information service that increasingly has been drawing the attention of Canadian firms. EDI, which links over 300 firms, makes it possible for firms using different computer hardware to exchange business documents electronically, to carry out business transactions and so forth (Sandy, Kemp D. A., 1987). In the wake of the Free Trade Agreement, trade between Canada and the United States is likely to be conducted largely through EDI ("Canada's Rapid Embrace," 1988).

The development of artificial intelligence is also having an impact on the business sector. The American business software manufacturer, McCormack and Dodge of Boston, plans to market within a year a system designed for administrative uses that will enable computers to respond to voice commands ("L'ordinateur qui entend," 1988). In the area of management information systems, it is expected that expert systems and natural language querying will become increasingly popular; among big enterprises surveyed "All of the companies were committed to highly functional and usable Management Information Systems and Executive Information Systems" (Evans Research Corporation, 1989). As a result of artificial intelligence, which makes it possible for computers to respond to voice commands, administrative uses should multiply.

1.4 The general public market

Services intended for the general public have also grown significantly: in 1984 consumer information services (teleshopping, sports news, entertainment news, electronic bulletin boards and so forth) accounted for sales of $77.8 million, or 5% of the total computer services market. Projections are that such services will generate revenues of $470 million in 1989, or 13% (Communications Canada, 1987). Examples (in the United States) of firms offering such services are CompuServe, Dow Jones News-Retrieval and The Source; the first two have more than 250,000 subscribers and the last has some 60,000.

But the most popular is unquestionably the French service Minitel, which has more than 2.5 million subscribers. In Canada, Alex (Bell Canada) was put on the market on an experimental basis in Montreal in the fall of 1988. It provides a whole range of services and electronic information including shopping, banking, lists of restaurants and cultural events, financial services and special bulletins on a 24-hour basis.

1.5 A new social organization

According to the President of Northern Telecom Ltd, David G. Vice, a new social and economic organization, based on telecommunications, will emerge in the 21st century. The integrated services digital network (ISDN) is an important step toward the establishment of universal networks and integrated services ("Les télécommunications à l'origine," 1988). AT&T, British Telecom and France Télécom have just installed a transoceanic fibre optic cable between Europe and North America capable of carrying 40,000 telephone conversations simultaneously. It is proving to be a key link in the world communications network ("La fibre optique," 1989). The cable will make it possible to transmit information in the form of voice, data or video. In Canada, firms will soon be in a position to transmit business documents electronically outside the country. An agreement between AT&T and Telecom Canada will allow for transmission of business documents such as invoices and order forms ("Échanges électroniques," 1989).

A report by the FAST group summarizes current technological changes this way:

> New information and communication technologies have overcome time and distance. Masses of data flow across the borders in different signals—analogue or digital—and through different media—post, telex, telephone, data networks . . . —This development is the result of the combination of telecommunications and data processing and is clearly demonstrated by the advent of satellites of a composite type which will equally well transmit voice, messages, pictures, and sounds and provide a powerful instrument of global communication. (Communauté économique européenne, 1984).

1.6 Trend towards concentration

The phenomenal growth in information products and services has been accompanied, however, by a marked trend towards concentration, which began several years ago. For example, the 10 main makes of computers (mini and mainframe) used by Canadian firms (Canadian Information Processing Society, 1987) are all American and account for 75 to 80% of the Canadian market. IBM and Digital Equipment have dominated the market since 1975. In the case of small and medium-sized businesses (maximum annual revenue of $40 million in 1985), the most popular makes in Canada as a whole are IBM (53% of the market), Apple (8%) and Tandy-Radio-Shack (3%) (Evans Research, 1985).

On the international scene, the United States is clearly the world leader in the database industry. US database producers and vendors constitute over half the total in both on-line and gateway categories (Communications Canada, 1987). The telecommunications sector is, according to many, a field in which Canada could conceivably make a good showing on international technological markets.

1.7 The importance of telecommunications

Canada is renowned worldwide for the extent and quality of its telecommunications network. In addition to the services offered by telephone companies, telecommunications companies offer a wide range of services: CNCP (mainly transmission of text and data), Teleglobe Canada (overseas communications) and Telesat Canada (communications by satellite) (Ministère des Communications du Québec, 1988a). This industry is characterized by a high degree of concentration.

The new cellular radiotelephone service is drastically changing the mobile telecommunications market. Two firms share this developing market: Bell Cellular, a member of CellNet Canada, and Cantel Inc., owner of a national network; they have 65,000 and 75,000 subscribers, respectively (MCQ, 1988a). Mobile Telecommunications firms are planning to expand by looking for new customers among consumers and the business community (small and medium-sized businesses) mainly by offering a new range of products and services while reducing rates (MCQ, 1988b).

As regards the Canadian telecommunications equipment industry, Northern Telecom (Nortel), a subsidiary of Bell Canada Enterprises, dominates the market with sales estimated to account for 70% of total sales of telecommunications equipment in Canada. Northern Telecom is also an important player on the world market; in 1984 75% of its sales were on the American market and 15% on the Canadian market (MCQ, 1988a).

The telecommunications equipment and communications sectors, which are growing at an annual rate of almost 11%, are a key industry for the economic development of Canada (MCQ, 1988b). According to the Quebec government, the success of the telecommunications equipment industry in Quebec and Canada is largely dependent on the growth of trade on the world market, especially with the United States.

2. Innovation Within Firms

2.1 Incentives and obstacles to innovation

With the production of new information goods and services, a number of studies have demonstrated the interrelationship between technological innovation, industrial productivity and competitiveness of our industries on international markets. They have pointed out the economic benefits of adopting and using new technologies with respect to productivity gains for example. Indeed, the competitiveness of our organizations seems increasingly to be linked to their ability to adopt and use effectively the new information technologies.

According to the Economic Council of Canada (ECC, 1986), in nearly 70% of Canadian firms, increased organizational productivity was the main factor behind technological changes. Managers' automation objectives rest mainly on criteria of productivity, profitability and competition. Other incentives mentioned include enhanced operational effectiveness and improved quality of products and services (ERC, 1989). This study also contends that information and telecommunications technologies will have a major impact on the labour market and the economy in general in the years to come. It is important, therefore, to monitor the pace of diffusion and the use of new technologies but also to identify the factors of development and the obstacles to the diffusion of innovations.

Although the diffusion of technologies is generally associated with a drop in the cost of equipment, this factor is still the major obstacle to innovation for more than half the firms that participated in a survey conducted by the ECC in 1985. A shortage of qualified staff and uncertain machine performance also hamper the adoption of new technologies, especially in small- and medium-sized businesses. Finally, the problems of standardizing languages and technologies constitute a deterrent for one-quarter of the firms. Solving these problems should have a significant effect on the ability of firms to use new technologies.

2.2 First phase of computerization

Heavy, costly and centralized computers were the first stage of computerization (MCQ, 1988b). Before 1975, they were used exclusively by large public and private organizations, mainly for everyday operations (accounting, personnel management and so forth). This first phase was characterized mainly by the introduction of word processors (WP) and data entry terminals (DET) in offices. Most Canadian organizations are still in this first phase (Dumas, M. C., M. P. Maurice and L. Deschênes, 1988).

According to CIPS (Canadian Information Processing Society, 1987), the number of computing facilities (excluding micros) leasing for a monthly rate exceeding $1,000 or worth a purchase price greater than $35,000 rose from 710 in 1965 to 14,503 in 1986. Almost 50% of these new technologies are used in Ontario. For example, during that period, Quebec's share of Canadian computing facilities dropped from 29% to 16%, whereas Ontario's share remained relatively stable moving from 46% to 45%. Although the number of computers in Ontario is almost three times higher than in Quebec, the

breakdown by cost of leasing is similar in the two provinces, most computers (55% or more) falling into the class that can be leased for between $1,000 and $4,999.

2.3 Second phase of computerization

The diffusion of microcomputers in the mid-seventies corresponds to a decentralized, distributed, broader form of computerization (MCQ, 1988b). The second phase of computerization in organizations meant a range of applications intended for a larger group of users. This is the phase in which informatics was applied to traditional office activities and equipment: word processing, electronic mail, records management and so forth.

The massive introduction of microcomputers in firms, however, is a recent phenomenon; the years 1980-1985 are generally considered to be the transition period in Canada. According to Evans Research (1985b), 64% of small- and medium-sized businesses with annual revenues greater than $40 million in 1985 had acquired their first microcomputer in 1983 or 1984; more than 75% of firms working solely with microcomputers had acquired their first microcomputer in 1984 or 1985; only 17% had made the purchase before 1984 (Lefebvre, L., E. Lefebvre and J. Ducharme, 1987). The recent popularity of microcomputers can be explained by the lower costs but also by the fact that there are fewer problems associated with introducing such technologies.

According to the ECC (1986), office automation applications (personal computers, workstations, word processing, networks and other applications) predominated in technological innovations in firms in all economic sectors in Canada between 1980 and 1985. For example, in the first half of the 1980s, office automation technology accounted for almost two-thirds (64%) of all applications introduced into Canadian firms. The applications adopted were the following: microcomputers and workstations (25% of applications), word processors (17%), and computers used for general administrative operations (16%). It is expected that from 1986 to 1990, office automation will remain the main form of technological innovation, accounting for 51% of all applications.

The early 1980s also saw considerable expansion in electronic mail and courier services, made possible in large part by the development of Canadian public services that meet international standards (Telecom Canada's Envoy 100 and CNCP's Dial Com). Evans Research (Chevreau, J., 1986) assessed the Canadian electronic mail market in 1985 at $15 million and estimated that the annual cumulative growth rate of 19% would double by 1989. According to Link Resources (Chevreau, J., 1986), the public electronic mail networks in the United States generated revenues of about three hundred million dollars in 1985, and this market should reach 1.5 billion dollars in 1990.

2.4 Third phase of computerization

In addition to the integration of office automation systems into Canadian firms, plans for office automation networks are also significant. About 5% of Canadian firms had integrated networks in 1986; the percentage is expected to double by 1990, according to the ECC. Advances in digitization and interconnection making possible the integration of informatics and telecommunications (telematics) and the appearance of networks (local, national and international) are associated with the third phase of computerization, which shows a marked trend towards greater integration of computerized systems.

In addition to local area networks (LAN), one can expect to see the development of public and private wide area networks (WAN) and of an integrated services digital network (ISDN) using fibre optics technology and capable of transmitting any type of message (voice, computerized data and images). Canada is expected to move towards complete digitization of its national telecommunications network, and it is in the forefront of ISDN on the international scene (Parker, E. B., 1976).

The establishment of a universal network integrating international standards should help to eliminate barriers to the exchange of information between countries. The development of networks

could lead to greater, sustained growth in new related services: electronic mail, videoconferencing, remote access to databases and so forth (MCQ, 1989). Evans Research predicts that demand will be increasingly for professional services stemming from telecommunications and informatics, which are expected to register a compound growth rate of 63% by 1990 (Communications Canada, 1987).

These developments pave the way for a fourth phase of computerization, that of distributed networks, characterized by deconcentration of processing and simultaneous multiprocessing. In addition to greater convergence between data processing and telecommunications, this phase will see voice converters, optical readers and other sophisticated equipment whose uses are still to be determined (Dumas, M. C., M. P. Maurice and L. Deschênes, 1989).

2.5 Trends in software demand

When considering trends in software demand, it is important to point out that during the first phase of computerization, that is up to the mid-1970s, large private and public firms used mainly custom software. In the early 1980s the custom software sector accounted for 47% of total sales of the Canadian software industry (ERC, 1985a).

During the second phase of computerization, corresponding to the diffusion of microcomputers, the market shifted in favour of software packages: standardized software that is mass produced and intended for mass consumption. The market for this type of software has grown steadily since the early 1980s: custom software accounted for 28% of the market in 1983, 16% in 1987 and is expected to drop to 15% in 1989, whereas the share of software packages climbed form 53% in 1981 to 83% in 1987 and may have reached 85% by 1989 (ERC, 1985a).

Development of the first sector should be sustained by the development and integration of new communications networks but also by the adaptation and modification of mass produced software. The second sector should continue to grow as microcomputers further penetrate the market and more and more small and medium-sized businesses computerize (MCQ, 1988b). The growth of the groupware sector should be important in the coming years.

2.6 Advent of telematics

The introduction of technologies related to telematics has been slower and more complex than expected, mainly because of cost, incompatibility of systems and an inadequate assessment of needs. Up to now, demand has been for gateway services and electronic mail and courier systems. The development and penetration of new professional services depend in large part on the expansion and viability of Canadian industries producing information, which seems increasingly to be the raw materials of Western economies (MCQ, 1988b).

A number of key sectors in the Canadian information industry are weak. One weak sector is the information production industry (production and publication of databases and software), in which Canadian firms—which constitute the raw material of the major networks—hold a tiny share of their own market. Canada is lagging behind considerably: supply is low (barely 5% of the world industry) and not very diversified, and requirements are generally met outside the country. Since the mid-1980s, however, the rate of growth of our domestic markets has been comparable to that of the United States (MCQ, 1988a). The United States, for its part, is indisputably the world leader in information creation: it has 53% of the planet's databases, which accounts for almost two-thirds of the world production of electronic information (MCQ, 1988b).

3. Diffusion of Information Technologies

3.1 Rate of diffusion

Over the past decade, the development of informatics and telecommunications applications has been an important factor in the transformation of our societies. In a context where the economic activity generated by information is greater than 50%, information industries are a growing part of the new economic structure.

But the revolution associated with information technologies is not so much the discovery per se of new technologies, which is progressive, but their applications (Faltas, 1988; Winston, 1986). The degree of penetration and diffusion of new information technologies is hard to assess because of a lack of statistical data that would make it possible to measure the degree of computerization of firms and the economy. Thus far, little analysis of the importance of the role of the information technologies industry in the social and economic development of Canada has been carried out. Hence, we have only a vague idea of the industrial and economic integration mechanisms in this industry and the characteristics of information activities. This is the result of a lack of statistics on the sector, which in turn is related to gaps in the classifications used by public and private statistics collecting bodies.

In light of these gaps, it is very difficult to find out the rate at which computerization is progressing in various economic sectors, to identify the strengths and weaknesses of the information sector and to measure how far we are lagging behind our international competitors. According to a study conducted by the United States Office of Technology Assessment, "At the very moment new information technologies are transforming the economy, we are forced to rely on data that are often outmoded and outright misleading" (Kelly, H. and A. Wyckoff, 1989).

A recent study undertaken by the ECC indicates that the degree of computerization of firms is high, with 75% of firms stating that they had adopted at least one innovation based on computer technology between 1980 and 1985, and the figure is expected to reach 85% by 1990 (ECC, 1986). It is important to note, however, that the diffusion of technologies does not occur in a uniform manner. It varies considerably depending on the size of the firm, the industry and the region of the country.

3.2 Firm size

The degree of computerization varies first of all according to the size of an organization: the larger the firm, the more likely information technologies have been introduced (500 or more employees: 99%, and 50 or fewer employees: 55%) (ECC, 1986). A study conducted in Quebec showed similar results: the rate of computerization in small manufacturing firms is lower than in large manufacturing firms (Lefebvre, L., E. Lefebvre and J. Ducharme, 1987).

The value of the hardware is also directly related to the size of the firm: the larger the firm, the more the computer equipment is worth (ECC, 1986). For example, in large firms (more than 500 employees) the average value of present hardware is $500,000; in medium-sized firms (from 100 to 499 employees), $300,000; and in very small firms (1 to 19 employees), $55,000. In the latter case, it is likely that microcomputers are used, as they require a lower investment. In an economy composed mainly of small and medium-sized businesses, the value of hardware plays a determinant role in the adoption of new technologies (MCQ, 1988b).

Although the larger the firm, the greater the number of applications (ECC, 1986), it seems that it is mostly small firms that plan to introduce new informatics technologies over the next few years (Lefebvre, L., E. Lefebvre and J. Ducharme, 1987). Moreover, short-term purchase plans by small firms are mainly for new informatics applications related to stock management, accounting, finance and to a lesser extent personnel management, whereas large firms are mostly interested in electronic mail and records management, especially in the business sector (MCQ, 1988b).

Purchase plans show that the computerization process is far from over: in medium-sized and large firms (from 100 to 500 employees), the value of planned informatics equipment is generally as great as the value of existing equipment (MCQ, 1988b).

Small businesses in the manufacturing and business sectors are lagging behind somewhat small businesses in the service sector, a difference explained by the high cost of computerization in the two sectors and a lack of human resources (MCQ, 1988b).

Firm size also has a direct effect on the language of the software used in firms in Quebec: small firms (less than 100 employees) reported using a higher percentage of French software (50%) than larger firms (MCQ, 1988b). Taking accounting software as an example, French software is used in 50% of small firms, 37% of medium-sized firms and 30% of large firms (1987). Large firms use more English software (35%) than French software (30%) for accounting.

3.3 Economic sectors

Some firms have a higher level of computerization. For example, the degree of computerization is higher in service firms. It varies according to sector: wholesale trade (91%), communications and other public services (87%), business services (82%), finance, insurance and real estate (79%) (ECC, 1986), or according to service offered, which itself is more or less dependent on computerization. The four most highly computerized sectors are also the ones that have opted in great numbers for office automation technologies (87%, 79%, 79% and 77%).

Some important differences were noted (ECC, 1986), in particular with respect to the adoption of office automation networks. For example, 25% of firms in the finance, insurance and real estate sector adopted office automation networks compared with 12% in the communications and other public services sector and 9% in the wholesale sector. Conversely, word processors, personal computers and office automation networks are used more in the primary and manufacturing industries.

The value of the equipment is also influenced by the economic sector, especially with respect to very small firms. For example, in the manufacturing sector, investment by very small firms is three times higher than investment by firms in other sectors. This can be explained by the relatively high initial cost of some specialized applications such as computer-assisted manufacturing (CAM) technologies. In addition, the commercial sector is the one that plans to invest the most in the acquisition of informatics equipment (MCQ, 1988b).

3.4 Region of country

Diffusion of technologies is also very different according to region of the country. The percentage of Canadian companies that introduced new technologies between 1980 and 1985 increases from east to west: Atlantic, 67%; Quebec, 71%; Ontario, 76%; and the West, 81% (ECC, 1986). Quebec and Ontario are ahead of the other provinces in terms of expenditures on informatics equipment and costs associated with production automation in the manufacturing industry (MCQ, 1988b).

If one looks at the use of computers (CROP, 1987) by persons 15 years of age or older, one also finds significant fluctuations according to region: the Atlantic Provinces have the lowest percentage of users (18%), followed by Quebec (24%), while Ontario (31%) and the Western provinces (35%) have higher rates. The percentage of people who have been using a computer for more than three years is also higher among residents of the West and Ontario (47% and 38% over against 30% and 31% in Quebec and the Atlantic Provinces). There is a considerable gap between Anglophones (42%) and Francophones (28%) (Deschênes, L., 1988).

If one looks only at the work force, one notes that in 1987, more than two Canadians out of ten (21%) used a microcomputer for their employment either occasionally (10%) or regularly (11%). The percentage of users also increases from East to West (Atlantic Provinces, 16%; Quebec, 20%; Ontario,

21%; and the West, 23%). Anglophones use microcomputers at work more than Francophones (23% over against 17%).

Among people who have microcomputers in their homes (13% in 1987, CROP), the percentage of Anglophone households is higher (15%) than the percentage of Francophone households (10%). The highest percentages are in Ontario (16%) and the West (15%). People who use computers in their homes do so mainly for work or entertainment. They are used most often for word processing.

Overall, firms in the service sector are more computerized; the rate of computerization is directly related to the size of the firm; the pace of diffusion of new technologies is much slower in small and medium-sized businesses and increases from East to West in the country; and the hardware comes mostly from abroad.

4. Toward an Information Society

4.1 Information activities

Research undertaken so far on the national and international scene clearly points to the growing omnipresence of new information technologies. All sectors of the economy, whether manufacturing or services, are being profoundly transformed by advances in the informatics and communications sectors. Not only are goods and services affected, but also the internal organization of firms, relationships between the various economic players and even the very foundations of our society are affected.

According to the OECD, information activities (creation, processing, diffusion and infrastructure) account for between 18% and 25% of the GDP in industrialized countries and for between 27% and 41% of jobs (OECD, 1986). Growth in this industry even exceeds that in the GDP, an observation which is also true for Canada (Communications Canada, 1987). On that score, the industrialized countries are running a veritable race to get new information technologies.

Although these industries have a high export potential, it is the United States and Japan that are particularly successful in exporting; for its part, Canada has a trade deficit for most products. It goes without saying that Canada could take a greater share of the international market, especially in the sector of new services.

Many consider that the current revolution in the production, processing and distribution of information, in which the computer plays a central role, occurs in the context of the post-industrial society, while acknowledging that information is a factor of change: "By information I mean data processing in the broadest sense: the storage, retrieval, and processing of data become the essential resource for all economic and social exchanges" (Bell, D., 1981). The boundaries of the three traditional sectors (primary, secondary and tertiary) are expanded to make room for a new sector, the information sector, in which the informatics and telecommunications industries play an essential role. The underlying concept is that knowledge and information have become strategic resources and agents of transformation of the post-industrial society, which has reached a new stage: the information stage.

The FAST group (CEE, 1984) is of a similar opinion: the information society is tending toward an advanced industrial society in which new information technologies would play the role of the central nervous system.

4.2 The information economy

One could probably say that we are witnessing the industrialization of the activities related to information, knowledge and data following the same basic principles as the industrial society: namely the standardization and maximization of the production of information goods and services. However, whereas the post-industrial society was capital intensive, the information society is information

intensive. In other words, information is now the raw material of the new economy and the principal factor of growth and development. "Today the return on investment in information is estimated to be approximately 15%, whereas 30 years ago it did not reach 4 or 5%. The earning power of capital, which was approximately 10 to 12%, on the other hand, has dropped to less than 4% per year. Capital is no longer the source of development and power it once was" (Lanvin, B., 1986).

The pace at which our societies are changing from economies based on the production of goods to economies built on the creation, management and diffusion of information and related services is unprecedented. The fact that information has taken on such importance has led to some consensus regarding the advent of an information economy, or at least an economic structure with a very major information component. It is in this light that the term information economy is now applied to the group of countries made up of the United States, Japan and most of the OECD countries.

In spite of the many different analyses undertaken on the subject at the international level, we still do not find a standard definition of information economy on which statistics are gathered.

Although we are being propelled toward the information society by developments in the informatics and communications technology sectors, it has proved difficult to get a clear picture of past trends and the effects of such changes in the short- and long-term. By this very fact, political decision-makers and planners in the public and private sectors do not have available the relevant information to enable them to plan, co-ordinate and develop policies and programs adapted to the information sector and the new needs of Canadian society.

It is important, in light of the above, to promote economic and social research related to information activities, because this new industrial sector conditions international development in an era of greater and greater integration of informatics and communications technologies, and because this new sector is of definite strategic importance for the future of our country.

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The Structure of Canada's Information Technology Sector: Recent Changes and Future Prospects

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Information technology provides exciting opportunities, and just as importantly, major challenges for both Canadian users and providers of information technology products and services. For example, users must not only continually keep pace with the rapid technological changes occurring within this field, but they also must become more aware of the important strategic role information technology plays within their organization. Canadian vendors, on the other hand, are faced with the challenge of increased global competition. Finally, policymakers and educators must examine ways of providing an environment that not only encourages the development of and training in leading-edge applications, but also that ensures the Canadian information processing industry can compete internationally.

My purpose is to discuss with you a backdrop to the following issues:

1. The size and the growth of the Canadian information processing industry over the last ten years and future projections;
2. The structure of the industry with primary emphasis on trends concerning the major players, new market entrants and the users of information technology;
3. Some broad differences between the Canadian and U.S. information processing industries;
4. Finally, some of the major trends in this industry.

I will not be addressing each industry sector separately, but rather I will be addressing major issues relating to the Canadian information processing industry. The observations and statistics expressed in this presentation come from two sources: the work that is done in our company, Miller, Toller and Evans Inc., which is a strategic and marketing consulting firm, and also the work in our affiliated company, Evans Research Corporation, which provides market research on the Canadian information processing industry.

Exhibit 1 provides a starting place by showing the size of the Canadian information processing industry and by demonstrating some of the major shifts that have occurred in this industry over the last ten years. This exhibit shows the revenues from the Canadian information processing industry from 1981 forecasted to 1993, and what percentage of the total relates to hardware, software and services. The revenues shown exclude exports and offshore revenues, and they also exclude revenues generated from the reselling of hardware and software. The hardware revenues include sales, lease, rental and maintenance of hardware, and the software revenues include application packages, systems packages, and systems development. Revenues from the industry have increased nearly 75% between 1981 and 1985, and then levelled off slightly between 1985 and 1989 increasing by 45%. It is forecasted that revenues will increase 34% between 1989 and 1993. This is assuming a 4% inflation rate over the years, and represents our worst case scenario.

Much of the earlier growth between 1981 and 1985 could be attributed to the introduction of personal computers and associated peripheral, software and services which spawned a new segment of the industry and, generally, brought about greater awareness and subsequent usage of all computer equipment and services. Exhibit 1 also indicates the decrease over the years in hardware as a percentage of the total from 72% of total revenues in 1981 to 60% of the total in 1993. This is compared with the software and professional services which have increased their share of the total market over the years. This shift away from hardware to software and services is not unique to Canada. As hardware becomes cheaper, smaller and faster and we see improvements in price performance, hardware sales have become more commodity-like, particularly in a multi-vendor environment. Software and professional services are now the mechanisms for vendors to deliver customized, unique solutions to the client.

Exhibit 2 shows the dramatic impact PCs have made on sales in the Canadian computer industry, and ultimately on the way the industry functions. While introduced to the Canadian market in 1978, PCs received a big boost with the August 1981 introduction of the IBM PC. The PC market has grown from 4% of the total hardware industry in 1981 to 40% in 1989 (including workstations). The PC market continues to be one of the fastest growing segments within the Canadian information processing industry. The mainframe market has been, and will continue to remain, stagnant while the medium-size system market has experienced the "mini squeeze".

I would now like to provide a brief analysis of the structure of the Canadian information processing industry by concentrating on some of the characteristics and trends relating to the major players, new market entrants and the users.

This industry, particularly as it relates to the vendors, is presently fraught with much volatility and rivalry. In most segments of the industry (hardware, software and even in the services sector), users are faced with an enormous selection of vendors and their products from which to choose. As standards emerge, what we see is a lack of product differentiation amongst many of the competitors—particularly amongst what we call the mid-tier competitors. At first glance, the products are confusing to the user since there is not much to tell them apart.

This lack of product differentiation and the emergence of standards has forced hardware into becoming more and more commodity-like. We see this not only with the PCs and laptop, but also in the mini area and with mainframes. Hardware is being judged primarily on price performance—the best product for the price—and no longer strictly on a vendor's reputation. Some companies are trying to counteract this by providing more value-added services to their product.

Users are also faced with fewer switching costs in moving from one vendor to the other. Again, this is due to standards emerging and commodity-like behaviour hardware. By switching cost, I mean the one-time cost facing the buyer when switching from one supplier to another. For example, not long ago moving from one vendor to another meant not only the purchase of new hardware and software, but it also meant massive conversion and retraining costs. Now, with more standardization and open systems, switching costs are decreasing, and with it customer loyalty. Again we see this specifically in the PC world. All this results in an industry that is fiercely competitive and that is encountering price wars. Price wars now exist in virtually every segment of the industry, not just with PCs and workstations, but even in the services sectors.

Margins are being squeezed as competitors fight for market share. One way major players have avoided competing primarily on price, is to provide more and more value-added services and to differentiate themselves, not on cost, but on the service they are providing the customer. And some are doing this through a delivery mechanism called systems integration, which I will be addressing later.

Other major players are responding to this competitive environment by forming strategic partnerships, technological alliances or by merging with other companies. It is often difficult for a company to exit certain segments of the market even if they are losing money because that market

segment is of a strategic importance to the rest of their operation. By forming alliances or partnerships, organizations can achieve scale economies in marketing, administration and, sometimes, in manufacturing. As well, they might gain access to new technologies and, just as importantly, to distribution channels. Finally, it might be advantageous for a company to form an alliance or merger just for the sake of eliminating a competitor or gaining market share.

Examples of strategic partnering can be seen with the unlikely partnering of Digital and Apple working together to ward off IBM. They are looking at methods of integrating the Mac world with the Digital environment. As well, some companies realize that they cannot "be all things to all people", so you see technological alliances such as the integration of the Apple's Mac with Nortel's communication products. Finally, we have seen examples of former competitors such as Apollo and HP merge to form a new entity. Rather than continuing to fight it out in a market characterized by low margins and price wars, these two organizations are combining their respective strengths in the hopes of opening up new markets and achieving greater market share.

We have also seen some interesting developments recently in the area of new entrants into the markets—large data processing shops from national companies that have been spun off into their own entity. We see this in the utility areas and with financial institutions. We call these new market entrants illogical competitors because they do not fit the standard mould of an industry vendor. Reasons often given by management for spinning off their data processing operations include the need for more accountability, and the improvement of customer service. As well, many of these organizations have industry-specific applications that they have developed, and would like now to bring into the market. These new market entrants could make significant inroads into the Canadian information processing industry for several reasons: they have economies of scale in both size and financial stability; they have the expertise (they are usually large experienced data processing shops that have sophisticated applications); and, perhaps most importantly, they have access to distribution channels through their data centres, their branch offices and the communication networks.

We have also seen some interesting trends with users over the past five years. The primary trend has been the shift that has occurred from professional MIS control to end-user control. More and more powerful departmental computing can be seen throughout organizations. Users are also becoming more knowledgeable and demanding of what information technology can do for them. As well, the control of buying decisions is no longer centralized in MIS. This makes it very difficult for vendors to target the "influencers" and the "decision makers" within a large organization.

There is the tendency to discuss trends in the Canadian and U.S. information processing industries as if they were one and the same thing. There are, in fact, some important differences in these markets, apart from size, that fundamentally affect the way in which information technology is marketed and used.

To begin with, there are fewer medium-sized manufacturing firms in Canada than the United States. By that we mean companies with about 100 employees and with annual revenues between $10-80 million. Canada is characterized primarily by large organizations and smaller companies, and we tend to have these extremes with little blending of the two. Therefore, vendor distribution channels tend to concentrate their marketing efforts on large customers only. Smaller companies are rarely approached, and it is only recently that the usage and applications of information technology have been marketed to them.

Another, perhaps obvious, difference is that most hardware firms in Canada are foreign subsidiaries. Yet many of the larger subsidiaries have world product mandates to manufacture in Canada for specific niche markets. These facilities compete on an international basis. Although the Canadian federal government has conceded that Canada does not have an indigenous hardware industry, it has placed much emphasis on building up an indigenous Canadian software and services sector. Yet over the past few years, foreign ownership of these sectors has been climbing—witness Reuters buying I.P. Sharp and more recently Computers Associates buying Bedford Software.

One definite difference in the Canadian market, and one that certainly has attracted much attention, is our higher communication costs, specifically relating to long distance service and high speed dedicated lines. As the industry moves more and more to a situation where "the network is the system", if our communications infrastructure is not competitive enough, Canadian businesses will certainly be at a disadvantage relative to international competition.

Finally, we have noticed that generally Canadian users tend to be more conservative in the adoption and implementation of technology than their American counterparts. For instance, the introduction of PCs was proportionately much higher in the U.S. than in Canada.

Now I would like to turn to some of the major trends that we have seen developing in the Canadian information processing industry. As mentioned earlier, it would be impossible to cover every trend in every segment of the market. I would like to touch on two important trends that we have found to be creating great interest in not only the literature but also among our client base.

The first trend really ties all of the elements of the information processing industry together: systems integration. This is a methodology for the delivery of services that is being employed more and more by vendors. We have seen this concept emerge from environments where technology is rapidly changing, and the user, while more knowledgeable, has more constraints on his or her time. These users would like to deal with only one vendor for providing a solution, and would be willing to pay a premium price in order that the vendor assume risk and responsibility for the success of the system.

In systems integration, a prime contractor, the systems integrator, negotiates with a client for a fixed fee contract for a complete operational system. Generally, the contract commits the system to specified performance characteristics. The prime contractor, in turn, subcontracts services to the extent required and purchases the hardware and software. From the client's point of view, the appeal of systems integration is "one stop shopping", where one vendor is responsible for the system.

The systems integration market in Canada in 1987, excluding revenues from reselling hardware and software, was $320 million, and we anticipate that it will grow 20% per year to reach $800 million in 1992. Strategically, systems integration is one of the most important distribution methods in the industry.

The phases or elements involved in systems integration are as follows: planning which involves technology strategies and technical assessment; the development of plans for network and architecture; the design which involves the design of prototypes, modelling of site, office, and factory; the development of customized packages, and performance predictions; the site work which involves construction, and site planning for a multi-vendor environment; and then operations which involve performance analysis, upgrades, contingency planning, training and facilities, and often facilities management.

The advantage to users of systems integration is that there is a fixed fee. The user pays one fee for the development of a complete system and also has a prime contractor, or "one stop shopping". The user does not have to deal with many different vendors but with one authority. Also, total system solutions are very important, particularly in a multi-vendor environment, where the user wants the benefits of different products and services without having to put it all together himself or herself. As well, there is transference of some risk and responsibility. Risk can never be totally transferred, because ultimately the client must be responsible for his or her decisions, but with systems integration, instead of pointing fingers at several vendors, one vendor has sole responsibility.

The advantage to the vendors of systems integration is that they are now competing on value-added benefits rather than on just price. They can also charge a premium price for their assumption of greater risk, and they can leverage some of the strategic partnerships that they have been developing over the years. As a prime contractor, a vendor will be able to maintain account control—systems integration is certainly a wonderful marketing concept. Finally, smaller vendors who are

subcontracted out in a systems integration methodology, particularly those specializing in niche markets, will now be able to have access to clients they normally might not be able to service.

An application that also appears to be drawing much attention lately, and that has the potential of making a sizable contribution to the growth of the Canadian information processing industry, is the Geographic Information Systems or GIS. This is the computerized mapping storage and retrieval of all landmarks within a given area—of roads, of waterworks. There are three building blocks to GIS: graphics which are lines representing rivers and streets, and there are symbols which represent houses and factories; the data base which describes the properties of the symbols of the tabular data; and then a tool kit which relates all of the graphics, the data base and the text. We expect that today the GIS market in Canada is worth $450 million dollars and an annual growth of 45% is expected to 1993, with annual expenditures topping $2 billion dollars. The largest users of these systems are obviously the municipal governments with their fire and police departments. But also provincial and federal governments are very interested in this application. Other users include utilities, telephone companies, and retailers.

Exhibit 1

Canadian Information Processing Industry
Industry Revenue Forecast to 1993
(Excludes Exports)

	1981	1985	1989	1993
Hardware	72%	68%	64%	59%
Software	10%	11%	17%	23%
Professional Services	4%	6%	10%	12%
Processing Services	14%	15%	9%	6%
Total	100%	100%	100%	100%
(C $ Billions)	4.7	8.2	11.9	15.9

Exhibit 2

Canadian Hardware Industry
Forecast to 1993 By Type

	1981	1985	1989	1993
Large systems	43%	30%	25%	21%
Medium systems	28%	23%	15%	13%
Small systems	25%	25%	20%	15%
PCs/Workstations	4%	22%	40%	51%
Total	100%	100%	100%	100%

Source: Evans Research Corporation.

Canada in a New Global Economy

Lucille Fowle
Associate
Canada Consulting

The primary factor driving globalization of information technology is the information requirement of industry itself. The sector that serves this information requirement is being compelled to become more global. The scale of investment required to compete is so vast that a company has to be global just to keep up, especially in the hardware side. Shifts are occurring in demand, and the industry is moving to where the growth in demand is located. The price competition is driving hardware manufacturing offshore. And the new emphasis on software and services obviously requires local infrastructure to meet those needs.

Consider how Canada has done with each of these developments. In terms of keeping pace with the required scale of investment, Canada has not stayed in the race. We have not maintained sufficient momentum in investment in computer hardware, and we do not have a local Canadian IBM equivalent, although we do have in the telecommunications side, of course, with Northern Telecom. In terms of the convergence to standardized environments, what has that done for the Canadian industry? Attempts in Canada to create proprietary hardware environments have not been successful. Canada has more and more become a niche player. We have some excellent small, niche businesses as well as branch plants. In terms of the shift of manufacturing to low wage countries, naturally Canada has concentrated more on the software and systems side, not being a low wage country. And, most importantly, in terms of the globalization of the customers who require information, for many firms in Canada serving the domestic economy has been a strategy. But today it is going to require more of a global approach. Unfortunately for the Canadian firms, there are few global headquarters based in Canada from which they can move out and serve all of their subsidiaries around the world.

So what are the issues for Canada then? How can we gain national competitive advantage in an international industry? How can we be an attractive country for the location of multinationals to invest? How can we give a good start for our Canadian firms, what advantages do we have? One obvious advantage is our fine, advanced education in Canada. The engineering and computer science quality in Canada is one of the reasons why Northern Telecom is so active here. How do we create a sustainable position for Canada in sectors where we do not have a major Canadian multinational? You can see the contrast between telecommunications and computer hardware. Northern Telecom alone has spawned perhaps up to 100 other firms. They have almost created the Canadian telecommunications industry. In contrast, without a major leader on the computer hardware side, we have a lot of small niche players in the manufacture of computers and components.

How do we enable our firms to gain world class experience while still in the domestic marketplace? For them, we do not have as many challenging projects while still on their home turf as they would if they were a firm operating, for example, in the United States. And, again, how do you develop export capability when you have a small domestic market? Here the Australians are envious of Canada because theirs is even smaller and even further away from all the other markets. But still

this is what the Ontario Premier's Council came to call the small country problem. How do we have enough sales within our own country so that we can be big enough to be a success overseas.

Consider the trade deficit position in the computer industry today, where 90% of hardware sales are by the multinationals. On the software and systems side, the Canadian firms do better, having 25% of the marketplace. The difference is in competitive dynamics. IBM, for example, is over $300 billion in sales now, whereas our largest software firm in Canada is around $100 million in sales. A firm can be a major player in software without being a billion dollar company. Consequently, Canadian firms in the software business have been able to maintain their competitiveness. Some have gained a substantial market share in North America on product sales of $10, $40, even $4 million dollars, which would be unheard of in hardware. But this is because software up until now has been a different business: it has been a fragmented business, and one in which you could specialize and succeed in a global sense even as a small company.

However, one of the trends that I keep hearing about these days as I interview computer firms in both Australia and Canada is globalization of the software and service side. There are indications that some of the above factors that are driving globalization on the hardware side are now affecting software. And so the fragmented industry structure that has grown up in Canada may be vulnerable. Today, many firms are saying that they either have to scale up aggressively to get to world markets, or develop the sustainable niche strategies. And the multinational computer companies which are now expanding so rapidly in software and services will want to push for global scale in order to drive their smaller competitors out.

In terms of surviving globalization, the major factors for the software and service firms seem to be on the package software side, where distribution is the big issue. How do you get your product out to enough customers quickly enough to stay in the race, to get your next product out? For these Canadian software and service firms, getting distribution is the central challenge. Many have excellent products and excellent potential, but without the distribution they just cannot stay in the race. On the service side, the key according to companies that we have interviewed is how to leverage their local presence, in all the different countries that they are in, with their global expertise: how to take experienced people from headquarters who have developed a product somewhere and transfer it to that local marketplace. And we found companies that had $30-$50 million in annual sales, who already had fifteen or twenty foreign, overseas offices serving local markets, which is a tremendous cost to carry for a company that size. So all of this comes down in the end to a need for financing and investment.

There are two primary roles for the government with regard to the information technology industry: as policymaker obviously, and secondly, as customer. As Canada Consulting talks to various governments around the world, we hear lots of talk about pressure from governments to increase the local presence of the multinationals in their country. What are the mechanisms that are going to make Canada an attractive choice for investment of the multinationals and what can Canada do to back its local firms to help them achieve world scale?

I think that R&D assistance is one place to look at the impact of government as a policymaker. Northern Telecom has less than 1% of its R&D cost paid through government R&D assistance. Its primary competitor, AT&T, has 5% of its R&D paid through government R&D assistance. Here is a major competitive disadvantage for Canadian firms.

The government's role as customer is critical in the computer industry because the government is in fact 40% of the marketplace, 20% being specifically in the government and the other 20% in public institutions, universities, hospitals, etc. So if a computer firm does not have reasonable access to the government marketplace, that firm is operating in only 60% of the market; it is not operating in 100% of the market. Furthermore, many of the firms that we interviewed for the Premier's Council said that they got their start because of their government contract. For some, the most challenging thing that enabled them to develop a unique product was something they did in the government or university or hospital environment.

The usual approach to procurement has been local content mechanisms where a Canadian firm gets perhaps a 10% price advantage over a non-indigenous firm. In doing an analysis of those mechanisms, we found that they have a limited effect. For example in 1986, only 19% of the federal government's purchases of computers—in spite of all of these things in place and rationalization scores—were from companies that were so-called rationalized. All the rest were from firms who simply import into Canada. The other problem with local content procurement is that the decision is made at the wrong point. You are asking someone, whose job it is to make a decision whether to buy this product or that product, to make a policy decision that will have some effect on the development of industry. He or she is not the person to be doing that. And in fact he or she has a different set of objectives. For example, in the Ontario government in 1986, there were 4,000 separate contracts to computer hardware firms which added up to a total value of $183 million. Those were tiny contracts for computer hardware companies and, although they were very fair and spread out, no one really benefited much from any of those. So that is not the point at which to try to introduce some effect on the development of the industry. The Premier's Council advocated a strategic approach to procurement which basically means that instead of making a decision about procurement, purchase by purchase, do it on a strategic long-term basis.

There are a number of trends, specifically in the information technology industry, which affect procurement policy which I think are important for governments to be aware of when they look at procurement. First of all, there is definitely a trend to regional manufacturing. For many years we heard about world product mandates. Hardware firms would pick one place around the world where they would produce one product, such as personal computers, or some component. Now they are doing regional manufacturing for their high volume products. This may be a gain for Australia because they are an obvious pick for the region in the Pacific ring. Meanwhile, though, R&D still does operate under a world product mandate. In most cases, I think that IBM is one exception, R&D and manufacturing sectors report primarily to headquarters in these multinational firms. So if a government wants a multinational firm to do more in its country, talking to the local subsidiary will not help. That is a different organization. One of the things that Australia has done in developing their partnership program is that they had the partnership agreement of the multinational signed by a senior person in the international headquarters of the firm rather than negotiating it with the local subsidiary. It has had a tremendous effect on the results of their approach.

Many of the multinationals are contracting out more and more to local suppliers. Subsidiaries within multinationals are competing fiercely for their internal market share. The Canadian subsidiary of IBM has to fight with all the other subsidiaries of IBM to keep what it has here, and to get any additional product lines. It is not a policy decision within IBM where they are going to put a product line; it is a business decision, and that has to be recognized in any procurement policy.

Australia's approach, a partnership program, began in 1988 so it is very new and no one knows really how it is going to work. But the idea is that these firms are going to reach exports of 50% of their sales in that country and R&D of 5%. Fourteen multinationals have negotiated and signed with their international headquarters. The agreements recognize internal competition, and the program was developed in collaboration with the industry. The results that they are expecting are three-fold. First, increased R&D by the multinationals, but they see that as the most fragile result because that could move at any time, and so may not have long-term benefit to Australia. Second, they see upgrading of their local firms through the supplier contracts with them, but then again there is always concern that the local firms are going to become dependent on multinationals and they will never be full-fledged firms. It also can tend to leave the local industry fragmented, since there is no reason to consolidate and gain scale if the firm can just supply its local multinational subsidiary. Third, they see the increased innovation infrastructure, as they call it as being the ultimate goal.

Australia has also recently established a syndicated R&D investment fund, with a 150% R&D tax credit in Australia. Firms can invest in a syndicate which in turn invests in R&D projects. The syndicate owns the intellectual property, and the investee company has the chance to do its R&D quickly, and it can obtain rights to market the product.

The best hope for Canada I still feel is in the software and service side, but these too may become vulnerable to some of the global threats discussed above. Key policy responses are in the areas of procurement. Because the government is such a big customer, it has to have a major impact. Government also has a major role to play in getting risk capital into firms and offering R&D tax credits.

The Information Technology Revolution

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Introduction

The themes I should like to emphasize today are often neglected dimensions of the so-called revolution in information technology (IT). First, despite all the discussion about deregulation, policy direction and regulation are both increasing and more important than they used to be. Second, the most fundamental issues are not the technologies; rather they are the changing information and communication patterns that are made possible by the technologies. Yet we tend to focus the vast majority of our attention on the technologies themselves and not on their implications.

Thirdly, fundamental alterations in the structure of economic relations in all industries is what the information revolution is all about. The focus should not really be on the IT sector, as a sector. Rather, the information revolution is permeating all sectors—public and private, manufacturing and services. In permeating all sectors, it is changing the structure of relations in all industries, and thereby changing social and political relations as well.

Fourthly, our existing economic theories and statistical records are totally inadequate for describing and analyzing IT developments and their implications. We know less with each passing year. As we move towards the knowledge economy, our knowledge of the economy decreases. Perhaps the most scarce strategic resource for policy makers of all kinds, both in industry and government, is policy research of the economic and social implications of the global information economy.

Global Markets and Deregulation

An examination of recent trends with respect to global markets and deregulation indicates that what we are really seeing is a change in the form, the structure and the focus of policy-making. The day of the protected national monopoly is being eroded everywhere, not only in telecommunication and broadcasting, but wherever it has existed. In most instances, this is not as a result of a positive desire to do so. It is because external forces are requiring it.

Transnational corporations are becoming more and more detached from countries. In Canada, periodically we wonder whether Northern Telecom is really a Canadian transnational corporation, or whether it will pick up and leave to become some other country's transnational corporation. This experience is happening with more companies in more countries. Certainly there is a greater concern for the requirements of economic efficiency which must be addressed within the context for the global economy. That is one fundamental reason why the national monopolies are being eroded.

In pursuing efficiency, more nations are reaching the conclusion that the traditional national monopoly is not the best way to achieve economic efficiency. This is illustrated in virtually all developed countries. In the United States one could argue that policy concerns have become more

complex, but clearly in the age of US "deregulation", the Federal Communication Commission (FCC) is still in the business of establishing regulatory policy, and it will be for the foreseeable future. In Japan, and Britain, we have seen the establishment of formal regulation where previously there was none. In Europe, with the opening of the European Market, there has been the establishment of several new European regulatory institutions.

There appears to be an increasing role for regional and international agencies that parallels the declining role of national agencies. This is most evident, of course, in the European Community, and the regulatory and policy agencies being developed there. But it is important to recognize that in the global information economy there is a need for global policies. Historically the international agencies, including the International Telecommunication Union (ITU), GATT, and a number of other agencies, have generally been treated as agencies without much power or real influence, more to be tolerated than to be used as a foundation for major achievements. Clearly these international agencies are going to have to be made to work in the future if there is to be effective management of the global economy.

With the decline in the influence of national policies, we are seeing a new role for regional policies within countries, i.e., provincial in Canada, state in many other countries. The recent progressive activities of Ontario are not unique. They are being discussed by similar provincial and state entities at government levels around the world.

Finally, there is increasing recognition that, with the development of the information economy, the structure of fundamental legal property rights in information is something with which we are only beginning to come to grips. Despite the rhetoric, in fact, the information economy is going to be an economy that is very much directed by public policies and regulations.

Changing Information and Communication Patterns

There is a general assumption underlying a lot of both policy and resource allocation in the information technology sector that the way to economic progress is through invention. After a country invents something it will lead to innovation and be used for economic profit, jobs and growth. I am reminded of the article in *The Economist* in April, 1983, which was entitled as follows: "Invented in Europe, Patented in the U.S., Sold in Japan." This is a good illustration of the very simple fact that inventing things is not where the real economic action is. Inventing things is part of the process. However, without paying equal attention to the other parts of the process, and particularly the innovative applications, then indeed a country will not get those benefits.

I am reminded of an actual experience that I had back in the days when I was working with the FCC. After meeting with AT&T in its board room at its headquarters in New York, an AT&T executive observed that it was in that room that the patent licence for the transistor was signed with Japan. This wasn't very long after World War II when the Bell Labs invented the transistor and did not have much of an idea what to do with it. The Japanese wanted a patent licence. Since AT&T had no idea what the Japanese were going to do with it, AT&T asked what they considered to be a very large amount for the patent rights. The Japanese agreed to pay. There was great concern at AT&T about what the Japanese were going to do with the transistor. After all the papers had been signed, AT&T asked the Japanese what they were going to do with the transistor. The answer came back that they were going to use it to make radios. The AT&T executives laughed at the preposterous idea. We now watch television and listen to the radio on transistorized radio and television sets—mostly Japanese.

I use this anecdote to illustrate the point that in the invention/innovation/diffusion process, the economic, social, cultural, and political implications are at least as important as the technical implications. Recent studies have shown that one of the leading innovations that has led to profits, jobs, and growth over the past ten to fifteen years is known as the Just-in-Time Inventories System.

This is an innovation whose benefit comes entirely from new ways of generating and communicating information.

All of us here have had our lives changed in the last few years by the facsimile machine. The facsimile machine was invented, I suspect, before any of us were born. Yet we have seen the pervasive applications, the potential and the growth develop as a result of a lot of factors other than the technology itself. What we are seeing is a fundamental change in the speed with which information is generated and communicated. What this enables is faster reaction time. It enables decision makers to react to small changes. That is, a minor advantage can be turned into one of major significance because of the implication of these technologies.

The Changing Structure of Economic Relations

The spacial constraints on most markets are being annihilated. As a result, uncertainty is increased. In the face of increased information, the planning horizons of almost all decision makers are being shortened because they do not have enough knowledge from this information to cope with the increased uncertainty. International consultant friends used to justify their existence by saying they brought to management more information to help them make better decisions. But what they now say is they identify for management the 90% of the information that can be ignored so management can focus on the relevant information.

With the movement from an environment of information shortage to information surplus, there is now less understanding and less knowledge of the new environment. I am reminded of a quotation by the Canadian communication economist/historian Harold Innis who nearly forty years ago observed in his book, *The Bias of Communication*, that new methods of communication make understanding more difficult. As an economist I am particularly sensitive to these changes. In the course of my professional career, economic models have become more and more sophisticated, the volume of data processed has increased by an order of magnitude; the data processing has become infinitely better; and our understanding of the economy has become worse. The net effect is that the economy is changing, and becoming more complex, in ways that we have been unable to incorporate into our economic models, which tend to reflect yesterday's economy, not today's.

The increased global competition is not competition as we traditionally know it in theoretical competitive economic models. The closest economic model that economists have developed so far would be that of oligopolistic rivalry—meaning relatively few large firms making fundamental decisions that require major reactions from one another that create instability. This goes a long way to explaining recent developments, ranging from joint ventures to strategic alliances and the increasing involvement of national governments in international marketing. It is part of attempts to minimize instability and uncertainty by establishing favourable long-term arrangements in new national markets.

There is potential here for a quite unstable global market structure. In this market structure, specific localities for manufacturing and other operations may be quite vulnerable to relatively small changes that show shifting global comparative advantages. Localities may become extremely vulnerable. This is precisely what explains the responses of our local, provincial and national governments to the issue of how they are going to provide some kind of stability and security for domestic economic activity in this new global environment.

Most economic theories begin with an assumption of "perfect knowledge". That allows us to dispense with the minor details so that we can get on with the important mechanics of optimization. There has been relatively little attention to the spacial implications of information and communication. There is very limited attention to the economic implications of generating information, and certainly to the role of communication processes.

In this regard, I would like to highlight a weakness of conventional economics and that is the preoccupation with price. Most economic analysis tends to judge everything with regard to its price.

But what we are belatedly learning is that, in fact, price may be one of the least significant indicators in terms of long-run productivity and efficiency. Only in recent years have we seen some increasing attention being paid to the role of technology as a fundamental factor determining the long-run allocation of economic resources. In fact, price may be primarily useful for the very short-run problem of clearing the market of strawberries on a Saturday afternoon, but not very significant for the fundamental long-term reallocations of resources in societies.

So what do we see when we apply mainstream economic analysis to the information economy? Robert Solow received the 1987 Nobel Prize in economics for his work on productivity. He has observed that the information technology revolution can be seen everywhere except in the productivity statistics. One conclusion from that observation is the information technology revolution is not a revolution at all. It is a myth. There is no measurable economic effect. So why are we concerned about it? Another, which economists are probably more reluctant to accept, is that perhaps our economic methods of measuring productivity, and our theories of examining productivity, are deficient when it comes to capturing the implications of the information technologies.

Studies of Japan's success almost invariably explain it not in terms of invention, and certainly not in terms of price. It is generally explained in terms of superior innovation and diffusion, in terms of adaptability and flexibility to change in global conditions, to long-term marketing strategies and to quality. Underlying that seems to be a commitment to education and training at all levels and for all purposes.

According to the Financial Times, the majority of profit made by Japanese companies last year (1988) was for products that did not exist five years ago. The fundamental changes in exchange rates that have developed over the last few years—that were supposed to put Japan at a severe competitive disadvantage and allow the Western nations, in particular, to do better—have not had the effects that were predicted. Indeed, despite these developments Japan is doing quite well in the traditional manufacturing sectors. They are more profitable now than before the changes in exchange rates. One interpretation of this is that the Japanese companies are just overwhelmingly superior in terms of efficiency and productivity. I suspect a more realistic interpretation is that our conventional way of analyzing this issue is somewhat deficient, and economists' prediction of the implications of exchange rate changes did not prove correct because of deficient economic theory and analysis.

A major issue of concern to Canada, the U.K., and all developing countries is the implications of IT developments for the trade deficit. In the Programme on Information and Communication Technologies (PICT) that I have been associated with in the U.K., we have been looking in particular at the U.K. trade deficit in information technology (hardware, software, services) and telecommunication, and trying to project future developments. If we project according to trends, we would conclude that within ten years the trade deficit would become phenomenal. It would not be sustainable and could bankrupt the country. When one looks at the statistics for a great many other countries, this trend is exhibited. If Canada becomes a very effective applier of information technology, then Canada could very well have this problem because of the direct association between applications and imports.

There are certain conventional ways of dealing with this problem of trade deficits. But the conventional ways and what they mean are going to have to be reassessed because the changes in trade balances are occurring much more rapidly and with fluctuations of increasing amplitude. A fundamental economic issue for the future is to assess just what does a massive trade deficit mean in this new global information economy, and what are the range of policies for dealing with it other than crippling restraint at home?

Technical Knowledge and Social Knowledge

Finally, let me move on to the question of science and technical knowledge. It is common practice for most developed countries now to spend substantial amounts of resources on science and technology. The belief is that to be a leading economic power one must be at the frontier of science and technology.

Countries must invent; they must be involved in the generation of new science and technical knowledge. I do not dispute for a moment that it is important. But I do dispute the fact that the focus seems to stop there. A common belief is that if we focus our attention on generating science and technical knowledge, that will be the solution to our economic problems. This of course is exactly what the Science and Technology headline of *The Economist* of 1983 was talking about.

At least as much money must be spent on the other aspects, i.e., understanding the innovation and diffusion processes; the nature of training and education; and on appropriate organizational structures, so that there can be an institutional structure for applying the benefits of science and technology and diffusing them throughout society. The institutional issues are the fundamental issues from which governments tend to shy away. I have always felt that this was a fairly obvious issue. Yet most policy makers have never thought so. To paraphrase Will Rogers, the trouble is not what they don't know, it is what they do know that isn't so. When it comes to questions of hard science, it is quite clear that those of us not involved don't know. But when it comes to most issues of social science we all think we know. Perhaps that is what makes the issue of research and understanding more difficult. Before we can open ourselves to a new understanding of the state of affairs, we have to fight our way through a substantial barrier first, to be convinced that we don't already indeed really understand the situation.

I have been fortunate to be associated with a major new initiative in the United Kingdom over the past three years, which is examining the economic, social and policy aspects of new science and technology. Many of you will be aware of the major program that was developed in the U.K. in the early 1980's, a massive five billion dollar research program on the scientific and technical aspects of information technology. A lot of very good work was done there. The Japanese were very thankful to have that information. They applied some of it very usefully, and turned out a number of products and services that they are now selling back to the British, and around the world.

It was this recognition that prompted the British to set up a network of six research centres to deal with the economic, social, managerial, skill, employment, and policy implications of these developments. If this research leads to increased understanding of these processes, and the U.K. can adapt its policies accordingly, then perhaps the U.K. could get more benefit from the new technology it invents.

I had hoped that Canada, being the country that writes the best policy statements on the subject, might build on the experience in the U.K. and other countries, and take a position of international leadership in the field. I am now involved in the establishment of an international centre in this field that will examine the global issues from local, national and international perspectives in Melbourne, Australia. The new Centre for International Research on Communication and Information Technologies (CIRCIT) will build on the U.K. experience to develop knowledge that will influence not only policy making in the field, but educational programs as well. The knowledge will allow Victoria, Australia to carve out a role for itself in the global information economy that will give it balanced economic and social growth. That is the goal of all countries, including Canada.

Conclusion

There are some individuals and small groups in Canada, who are involved with this right now. But the effort needs to be increased by an order of magnitude. Canada is a unique country in that it never did have an economic reason for existing. Historically, any rational economic market development would not have seen Canada created. This unique history is a matter that Canada ultimately will have to face up to in a much more substantive way than it has to date. When it does, there will then be a basis for developing more informed policy decisions than Canada has been able to develop so far, for making more effective use of the information that now exists and can be developed, and for finding a role in the information economy that both builds on Canada's comparative advantages and looks to the issue of balanced economic growth and development.

In the global information economy, eventually all nations must face up to the fact that there is something more to this game than simply obtaining your competitive advantage over the other countries. It is after all increasingly a global economy. Ultimately, it must be managed as a global economy and the goal of all nations must be balanced economic growth and development. In order to do that we need a lot more knowledge about the knowledge economy than we have today.

Part B

Information Technology and Globalization

What Exactly is Globalization and What is its Relationship with Information Technology?

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The Nature of Globalization

"Globalization" is one of the recent buzz words that is making the rounds in policy circles. It can be found in the headlines of most weekly periodicals and has become almost a ritual incantation. Everyone seems to begin or end speeches with references to the "globalization of markets". Conferences like this one are organized with globalization as the principal theme and extensive studies are undertaken to examine its impacts. But what does globalization really mean? Is it real or just a convenient cliche? How new and significant is the phenomenon?

The first point that must be made is that, strictly speaking, globalization is *not* a new phenomenon. In fact, it is quite old. It can be traced as far back as the voyages of discovery in the early modern period. In the late fifteenth century, Europe sent explorers around the world. Some found new paths to India and the East. Others, like Columbus, discovered new continents like North and South America. From the voyages of discovery developed the first international economy—a global system organized around mercantilist trading blocs. This first global economy lasted through the eighteenth century. At the close of that century, the Seven Years War confirmed the supremacy of Britain as a global power and eliminated the other mercantilist empires.

Stage II of globalization occurred a hundred years later, at the end of the nineteenth century. By about 1900, the world had become an integrated market and was organized in three concentric circles. The innermost circle was centered on the North Atlantic and had on one side, the North American Eastern Seaboard and on the other, the Atlantic Rim of Europe. In that innermost circle trade flows were very intense. In the second or intermediate circle was the rest of North America and most of Continental Europe, linked to the first by intercontinental and regional railways. Here too, trade flows were intense but slightly less so than in the Atlantic Economy proper. The third and outermost circle incorporated the Rest of the World including the British, French and other European empires. In that external circle trade flows were characterised by the typical colonial pattern of export of finished goods and import of raw materials. However, the distinguishing feature of Stage II, as opposed to Stage I was the high mobility of financial capital. Britain was the banker of the world but, in addition to British capital, French and German capital also travelled overseas. It has been estimated that over half of French savings, in the period 1870-1914, was invested abroad, rather than in France. Truly then, in many senses of the term we had a global economy in 1900.

Stage III of Globalization came after the Second World War with the emergence of the multinational enterprise as a major actor in world affairs. The MNEs gave a new twist to the concept. Not only were markets globalized but, more significantly, *production too*. What this meant was that a vertical integration of production was orchestrated by the sprawling MNEs. A car, for instance, could be designed in Italy, have a German engine, French tires, a British chassis and assembled in Mexico for export to the United States. The MNE, with the world as its oyster, re-organized production and

trade flows. By 1980, over half of world trade involved branch plants of multinationals trading with each other.

Stage IV of globalization, the current one, involves not just the internationalization of markets and production but *increasing transborder movements of factors of production*. Initially, when the nineteenth century economists developed the theory of comparative advantage to explain trade flows between countries, they assumed free movements of *products* across international boundaries, but an immobility of *factors of production* which, they assumed would tend to stay within their country of origin. Gradually this assumption, originally true, became less valid with the passage of time. One by one the factors of production started to move across international borders. First financial capital then industrial capital, then labor and finally technology began to migrate across the planet.

Globalization and Comparative Advantage

The current stage of globalization, involving footloose factors of production racing around the globe in search of the highest returns, is having a profound significance on comparative advantage. Now that national factor endowments are no longer fixed, every country faces the possibility of losing comparative advantage almost overnight, because the productive agents upon which this advantage is built may migrate to another country. Conversely, by attracting foreign factors of production, a country may reverse its decline and become competitive in hitherto unsuspected fields. There is nothing in Japan's natural endowment which should predispose it to be good at watch-making, motor cycle, stereo, television, camera and car production and be even competitive in fashion! Most of the comparative advantages were acquired by learning, technology transfer and induced capital flows.

Factor mobility is a double-edged sword: it is an opportunity for those who can attract them and a threat for those who are about to lose them. This is where information technology comes in and further raises the stakes. The group of technologies which fall under the general heading of "informatics" include at least five branches: computer hardware, computer software, telecommunication devices, professional services and consulting services. All five have, within them, what is now being referred to as an "enabling" characteristic. They have the capacity to "empower" or "enable" branches of industry to become more competitive. Information technology is, to a large extent, a process technology which alters the mode of production by making it more efficient. The substitution of information capital for labor acts as a productivity multiplier and a creativity amplifier. The result is increased competitiveness.

In addition to the leveraging function of IT, is the fact that improvements in telecommunication have created what some people have called a "*world electronic highway*". The "highway" is now composed of many "lanes" such as satellite linkages, digital telephony, cable distribution, fiber optics, fax machines and videotex. This "highway" is realizing McLuhan's dream of the Global Village. It adds a new dimension to globalization by making events simultaneous in all parts of the world. In the financial field, markets have been truly globalized as never before and foot-loose electronic money chases its tail around the clock moving from time zone to time zone.

The "world electronic highway" further delocalises international production and makes productive factors even more mobile. In most of the high technology industries, localisation is much more a question of "soft" factors, such as climate, social amenities and quality of life than "hard" factors such as the cost of energy, availability of raw materials, etc. This is why "silicon valleys" and technopoles tend to congregate in pleasant areas of the world, California, the Mediterranean, etc. New competitive strategies have to be devised, whose purpose is to attract and keep valuable productive agents. In this task, governments and public policy continue to have a role to play, perhaps even an increasing role.

Globalization versus Continentalization

In the rush to discuss globalization there has been a tendency to subsume within it, a somewhat different process which I call "continentalization". Thus, in the 1988 Free Trade Debate during the Canadian federal election campaign, a false opposition was set up between the so-called "protectionists" seemingly advocating an inward-looking Canada, and the "free traders" advocating open markets and basing their arguments on "globalization". Actually, the Free Trade Issue involved "continentalization" rather than globalization. What "continentalization" refers to is the emergence of continental blocs such as Europe 1992, North America and South-East Asia. Each of these economic blocs are characterised by very high intra-bloc trade and factor movements and, more importantly, increasing harmonization of public policy within each bloc, including the imposition of non-tariff barriers on the outside world. Tariff barriers as such, are disappearing with the progress of GATT. But the more subtle forms of protectionism, which range from R&D subsidies to targeted procurement policies by governments, are not only surviving but thriving. Consequently, new patterns of economic location are emerging which are conditioned by these trade flows.

North American Continentalism or the bilateral integration of the Canadian and United States economy has been a strong historical process since the inception of the United States. It was resisted in the past by Canada. Since the Second World War it has considerably intensified. The signing of the Free Trade Accord in January 1989, although without enormous objective significance in itself, given the low level of tariffs between the United States and Canada even before the Accord, is likely to have enormous *psychological* effects. What was creeping continentalism is likely to become galloping. Already, Canada is being viewed in international circles as a subset of the United States and the path of policy harmonization between the two countries is a logical and natural outcome of closer economic integration. If, at the same time the process of European continentalism, marked by the threshold of "Europe 1992", accelerates, the pressures for North American integration, not only economic but also political, will become even stronger.

The Impacts on Canada's International Positioning

The twin but separate processes of globalization and continentalization are constituting new and important challenges for the Canadian Economy. With the old comparative advantages now vulnerable to new competitors enabled by information technology, Canada must devise and implement a national development strategy to maintain and improve its competitive edge. Failure to do so will lead to what I have called in a previous paper the Wayne Gretzky effect. North American continentalism may cause the flight of our best talent to the United States. With the 49th parallel separating the United States from Canada with protectionist policies, Canadian factors of production have tended in the past to flock to Ontario. The Maritime Provinces, in particular have suffered a brain and capital drain. Atlantic Canada, which was at the beginning of the century a highly industrialized region, is now a resource producing area, heavily dependent on federal transfer payments and exporting its best minds to Central Canada. With the disappearance of the 49th parallel as a meaningful border, the agglomeration effects are likely to take place further south, in the U.S. sunbelt, precisely because of the footloose nature of high technology. What this may mean is that Canada will export its most dynamic entrepreneurs and technologies which will seek the greener pastures of more temperate climes.

In order to reverse the potential "Maritimisation" of Canada, new competitive advantages must be developed. This is where the "enabling" characteristic of information technology comes in. As a sector, information technology contributes less than 3% to the Canadian GDP and 2% of the jobs. However, as an "enabler", IT can rewrite comparative advantage and turn around even the weakest of sectors. Japan gave up textiles in the seventies because it could not compete with low-cost South-East Asian workers. Now Japan is returning to textiles with laser cutters and robots believing that the latter will be cheaper than even the best Taiwanese workers. In fact, the lesson to be learnt is that, for

all intents and purposes, *there are no longer weak and strong sectors but, more meaningfully, weak and strong productive processes within sectors which affect the competitive position of the sector itself.*

In the context of a separate project conducted by the Gamma Institute for ITAC (The Information Technology Association of Canada), the "enabling effect" of information technology was defined, measured and assessed, in preliminary form. The overall message of that study was to show that the enabling potential is literally enormous—and that, in terms of actual use, Canada lags far behind some of its competitors. We are not making full use of our own technology, let alone that of others. On the contrary, our competitors are not only using their own technology but ours, in addition. In many areas we end up with a three stage process of technological change characterised by the following sentence: "Invented in Canada, patented in the United States and made in Japan..."

Conclusion

How can we sum up? The world system is evolving to a point where global competition is intensifying and information technology is playing a major role in determining who will be the winners and the losers. Canada, a small country by world demographic standards has an enormous high technology potential. It must meet the challenge of globalization head-on and its less visible but close cousin continentalization. At stake is global positioning. In the worst case scenario, complacency or misguided policies will make Canada lose its best productive agents to the United States and will force it to return to exporting raw materials for a living. In the best case, Canada can, by intelligent use of the enabling effect, together with appropriate public policies and private sector initiatives, develop centres of excellence and "go for the gold" in a number of areas. A necessary condition for this is for information technology to be no longer viewed as a sector, like shoes and ships and cabbages, but as a *horizontal enabler* to be used across the border in all areas of economic activity. This change in paradigm from *sectoral to enabling technology* although obvious, ex post facto, is still not clear in the minds of policy makers outside the IT field, and even in the IT field itself, where a number of executives still think that the name of the game is to export more and more computers and software programs to the rest of the world. On the contrary, the name of the game is to *use* computers and other IT devices in all forms of production, even if they are produced elsewhere. IT tools are the anabolic steroids of the international economic olympics—except that they are perfectly legal and, as far as one can tell, do not endanger health. Their intelligent deployment within Canadian industry should be the goal of public policy. Our leaders should adjust rapidly to this new paradigm—or see Canada irreversibly marginalised in the world economy.

Making it to the Global Major Leagues

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I am a strong supporter of the public and private sectors working together. I am also pleased that the objectives of this partnership are much more fundamental to our future than building a sports stadium. But I will admit that Skydome *is* an impressive joint government/industry achievement. In many respects that magnificent structure represents today's new world economy, with specialized contributions from around the world. Its one-of-a-kind video display is Japanese . . . hot dogs sold by an American franchise . . . the roof controlled by German computer systems . . . truly a United Nations effort. And I am proud that many Canadian firms have made their own unique contribution. Leading-edge design, engineering and construction services were provided by Canadian talent, the same expertise which is behind new airports, national telephone systems, power projects and many more.

So the line dividing domestic and international markets is quickly fading. I am speaking from personal experience. My bank's competition is just as likely to be an American travel card subsidiary or Japanese trading conglomerate as a Canadian bank. Today, I would like to share some thoughts on what characterizes our new world economy. Then I shall explore a *four-point strategy* involving information technologies that many Canadian enterprises are using in their quest for global business.

What is this new world economy? Words like "instantaneous", "24-hour", "borderless" come to mind. The world *is* becoming smaller. The application of computer and communications technologies *is* shrinking geography and compressing time. And this Information Technology *is* radically altering trading patterns.

Peter Drucker has predicted that in five years there will be two kinds of economists—those who think in terms of a world economy . . . and those who are unemployed. I believe that his comments will also apply to CEOs at the helm of virtually all companies.

Tonight, a New York law firm will transmit urgent research assignments to Hong Kong. While Manhattan sleeps, overseas lawyers trained in the English Common Law will electronically comb precedents. Draft memorandums will be sent to London for further editing. By morning, New York lawyers have their answers, ready to meet clients.

One of the fastest growing software development houses is in Bombay. It is called TATA. One of our English companies has used them. With skilled people earning comparatively lower wages it's no wonder a TATA executive has declared, "The world's 70 billion lines of COBOL code are India's acres of diamonds!"

But Canada's entrepreneurs are also taking advantage of information technologies to tap into the global markets. A Halifax firm applies skilled translators and artificial intelligence systems to translate documents for clients around the world. Olympia & York's mammoth Canary Wharf project in London and Battery Park in New York are being designed largely here in Canada. America's INET

information services network is a Bell Canada invention. And the Royal delivers Electronic Business Banking Services to 44 countries with systems developed just down the street from this hotel.

These, and many other examples, are testaments to Canadian excellence. All rely on information technologies for their competitive advantage. Such technologies increasingly influence world trading patterns. They are becoming indistinguishable from the products and services which they support. "The Medium has become the Message".

The same technology which we use to process a transaction between Trois Rivieres and Montreal earns us customers in Paris or Osaka. But it also enables foreign competitors to access our markets. So excellence in information technologies at home translates into success abroad. And while exploiting these technologies is not new for Canadians, let me review four strategies that I think are critical for success in this New World Economy. These are:

1. Developing Knowledge Workers
2. Exploiting Niche Markets
3. Pursuing a Technology Vision
4. Using Telecommunications as a Strategic Weapon.

I would like to direct the balance of my remarks to exploring each component.

1. Developing Knowledge Workers

The new world economy is being built by skilled knowledge workers. Information, not mortar or steel, binds this emerging global marketplace. So our most valuable resource is becoming knowledge. A simple illustration is the raw material and energy content of copper wire which is 80% of its production cost. In the case of fiber optic it is only 10%. The knowledge worker's contribution makes up the rest.

Developing the skills of our knowledge workers must be part of every company's strategic plan. And our public sector can make it a national imperative by encouraging our children, with role models, to take an interest in the physical and computer sciences. (Why are all the heroes on television private detectives, advertising people, teachers and lawyers?) It should continue at our universities and colleges where both industry and government must invest in delivering the information technology tools. And that's just the start.

Where do we stand in developing our knowledge workers? Well, here we have some challenges to meet. We sure produce enough lawyers: almost 40 for every 10,000 workers as compared with Japan's one lawyer per 10,000. It's not that I have anything against lawyers, but are these the sort of skills that Canada needs to stress in a new world economy? Japan's priorities are different. They boast almost four times the number of engineers per capita as Canada. Among these will be found the Information Age's key architects. But in Canada, enrollment in engineering faculties has fallen three years in a row!

Yet Canada has many strengths that we can turn to in developing our knowledge workers. Our universal educational system is still among the world's finest; it merely needs to be focused. The Royal Bank hires many of its graduates, so I know that we can produce the skills that we need to use information technologies for global advantage. And Canada's engineers and researchers are behind our telecom, aerospace, transportation and construction successes around the world.

Our Ontario Centres of Excellence are now off and running. And I should mention that this Province has made a much-needed supercomputer available to our universities, giving our students and teachers the resources with which to conduct world-class research.

While we have had great successes, we can't rest for a minute. We must *develop even closer ties* between our academic community and the business sector.

2. Exploiting Niche Markets

Let me now talk about market niches. Our competition is good. It's getting better. So I suggest that Canadian entrepreneurs choose their races with care. We can't win every one.

World tastes and demands are converging at the global village marketplace. This is producing opportunities and pitfalls. Success on a world scale can now be attained by finding and exploiting a very narrow commercial need. Capturing a single niche market in one country can often be leveraged in another. Conversely, once-safe domestic markets are being threatened by foreign niche players.

How is the competition exploiting this niche strategy? Japan may be credited with transforming the age-old practice of specialization into a science with its own formula. It's been called the "*Termite Strategy*" by Gunter Pauli and Richard Wright. Concentrating on target markets, the Japanese are tunneling into vulnerable niches. They are using low-cost production, and quality as their weapons. Before long the niche is captured and lateral expansion follows. We have seen it in consumer electronics and semiconductors. Telecommunications and financial services are next. And these are the industries which a unified European Community is systematically pursuing.

How has Canada fared in applying the strategy? We have some very high-profile successes to inspire new enterprises. But we could do better. For example, our country relies on resource extraction and processing for a good chunk of its foreign income.

But over time, Canada is losing its natural resources markets to many developing countries. But are these new countries using Canadian equipment? Canadian systems and expertise? Surely this is a niche market that we should excel in. And we have lost other lucrative niche markets. The opportunity to earn a share of the computer hardware market has slipped through our fingers. Will communications value-added services be far behind?

But let's look at the other side of the ledger. Canada is well-positioned to compete in the global leagues in many niche markets. We do have our own niche blueprint including Northern Telecom's digital switching revolution... CAE's dominance over flight simulators... Bombardier's urban transportation vehicles... I.P. Sharp's advanced networks. And Canadians have quietly dominated each through excellence in information technology.

The Royal Bank is using this niche strategy to its advantage internationally. We have the largest automated teller machine network on the continent. Our expertise won us the contract to handle all LINK network transactions between the U.S. and England. And this experience is being applied to developing other services for the Europe 1992 market. In the foreign exchange market, readers of *Euromoney Magazine* voted us number three in the world in 1987. We are proud of this achievement given that we are not even headquartered in a major trading centre by global standards.

And while governments need to be selective in which sectors they support, I believe to create in Canada an environment which produces a critical mass for innovation demands a focused approach.

3. Pursuing a Technology Vision

A third cornerstone of a winning world economy strategy is the passionate pursuit of an overall "technology vision". Within eight years of President Kennedy's declaring his space vision, America landed men on the moon.

Now, I'm not suggesting that Canada can, or should, pour comparable resources into our own technology vision. We already enjoy a lead in some areas anyway. But we must direct similar resolve to the challenge. *Focused objectives go a long way where money ends.*

Have our competitors adopted their own technology visions? Well, I *know* the Japanese are giving information technologies special attention. From unique tax incentives for industry to retire its computer equipment early... to joint public and private sector support of regional communications centres called "Telecom Plazas", the Japanese view computers and telecom as the keys to sustaining

their phenomenal growth. The European Common Market has its own technology agenda. France designated Telecom one of their top five strategies for the 90s.

How does Canada compare? Well, quite frankly, I am concerned. Yes, a few firms have succeeded globally by incorporating a technology vision into the very core of their organizations. But many have not. Without this high-level commitment at home, how can our enterprises be expected to apply technology abroad?

The business community's average spending for R&D is only 1% of sales. IBM invests more in research than Canada's public and private sectors combined! And of the world's eight key industrial players, Canada is last in private R&D spending, second last in government support of this vital activity. These are not new statistics.

But we can build on our strengths without spending lots of money. They are many and they are impressive. For example, my bank has adopted its own technology vision at the highest levels. It starts with training all of our people to use information technology tools.

And I believe that governments at all levels can make a key contribution to a vision. It looks like someone had a technology vision in Quebec. Aerospace . . . pharmaceuticals . . . telecommunications . . . engineering with firms like Lavalin, SNC, etc. These are but a handful of world-class industries with a huge presence in Quebec. Is it a coincidence that some of Canada's best systems consultants are also headquartered there? I'm thinking of such firms as DMR, LGS and CGI. Some have found the capital investments that they needed to expand globally through the innovative Quebec Stock Savings Plan. All have benefited from the Province's unique government procurement policies. These tend to give leading-edge work to outside firms. Contracts in this "buy not build" strategy have been large. They delivered the financial depth needed for global expansion.

There are many opportunities for these things to continue. For example, Canada's unique approach to government funding of health care services could represent a global opportunity for some suppliers if it were incorporated into a technology support policy. That is, we could package our available technology to support our health services and export these systems around the world. This could encourage our own innovators, like ServiceMaster, a Chicago-based company, which has succeeded in winning hospital maintenance contracts, in Japan and the U.K. and Canada, with its unique computer management systems.

What I am suggesting is that we *do* have the precedents for a national technology vision. But it is time for the public and private sectors to individually, and collectively, recognize the need.

4. Using Telecommunications as a Weapon

Finally, I want to talk about telecommunications. In the new world economy, communications services are the glue holding everything together. Telecom fuels all new information services. Without access to reliable, innovative and cost-effective telecom services, no enterprise should dare entering the fiercely competitive global arena. Most players in the new world economy must create and implement a telecommunications strategy. And every country in this global village must ensure that its trading enterprises have access to the communications services they need. Anything short of this will put them at a competitive disadvantage. How are other countries approaching this critical "enabler"? Japan has followed America's lead and introduced competition as the catalyst for telecommunications innovation and lower costs. Within four years it has licensed almost two dozen new basic carriers, and over 600 value-added service enterprises. They are using a competitive domestic market as a laboratory. In it they are perfecting the services that will ultimately be unleashed on the new world economy.

We see the United Kingdom pursuing a similar policy by ending British Telecom's monopoly in basic telecom services. And of course, we have all heard about the United States where about 500 companies, including the aggressive MCI and U.S. Sprint, compete for AT&T's former monopoly

market. The result? AT&T has introduced more new services in the past five years than during the entire century. Many of these services are new export products, both goods and services. Prices for long distance services are about one-half of what Canadian carriers charge our businesses. And in the case of high speed data lines the cost differential is an incredible seven to one! All this has occurred without jeopardizing Americans' access to affordable basic telephone service.

It seems that a week does not pass that I don't hear about jobs being lost in this country, lost because of our policies which shelter telecom services carriers in a monopoly. And I believe that jobs aren't being created here as well: switching jobs, clerical jobs, systems and technology jobs. This is transborder data flow at its worst! *All because communications policy makers do not believe in competition.*

On the other hand, Canada has much to be proud of. We built the first commercial satellite ... the largest microwave network ... our carriers and their research arms have blazed world trails in fibre optic and digital technologies. These are truly impressive achievements contributing to an infrastructure that is, or at least until recently was, the envy of the world. But that is the past ... and the new world economy is about the future. There is too much at stake for us to continue with the status quo. Our policy environment is fragmented between three levels of government. That must change.

But more importantly, for too long we concentrated on developing technology to the neglect of applications. While we are second to none in *creating* and manufacturing the hardware, other countries are racing ahead of us in *using* it to create and export jobs in every other information intense industry. But we can do something about this. Without incurring any cost to taxpayers, we can unleash the marketplace to stimulate the use of the telecom technologies that are already available. Competition is the key here.

I encourage each industry leader to become familiar with our communications policy crisis. I urge each policy maker to look at this issue closely. Place it high on your legislative agendas. Using telecommunications as a competitive weapon will not be available to our entrepreneurs without these policy changes. Canadian users of communications services would prefer to support Canadian carriers. They do not want to by-pass them in favour of foreign companies. But will they have any choice if survival in the new world economy is at stake?

Wrap-up

In closing, the strategy for global competitiveness which I have outlined consists of four basic parts:

1. Developing Knowledge Workers
2. Exploiting Niche Markets
3. Pursuing a Technology Vision
4. Using Telecommunications as a Strategic Weapon.

I am not suggesting that it's a magic, universal solution to the challenges before us. But I can tell you that it has worked for my organization. And it has worked for others with experience in foreign markets. Given such impressive achievements abroad, I am optimistic. I am also optimistic because this forum has brought together representatives of industry, government and our universities. Each plays an important role in Canada's participation in the new world economy. Each can make a difference.

I am reminded of Wayne Gretzky. Stunning achievements on the ice can only partly be due to his knack at team work. But he also has the uncanny ability to sense where the puck is heading. His opponents merely follow it.

If team work and foresight are national characteristics of Canadians, they will be invaluable in our pursuit of victory at the global arena.

Japan, Globalization and the Information Economy

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Introduction

Technology is the new basis of national competitiveness—the trade battleground of the 1990s. Increasingly the competitive strategies for corporations and nations alike will be and are based on a complex mix of technology, marketing prowess, and sophisticated production (see McMillan, 1989). In this respect, the future dynamics of job growth, industrial development, and wealth creation are heavily influenced by knowledge creation and commercialization in each advanced economy. Canada, with a commodity-based industrial structure, is particularly influenced by global technology in two fundamental ways: first, in the long-term change in the demand for raw materials and unprocessed commodities, especially in such vital job-intensive manufacturing as automobiles, consumer durables, aerospace, and transportation goods; and, in the transformation of manufacturing and services around new products, processes, and engineering applications organized around advanced technology, especially electronics, but increasingly biotechnology and advanced materials such as ceramics and plastics.

Technology is pervading the policy perspective of all modern societies. Technology raises serious issues for the public at large, including potential side-effects, from privacy to job stress, from skills obsolescence to job displacement. Moreover, science and technology issues now dominate discussions in many public policy areas not directly related to the economy:

- Environmental protection, including weather and climatic trends;
- Sports, leisure and athletics;
- Military/Detente—war has been one of the twentieth century's technology industries; and
- Crime—from drugs to counterfeiting, forgery to smuggling.

Among industrialized countries, Japan is particularly well placed to apply technology to the needs of everyday life, because as a resource poor country, it has the most to gain. Moreover, as a rapidly aging society, where longevity among males and females is among the highest in the world, Japan can apply its enormous commercial strengths to develop products and processes for the new demographics typical of most advanced industrial societies. In fact, Japanese technological developments and science policy are at a watershed, in three basic respects (see Tatsuno, 1986):

1. Japan has almost no room to continue its century old policy of learning from abroad. In almost all major areas, Japan science has caught up to the West; in the mechanisms for commercialization, it may be the leader.
2. Science itself may no longer advance in many fields on the basis of continuity, incremental improvements and progressive refinements—an approach where Japan had particular qualities

to close the technology gap with the U.S. The entire technology frontier may change, opening up new opportunities for technology leaders.

3. Japan's efforts to become a science pioneer require not only new commitments of financial and human resources, but new methods to organize science, including the need to move beyond such traditional areas as nuclear energy, computers and space.

Telecommunications and information technology are two of the most dramatic changes which impact industrial economies and political structures everywhere. Whether the examples are television images of student protests in China's Tiananmen Square, or Chinese students in Boston, Toronto and San Francisco sending media reports on facsimile equipment to Beijing—perhaps the world's first high-tech student revolution—technology brings home anew the pervasive impact of the information revolution and how important it is in the development of the information economy.

This paper has two aims: to review the trends and developments in information technology in Japan and second to highlight the impact of these trends for Japanese industry and corporate strategies (see Abegglen and Stalk, 1985; House, 1989; McMillan, 1989).

The Information Technology Revolution

Information technology and information technology industries have become such an ubiquitous and pervasive presence in the Japanese economy that a simple definition is very difficult. Traditional industry boundaries, such as telecommunications, computers, consumer electronics, semiconductors and office equipment have become all but meaningless as companies became vertically integrated and diversified. American companies remain the sales leaders in information technology, but the international trend is clearly towards complex global integration and sales outside the home market. Moreover, because the electronics revolution has pervaded Japanese industry to such an extent, Japan is rapidly becoming a truly information economy, no less so because two of the most formidable industries—finance and automobiles—have become so reliant on a sophisticated production, application and use of information technology.

Indeed the trends to globalization, international capital flows and new financial technologies all suggest a new corporate form, that of corporate networks. The leading Japanese companies have embraced this concept with a vengeance. The traditional firm may be viewed as a chain across diverse operating units—subsidiaries, divisions or profit centres—linked in a hierarchical fashion to central management which co-ordinates planning and resource allocation.

In this new form of the information economy, the corporation is seen as an organizational network, tying together the diverse operating units centrally, but also linking subcontractors, suppliers and customers into an integrated and complex information system. Advances in telecommunications and computerization have played a central role in this new form, permitting the rapid transfer of data throughout the organization, regardless of national boundaries or political jurisdictions.

Lest all this sound overly abstract, consider the implications for a specific company. A large firm like General Motors may be traditionally viewed as an integrated automobile company. Quite a different perspective would be to see GM as a large telecommunications company, linking a quarter of a million separate offices and operating units across satellite systems and fibre optic networks through some 500 telecommunications switches.

This perspective of a network allows a totally new integration of functions across a host of vital operating decision areas—inventory control, computer-aided design, financial transactions, cash flow and payables. Among the major Japanese manufacturing multinationals, Toyota and Nissan have become two of the most advanced network organizations, linking their global chain of suppliers, subcontractors and car dealers into an on-line assembly not only for manufacturing, but for all financial transactions, from cash flow management to foreign exchange, from bills of credit to bills of

lading. In this new network, the largest Japanese companies operate like a large bank, integrated across markets and products in a giant financial clearinghouse. In fact, Japanese automobile companies have become so advanced in these electronic data applications that they may be realizing savings as high as $300 per vehicle produced, relative to North American and European competitors.

Table 1

Information Technology: International Leaders

Companies	Headquartered in	Total worldwide computer-related revenues * 1987	1988
IBM	USA	$55,256	$59,681
Digital	USA	10,391	12,285
Unisys	USA	9,713	9,902
Fujitsu	Japan	9,107	N/A
Hewlett-Packard	USA	8,629	10,349
NEC	Japan	7,806	N/A
Hitachi	Japan	5,782	N/A
NCR	USA	5,641	5,990
Siemens	West Germany	4,773	5,650
Olivetti	Italy	3,667	4,180
Apple	USA	3,041	4,434
Tandy	USA	3,655	3,992
Control Data	USA	3,367	3,628
Wang	USA	3,048	3,075
Toshiba	Japan	2,761	N/A
Bull	France	2,736	3,003

Source: International Data Corporation, World Link

Notes: Rankings are based on 1987 computer-related revenues. Bull figures do not include Honeywell-Bull USA. Tandy numbers include revenues for all stores which sell more than computers.

* in US$ millions

Obviously, financial savings in this integrated network approach are not confined to automobiles, but extend to sectors as diverse as chemicals, electronics, steel, transportation and even telecommunications in the highly competitive Japanese economy.

The implications of this corporate network concept for Canadian companies is clear. Corporations must take advantage of globalization—of markets, finance and technology—by extending their horizons into three main trade blocks: Europe, North America, Japan and Asia. The concept of corporate networking offers a new approach to developing competitive links in distant markets. Certainly, the approach is not without cost, but it does provide a window to each major geographic area and its decision-making centre.

Unfortunately, Canadian firms, for the most part, have a weak presence in the Pacific Rim, not to mention Japan, the world's largest financial centre. Japanese companies, in particular, fully recognize this network concept and use it strategically to penetrate foreign markets and win new customers. That is one reason why Japanese manufacturers and investors do not limit their business connections to Japanese banking subsidiaries in North America. They know the value of developing wider relationships and contacts, especially since Japanese companies may not have familiarity with niche areas in foreign markets. Canadian companies, in financial services as well as in manufacturing, have an enormous opportunity to expand their informational and technological inroads into the Pacific Rim by adopting similar strategies. They should be broadening their international networks, developing strategic alliances, and exploiting their information advantages to gain a strategic edge.

Moreover, these trends parallel the rapid evolution and expansion of international markets in information technology, in particular the break-up of AT&T in the U.S., changes in the European Common market and major procurement/modernization programs in OPEC countries, the Third World, and the booming economies of the Pacific Rim (see Robinson, et. al., 1989; Anderson and Cowhey, 1988).

Japanese Information Technology Strengths

Technology is the lifeblood of the information economy. Most Westerners view non-Western sources of technology as either accidental or cheaper imitations of domestic creations. Japan has smashed this Western myth. Japan is the center of all major auto-based technological changes. Japan is revolutionizing Western concepts of mass production, including the use of robotics, computers, and management software as regards quality, inventory management and distribution. Japan holds about 50 percent of current global patents, a key to subsequent product commercialization. The Japanese dominate foreign patent listings in the U.S.—21 percent versus nine percent for Germany and three percent for France and Britain. The Japanese know the challenge of becoming a world scale science innovator: what is less well appreciated by foreigners is how well Japan can afford to pay for a science-based economy. Japan out-spends all Western countries in civilian research; 20,000 Japanese study in U.S. universities; Japan rivals the U.S. in research employment, about 65 for every 10,000 workers. By the end of the next decade, Japan will be a world leader in the next century's technologies: unmanned space systems, artificial intelligence, biotechnology, advanced materials, high-energy physics, media power, and many commercial applications of advanced pharmaceuticals.

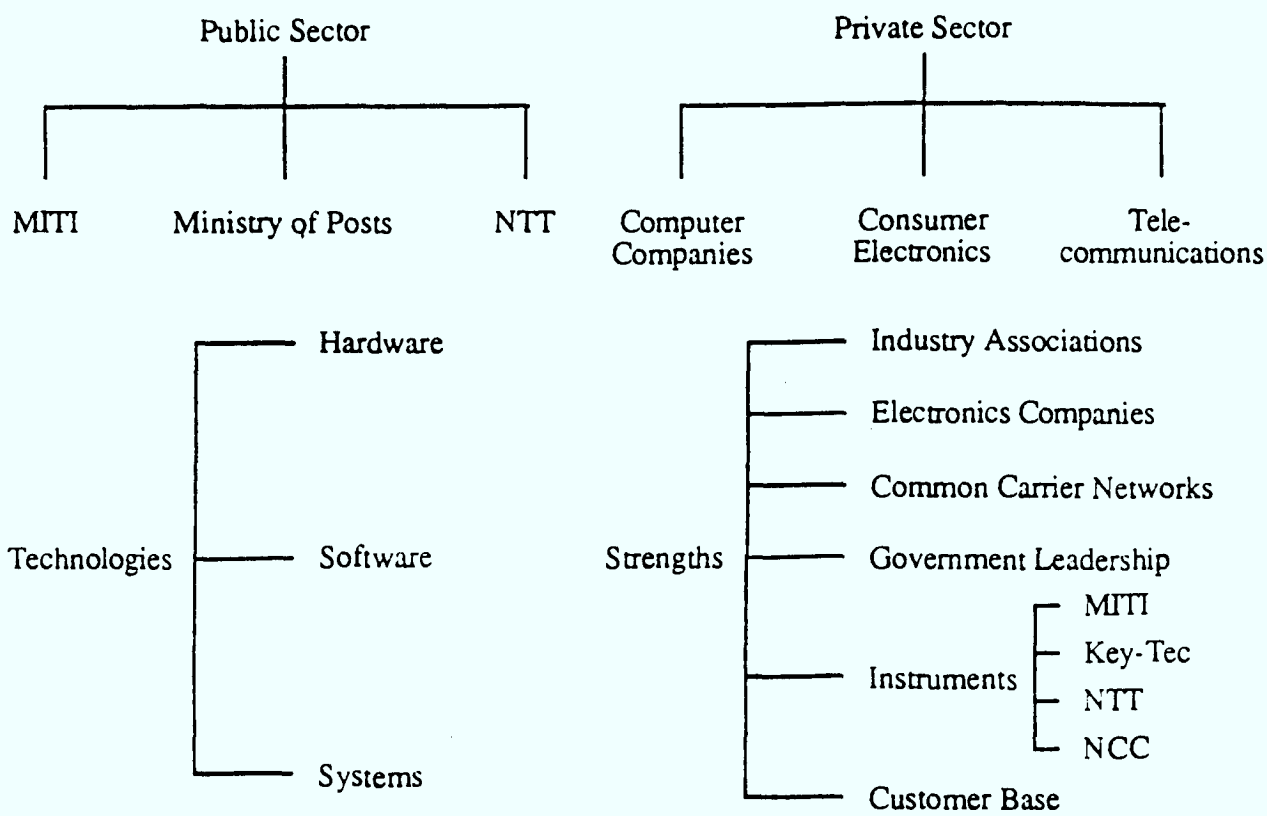
Japan's comparative advantage in using and applying technology has been greatly enhanced by advances in manufacturing—in production engineering, plant layout, worker training, in inventory management, in linking the flow of parts and components from supplies to the product line (see Mcmillan, 1987). Traditional production engineering as applied to assembly line sectors—automotive plants are the classic example, but there are numerous others—has favoured economies of scale, relatively long production runs, and minimal product diversity, except through add-ons, special features and component interchangeability. Economies of scale result from declines in unit costs as absolute volume increases over a given time period. Long production runs decrease costs because of

learning and sequential improvements with cumulative volume. Production specialization adds to productivity because of the decreased need to change equipment and to incur set up costs as a result of product diversity. Inherent in this kind of automation is a system that manages centralized data flow while still directing and controlling material flow and production conversion activities.

In organizational and management terms, these influences are revolutionary. They fundamentally change the production process. The distinctions between variable costs and fixed costs become meaningless. Traditional mass production is not just a process of standardization but an investment in costly, fixed investment. The new watchwords of competitive dynamics involve new concepts and new approaches. Fixed investments are not for standardization but technological flexibility. Market share is not just a measure of competitive performance but a key to continued cost reduction. Productivity is the capacity to improve and constantly reduce costs, the underlying cost structure of a product, and to adjust work processes in every functional area and organizational level. Technology, not marketing, finance, or production, is the driving force because technologies embody both the production function—the raison d'être of the firm—and the organizational functions which link the firm to suppliers and markets. Japanese managers recognize that these changed production systems greatly favour information technology, especially where the technology cycle favours speed, flexibility and rapid production growth to be competitive.

Exhibit 1

Information Technology in Japan



The complexity of these processes indicates the need for more sophisticated understanding of product innovations. The assumption is that product innovations stem from product manufacturers. However, research shows that product innovation often comes from other sources, including innovation adopters, suppliers of innovation-related components and materials, and distributors. Managing these processes is central to competitive success internationally, reinforcing the need for flexibility and adaptability to market needs which may not be defined by national boundaries. Japan's public and private sector managers fully understand these trends.

Within the Japanese government, a key instrument of forward planning is MITI's Industrial Structure Division, whose five criteria for developing Japanese industry—sector by sector—can be summarized as follows:

- the rate of growth the industrial sector is capable of sustaining, given financial, labour and other constraints;
- the desirable structure of the industrial sector in terms of input-output balance, socio-economic limits like regional balance and environmental protection, the need for productivity increases, etc.;
- international competitiveness;
- corporate vitality, particularly adequate profitability and reinvestment rates;
- the optimum rate of structural change that would meet economic targets while keeping dislocations tolerable.

Japanese companies have developed an enormous infrastructure of in-house technology, increasingly in basic research such as information technology, biotechnology, advanced materials, artificial intelligence and electronics. Further, Japanese companies have developed technology agreements, licences and strategic alliances with U.S. and European companies. Canada is largely outside these networks. Moreover, Canadian mechanisms to monitor and tap into these technology developments are very weak, because of understaffing by Canadian industry associations, corporate groups, and Canadian government personnel in Tokyo and Osaka.

Table 2

Japanese Space Targets
(Billion Yen)

	Year	Budget
Japanese Space Station	2008	1060
Manned Platform	2001	480
Geo Stationary Platform	2008	360
Orbital Transfer Vehicle	2008	900
Orbital Maneuvering Vehicle	1995	120
Space Shuttle	2006	2300
Co-Orbiting Platform	2010	480
Polar Platform	2006	180
Experimental Module Program	1995	310

Source: Special Committee of Space Activities Commission

Japan has advanced a number of new technology initiatives, including financing manpower and projects in basic research. MITI has been the instrument to promote technology transfer. Its English language publications, never mind Japanese publications, are better by far than anything produced in Canada or the U.S.

MITI has promoted patent registration in the U.S. as well as around the world, and the Japanese system of some 200 small specialty laboratories brings the latest technological developments and processes to small- and medium-sized industry. These small research centres and laboratories serve as a bridge between big companies and small companies by their focus on particular areas such as textiles, metals, ceramics or pulp and paper and the emphasis is on technology diffusion. Patent registration statistics reveal Japan's growing strengths across the technology spectrum. Japanese patent registrations account for 20 percent of U.S. patents, and U.S. payments to Japan for technology royalties are growing at a rate of 20 percent per year (Dertorizos, et. al., 1987).

Japan's strengths in information technology are often measured in consumer and office products and systems from videocassette recorders to facsimile machines, from television and entertainment to computers. Increasingly Japan's strengths cross the divide between civilian and defense sectors. The electronics revolution has profoundly altered this relationship. Not only has the defense electronics market become enormous—over $25 billion in 1988—but the very basis of weaponry has become dependent on electronics. That electronics strength increasingly rests with the Japanese. It is the Americans who are leaders in basic hardware: warships, aircraft, nuclear weapons, submarines, and satellites. Yet the manufacturing context of these sophisticated weapons systems increasingly involves advanced electronics and components, for surveillance, accuracy, delivery, and cost containment. Japan's exports in electronics now exceed $65 billion annually. The U.S. is increasingly a net importer of the hidden infrastructure of defense weaponry: semiconductors, dynamic random-access memory chips (DRAMS), robots, telecommunications, and lasers. Where the U.S. leads in selected technologies, the Japanese lead in process engineering, production and commercialization.

Defense production in the U.S., therefore, is increasingly tied to Japanese imports, especially of state-of-the-art electronics and electronic components. Indeed, to a degree that many analysts may not appreciate, multinational corporations are developing complex alliances and cross border linkages, especially in basic technologies such as semiconductors. Whether Canadian companies are fully represented in these technological and commercial ties is a moot point, but one which affects Canada's future technological development.

The U.S. defense department already produces more than a fifth of all American manufacturing and perhaps a third of manufacturing in high technology. Almost half—46 percent—of U.S. science expenditures are paid by the federal government: two-thirds on defense. Yet the Japanese penetration of the U.S. military procurement market has changed the relative position of Japanese technology, especially in areas such as anti-aircraft, anti-tank and anti-ship missiles. According to one assessment, "Japanese industry will eliminate the collective technological superiority previously enjoyed by the United States. The United States will grow increasingly dependent on Japanese technology. The strategic concentration of the Japanese system will confer substantial advantages in bilateral negotiations and global rivalry" (Ferguson, 1989).

New Technology Frontiers

Japan's futuristic science planning is a judicious mixture of wishful thinking, ruthless assessment of domestic strengths, enormously talented bureaucrats, and a sharing of information, based on superb data banks. The long-term "vision" documents published by economic ministries such as MITI or the Economic Planning Agency may not represent an accurate depiction of what will happen, but their capacity to project what might happen has been extraordinarily successful. The planning done by public agencies is important less as an instrument of government-directed activity, much more as a signal to have the enormous talent and data in the trading houses, financial institutions, private

research organizations, and academic establishments address basic issues. Industry associations, business groups and companies thus have a rich literature to provide a context for their own long-term planning and strategy development.

Exhibit 2

Japanese Technologies Applicable for Military Use

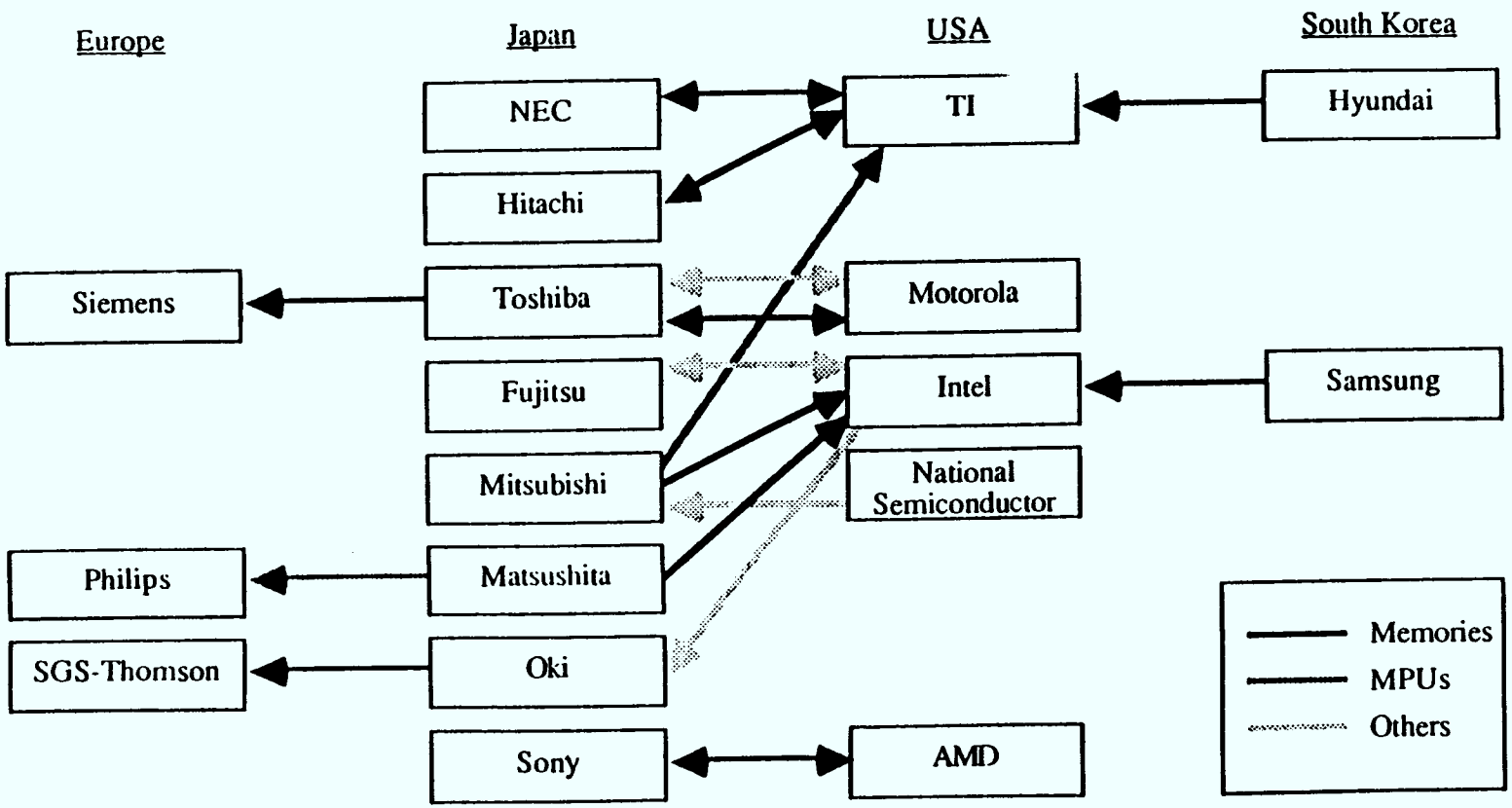
	1	2	3	4	5	6	7	8	9
Fujitsu Ltd.	■	■			■	■		■	■
Hitachi Ltd.		■	■	■	■				
Japan Aviation Electronics Industries, Ltd.								■	
Mitsubish Electric Corp.	■	■		■	■		■		■
NEC Corp.		■		■	■				■
Matsushita Electric Industrial Co., Ltd.	■	■	■	■			■		
Oki Electric Industry Co., Ltd.	■		■			■			
Sharp Corp.		■	■	■					
Sony Corp.		■	■			■	■		■
Sumitomo Electric Industries, Ltd.	■		■						
Toshiba Corp.	■	■	■	■	■	■			

1: Galium-Arsenide Equipment
2: Broadcasting Satellite Receivers
3: Semiconductor Lasers
4: Visible Light Image Pickup Elements
5: Infra-Red Ray Image Pickup Elements
6: Fiber Optics Telecommunication Equipment
7: High Resolution Cathode-Ray Tube (CRT)
8: Liquid Crystal Plasma
9: Galium-Arsenide IC's

Source: U.S. Department of Defense

Exhibit 3

International Alliances Among Major IC Producers



Source: The Japan Economic Journal, February 11, 1989

Government agencies and private corporations are applying their resources to the long-term implications of technological changes, including the basic changes in social infrastructure, cultural amenities, increased leisure time, and improved lifestyle as a result of better social security and medical systems. What is more to the point from the perspective of technology development and commercial applications is the Japanese ability to formalize the planning horizons for each basic technology with specific commercial areas and the market sectors which offer opportunities first at home and then in export markets.

This planning framework illustrates the new strength of Japanese corporations:

- long-term basic research in fundamental technologies;
- extreme adaptability to apply science to commercial opportunities; and
- capacity to finance research at each stage of the technology cycle.

Most Japanese corporations of scale have adapted to the rise in the yen by introducing new technologies, upgrading their products, and retraining their workforce. Exchange rates are no longer the brake that economists once thought would slow down Japanese export competitiveness. The approach also explains why Japanese plants located offshore can apply equally adaptive approaches to export from overseas markets, especially where incremental innovation comes from close relations between design and manufacturing—the areas where Japanese firms excel.

Perhaps no sector illustrates the dramatic changes taking place in Japanese industry more than telecommunications. Since Japan's telephone monopoly was deregulated in 1984 and fully privatized in 1987, new entrants have come into the market, bringing together corporate networks of companies with quite diverse skills. The deregulation and privatization initiative resulted in fierce political debate within Japan's corporate groups and government departments (in particular MITI and the Ministry of Posts and Telegraphs). MITI was especially dissatisfied with both MPT and NTT, seeing the bureaucratic inertia as an obstacle to new media developments such as cable television, teletext, value-added networks and new integrated information networks for Japanese industry (Imai, 1986).

Exhibit 4

Japan's New Common Carriers

NCC	Affiliates	Technology
Japan Telecom	Japanese National Railways	Fibre Optic Cable
Teleway Japan Corporation	Toyota Motor Corp. Japan Highway Public Corp.	Optical Fibre Network
DDI (Daini Denden Inc.)	Kyocera Corp. Sony Corp. Ushio Inc.	Microwave Transmission
TTNet (Tokyo Telecommunications Net)	Tokyo Electronic Power	Optic Fiber Cable

Source: Ministry of Posts and Telegraphs

The Japanese telecommunications sector is enormous, with NTT's sales in excess of $36 billion. The privatization and market liberalization initiative was not a Japanese divestiture equivalent to the break up of ATT, which meant breaking up the vertically integrated company—research, manufacturing and telephone network. In Japan, the NTT Network remains intact. The four major long distance NCC's (new common carriers) have concentrated on the heavy use traffic area between Tokyo and Osaka, employing different technologies based on the strengths of the consortia members. Two immediate results have occurred. First and predictably, NTT has increased its cost performance. Second, the NCC's have spurred growth in the telecommunications sector, from about 6.5 percent in 1983-1985 to 9.7 percent in 1987-1988, and price discounts on long distance calls have averaged about 25 percent, although the price gap between NTT and NCC's will decrease to only 8-13 percent.

NTT's recent reorganization, bureaucratic rivalries with MITI, and a more competitive stance vis-à-vis the NCC's have been a catalyst for aggressive research projects in semiconductors, digital switching, fibre optics and computers. NTT's twenty year Information Network System (INS) is a long-term plan to wire Japan with new digital technology and serve as a "bullet train of telecommunications" for the 1990s. The potential market for new equipment and services could amount to $300 billion over two decades and lay the groundwork for a true computer and optical communications network for home, office and leisure systems.

The larger impact of Japan's market liberalization and privatization initiative may well be international. Already, Japanese strengths in information technology cut across a range of diversified vertically integrated companies, engaged in semiconductors, telecoms, computers, consumer electronics and advanced control systems—what NEC calls the C&C Revolution. Worldwide, the market for telecommunications and information goods is enormous—some $500 billion and growing at 8-9 percent per year. It is a game of rivalry of giant corporate players which combine the full range of strengths in research (averaging 10-15 percent of sales and large critical mass), state-of-the-art production capabilities, flexible manufacturing skills, international marketing and deep financial pockets capable of taking the long view. Market entrants in telecommunications may, indeed will be, outside the traditionally-defined sector. In fact many of Japan's largest non-electronic firms are moving into one or more product areas: Kawasaki Steel, Kubota, Minebea and Kobe Steel are examples. Specific product niches vary enormously: terminal equipment, transmission equipment and switching equipment. Japanese companies are strong in each and have aggressive market capabilities relative to what were formerly lethargic monopolies in the U.S. and Europe. Moreover, the big Japanese companies are active in strategic alliances with large U.S. and European IT companies, such as ATT and the Mitsui Group. (Twenty years ago, exports in telecommunications equipment hardly existed; in 1984, U.S. growth in exports ranked eighth of thirteen countries; Japan had the highest market share.) The government is promoting the use of digital switching through rapid depreciation and advanced networks.

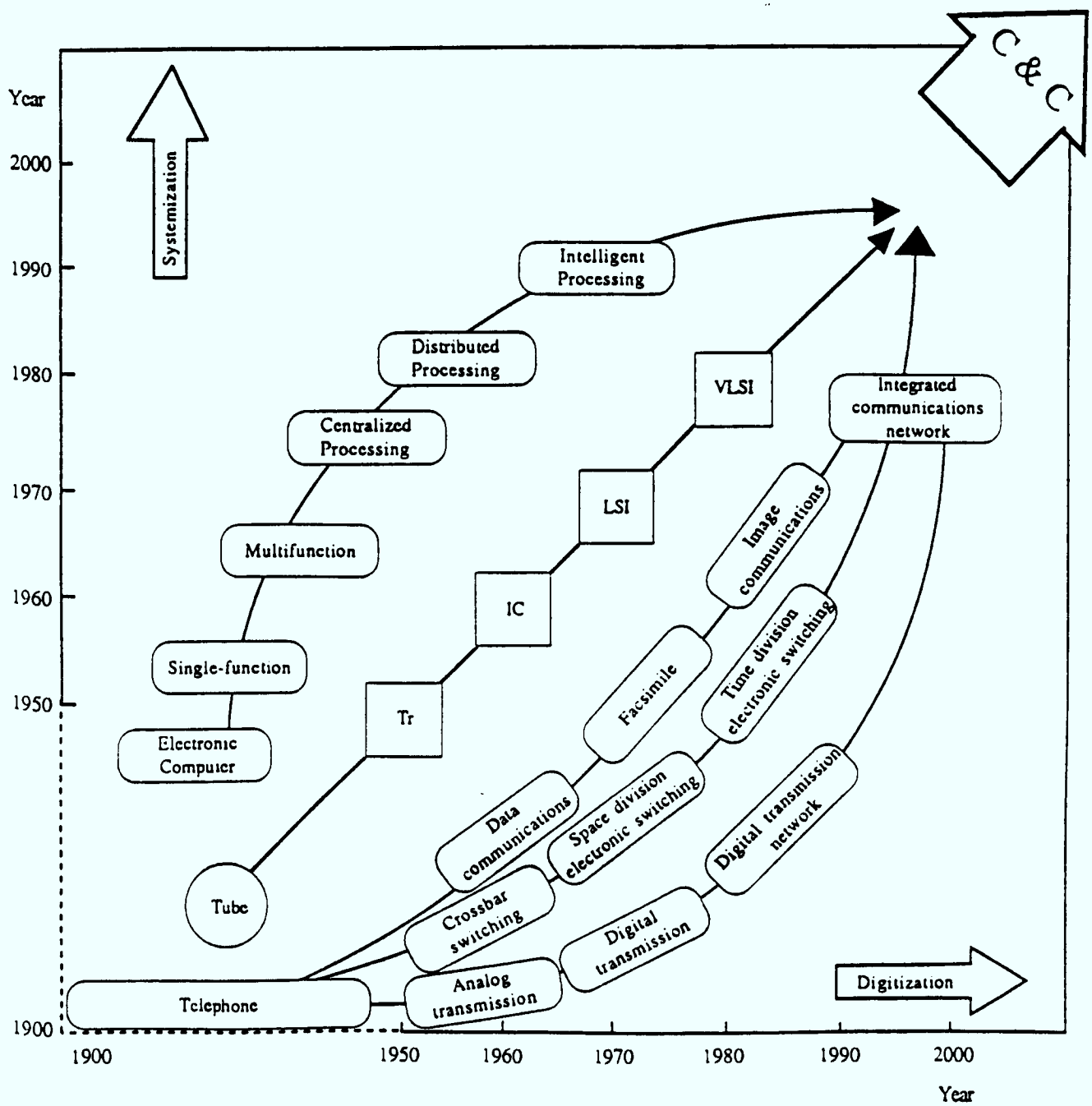
Summary and Conclusion

The information economy is transforming the modern economy and the linkages between manufacturing, services, and finance. Information technology is such a pervasive and important factor in advanced economies that both public policy and corporate strategies cannot afford to ignore it. Yet sadly that is the story in Canada. Policy is disjointed, planning is haphazard, government structures are overlapping and confused, and managers are not applying information technology to the degree that U.S. and Japanese competitors are.

The U.S. and Japan are the technology leaders in information technology. They are rapidly establishing a two-tiered structure among advanced countries—the U.S. and Japan and the rest of the world. The main U.S. and Japanese companies have made the transition from passive utilities to aggressive competitors on the global scene, keen to force standards as a result of technological advances. The competitive position of a variety of sectors—manufacturing and service alike, will depend on the use and application of these technological advances.

Exhibit 5

THE C & C EVOLUTION



Much has been written about management attributes, special institutional strengths (e.g., U.S. venture capital, Silicon Valley entrepreneurship versus government planning and long-term Japanese financial planning) and national leadership in science and technology—Japan relative to the U.S. These issues are largely beside the point in the next decade. Both the U.S. and Japan have their strengths and market driven corporate dynamics. That is not true in most other Western economies, at least to the same degree.

The information technology revolution is real. It affects the entire economy and increasingly it will impact the international trading system. Japanese corporations and government policy are in the vanguard of these changes. As R&D performers, they are spending billions, less than the Americans to be sure, but they are more effective at bringing products to market. As manufacturers, they excel because of the unsurpassed engineering skills, employment practices and devotion to quality. As marketers, they have a huge, rich and highly competitive home market, but with market intelligence on every major overseas market which they cultivate with a vengeance. Their overseas plants add to this domestic capability, a strength they share with leading American IT firms, including highly successful U.S. companies with a strong presence in Japan (IBM, Hewlett Packard, Motorola, Texas Instruments, Tandem, etc.).

The information technology sector is at a new threshold of development, from national to transnational, from reactive and market segmented to aggressively proactive and vertically integrated, from a policy framework which is shaped by domestic concern and government to one of international networks and international trade. Japanese companies are the aggressive players in this game: foreign companies and governments would be advised to study and understand these developments and emulate where necessary. The key will be a judicious use of planning and proactive market responses. The worst scenario would be inaction, overregulation, and reliance on the status quo.

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Globalization and Industrial Policy: An Assessment of the Report of the Premier's Council of Ontario

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Introduction

This paper investigates the linkages between technology and the international trade and investment strategies of firms faced with global competition. The problems faced by businesses competing in a global environment characterized by the power of the "triad" economies of Japan, North America and the European Community have been analyzed by Rugman and Verbeke (1987, 1988a, 1989). The latter paper also provides a new framework which describes the various strategic alternatives available to firms when dealing with government policy (or the lack of it) towards subsidies and technology.

Here this theoretical framework is applied to explain a new global trading phenomenon: the recent escalation of industrial policies in many nations, where the focus is often upon the promotion of "high-tech" sectors. Such policies are actually a form of subsidy which can adversely affect the environment for corporations when used as a strategic weapon by protected firms against their trading rivals. As an example of public policy in this area the recent report of the Premier's Council of Ontario is examined in detail.

Rugman and McIlveen (1985) found that most of the successful Canadian multinational enterprises are in resource-based industries, with only Northern Telecom and Moore Business Forms being active in the "high-tech" areas which are normally thought of as the domains of the world's largest multinationals. Yet the managers of these resource-based multinationals have exhibited considerable strategic management skills in positioning their product lines in world markets. They have organized the harvesting, processing and distribution of resource-based product lines in a scientific manner. Today, the "firm-specific advantages" of the resource-based Canadian multinationals are just as strong, if not stronger, than the proprietary knowledge advantage of the more traditional high-tech multinationals from foreign nations.

The key reasons for the success of the largest Canadian multinationals are related more to private sector management of a value-added chain than to government help from subsidies for technology in the form of an industrial strategy for Canada. However, the relatively low level of R&D expenditures in Canadian firms, as well as the relative lack of internationally competitive high-tech firms in many industries has often been considered a major weakness of the Canadian economy. This results in it being a source of public policy concern. We need to be concerned about the optimal design of an industrial policy for a small open economy such as Canada. In this paper, a conceptual framework will be developed to help us assess the relative effectiveness of various industrial policy measures.

Industrial Policy and Global Competition

The report of the Premier's Council of Ontario, published in mid-1988, states that active policies are required to create and sustain Canadian multinational enterprises. These MNEs need strong firm-specific advantages (FSAs), in order to overcome entry barriers in larger markets. The report recognizes the existence of strong resource-based multinationals in Ontario and Canada, but finds a relative lack of such firms in high growth, non-resource-based sectors.

Three major related problems are identified in the report:

1. the low level of R&D across industries;
2. the lack of niching strategies based upon innovative product differentiation;
3. insufficient government support for firms competing internationally on the threshold of becoming true multinationals.

To overcome these problems the report recommends that government intervene selectively in favour of stimulating growth and higher value-added in indigenous traded businesses (those exposed to strong international competition) which will remain, or become, internationally competitive in terms of exports.

The seven objectives identified by the Premier's Council as guiding its strategy are broad enough to be acceptable to virtually all private sector and government groups. The objectives are to:

1. encourage "competitive higher value-added per employee" in all industries
2. "focus industrial assistance" on traded sectors
3. emphasize the growth of "major indigenous Ontario companies of world scale" in the traded sectors
4. "create an entrepreneurial, risk taking culture"
5. "build a strong science and technology infrastructure"
6. "improve the education, training and labor adjustment infrastructure"
7. follow a consensus approach in creating economic strategies and programs.

The Key Objective: Indigenous Multinationals

Of these the key objective would appear to be number three; it calls for the development of large indigenous multinational enterprises. Earlier, in summarizing the economic challenge facing Canada, the Premier's Council lays the foundation for this conclusion when it states:

> Success in the high-growth industries of today and the emerging industries of tomorrow will require a set of economic skills we have not yet mastered. Primarily these are the talents required for creating and sustaining multinational enterprises which compete, not on the basis of low labor or raw materials costs, but rather through a process of continual renewal of their products, their systems, their factories, and their people.

Later the Council is even more explicit in its recognition of the need for support structures for indigenous multinationals:

> As the Council has examined the adequacy of our current economic situation, a number of structural and competitive weaknesses have come to light. Chief among these is the lack of a healthy base of indigenous Ontario multinational companies in non-resource industries.

The Council also identifies low R&D spending, too many "undifferentiated commodity-type products", small scale plants in core industries and an inadequate support climate (of both technology and human capital) for both small and large business. In particular, the Council states:

> The lack of support for threshold firms is of particular concern because it will be from the ranks of such companies that the indigenous multinationals of the future can emerge.

Free Trade and Global Strategy

This consistent theme concerning the need to develop multinational enterprises is undoubtedly correct in today's interdependent global economic system. Today multinationals from the triad powers of Japan, the EC and the United States dominate world trade and investment, (see Rugman, 1988). However, the Premier's Council exhibits amazing myopia by refusing to link the trend towards globalization to the need for access to one of the triad markets, in Canada's case, to the United States through the Free Trade Agreement. The Council's only reference to free trade is in the following elliptical statement:

> The adjustments taking place in the core industries in Ontario are driven by maturing markets and intensifying international competition. While the proposed Canada-U.S. Free Trade Agreement may accelerate the adjustment process, it will not change it fundamentally.

But what if the Free Trade Agreement had *not* been passed? Surely turning our back on access to the U.S. market would not have helped Canada, or Ontario, achieve the development of large scale indigenous multinationals? In fact, the Premier's Council has been fortunate; now that the Free Trade Agreement is in force there are opportunities to achieve its objectives. Without free trade they were obviously unrealistic. For a review of the evidence on this subject, see Rugman (1988).

An Assessment of the Premier's Council Report

The report states that mature manufacturing and resource-based industries have been the core of wealth creation in Canada. It argues, however, that today both types of businesses are generally characterized by relatively slow growth and increased international competition. Therefore, the report calls for a government focus on the expansion of high growth sectors. In addition, it is argued that mature manufacturing in Canada lacks "indigenous world-scale companies". These are necessary to help us engage in (a) strategic management decisions on resource allocation from a Canadian base; (b) R&D and marketing activities from a Canadian base; and (c) the development of "infrastructure" activities, including finance and R&D decisions from a Canadian base. As a result, dynamic external economies in Canada are rather low. This simplistic belief in the value of high technology firms over resource-based firms has been criticized in the past, for example see Rugman (1985). A somewhat more balanced view of the role of resource-based firms appears in a recent report by the Canadian Institute for Advanced Research (1988).

Although it is recognized that non-indigenous firms should also be stimulated to expand, emphasis is placed on trying to become more like Sweden through support for indigenous firms. The Premier's Council viewpoint on Sweden appears to neglect the two-way nature of foreign direct investment, including foreign-based multinationals within Sweden, as discussed in Hornell and Vahlne (1986). Similarly, the role of non-indigenous subsidiaries in Canada, which benefit from their parents' FSAs, is still substantial. The inefficient tariff factories and purely branch plants of the past, which lacked autonomy, are no longer representative of foreign-based subsidiaries in Canada. This has been demonstrated by D'Cruz and Fleck (1988), Rugman (1988) and others. It should also be recognized that Ontario already has a large number of core resource-based and mature manufacturing multinationals characterized by strong FSAs.

In its discussion of government policy, the Premier's Council Report emphasizes the failure of past government support programs for industry, both national and provincial ones. They usually fail for reasons of (a) pursuing distributional objectives; (b) insufficient selectivity (e.g., toward traded and high-growth businesses); and (c) unadapted support tools, such as promoting fixed asset investments instead of intangible infrastructure efforts (e.g., R&D, marketing know-how, etc.), which are very important in most high-growth industries.

The Premier's Council considers that only a limited number of existing programs are effective. These include the Export Development Corporation and the Federal Defence Industry Productivity Program, which focus both on high-growth and traded industries. In terms of training, the Premier's Council has a sensible emphasis upon training for competitiveness.

The successful industries in Ontario identified at various stages by the Council are aerospace, telecommunications equipment, autos, steel, and basic chemicals. Those with work to do to become internationally competitive include food processing, forest products, specialty chemicals, rubber, computers and biotechnology. This is a reasonable breakdown and one of the strengths of the Premier's Council report is Volume II, with its descriptive and analytical work on industry performance, competitiveness, market shares and strategic positioning. The use of modern analytical concepts from business policy is welcome.

Unfortunately, the prescriptive part of the Premier's Council Report (Volume I) appears to bear little relationship to the analytical work of Volume II. The first volume demonstrates an erroneous view of the potential effectiveness of industrial policy in a small open economy faced with an environment characterized by triad power. This can be clarified through the use of Diagram I on the nature of industrial policy.

A Model of the Nature of Industrial Policy

The horizontal axis of Diagram I captures the types of government intervention, either indirect or direct. Indirect intervention refers to the promotion of the infrastructure and such environmental factors as support for human capital, as well as the development of generally available measures in favor of particular firms and industries. It is of primary importance that these firms and industries meet preset criteria, with minimal bureaucratic discretion or politicized choices occurring in the implementation stage. In contrast, direct intervention means discretionary choice by bureaucrats and politicians in the implementation stage. Thus, with direct intervention there is a lack of general availability of the program for all firms that meet preset conditions. This leads to the creation of shelter for the program beneficiaries.

The vertical axis distinguishes between the focus of intervention, either discriminatory or non-discriminatory. Discriminatory measures here relate to government intervention in favor of firms with domestic ownership or domestically located corporate headquarters (i.e., indigenous firms). It also refers to government intervention in favor of firms located in the province of Ontario. In contrast, non-discriminatory measures do not favor indigenous over non-indigenous firms; nor do they favor Ontario firms over firms from other provinces.

Diagram I represents four types of industrial policy that can be pursued by a national or provincial government. It is our view that only an industrial policy positioned in quadrant one can be effective for a small open economy, such as Canada, faced with external protectionist trading partners.

Effectiveness refers here to the actual contribution of government support to the development of multinational activity in Canada, taking into account negative secondary effects of this support on the national economy. Non-discriminatory measures are thus more effective than discriminatory ones in favor of indigenous firms. The latter type of support neglects the important role of domestic subsidiaries of foreign-based multinationals in Canada. For a discussion of the economic impact of all multinationals on the Canadian economy, see Rugman (1989). In addition, discrimination in favor of companies located in a particular sub-national territory (such as a province) should be avoided. This

leads to the generation of competitive bidding amongst provincial governments, which results in welfare losses at the national level, as discussed in Rugman and Verbeke (1987).

Diagram 1
The Nature of Industrial Policy

Focus of Intervention \ Type of Intervention	Indirect Intervention	Direct Intervention
Non-Discriminatory	1	3
Discriminatory	2	4

Direct intervention in the form of support for particular firms or industries as a result of bureaucratic discretion or politicized choices in the implementation stage should be avoided, for different reasons, even if used in a non-discriminatory fashion. First, direct intervention may initiate sheltering strategies of business firms. This occurs if the institutional structure through which industrial policy is implemented is characterized by a high sensitivity to clientele groups, as discussed in Rugman and Verbeke (1988b, 1989). Second, such support, if characterized by high visibility, may lead to protectionist reactions of larger trading partners. This occurs in the form of countervail and anti-dumping actions, or attempts to impose voluntary export restraints.

Direct intervention may also stimulate foreign governments to protect their domestic companies based on the infant industry argument, the old industry argument, or the dynamic internal and external economic arguments associated with the theory of strategic trade policy (see Krugman, 1986). In all of these cases, the asymmetry in size and international economic significance of industrial policy measures of the small open economy and its larger trading partner should stimulate the former to refrain from direct intervention.

The Fourteen Recommendations Reviewed

The conceptual framework developed above will now be applied to the recommendations formulated by the Premier's Council of Ontario. In each case, the recommendations will be positioned in one of the quadrants of Diagram I, and will be assessed using the policy prescriptions set out in the previous section.

To deal with the problems of lack of international competitiveness in Ontario the Council makes fourteen recommendations. These recommendations are broken down into six categories, consistent with the groupings in the Council's report. Here only the most important recommendations will be discussed in detail. These are themes not only relevant to Ontario, but also to Canada as a whole.

I. Core Industries

1. The creation of an Ontario recapitalization incentive plan (ORIP). This would give tax incentives to investors engaging in equity investments in middle-sized (minimum 50 employees in Ontario), high-growth, export-oriented "indigenous" businesses.

This is potentially an effective measure, but only if it is implemented in a non-discriminatory, indirect manner. This means the support must be made available to both indigenous and non-indigenous firms, and there must be no bureaucratic involvement which could lead to unintended policy outputs. It is export promoting if it builds upon the FSAs of companies. It also helps to compensate for possible capital market imperfections faced by smaller firms when confronted with entry barriers in foreign markets. However, ORIP is discriminatory in nature, as it is targeted towards indigenous firms only. This places it in quadrant two of Diagram I. Thus, it must be altered so that it will fit into quadrant one.

2. The creation of a "sound industrial restructuring process" for exporting firms that have become unprofitable, but with viable "restructuring opportunities".

This measure should be rejected on the basis that it represents direct intervention of a discriminatory nature, placing it in quadrant four. This will likely lead to corporate "shelter", by allocating money in response to corporate pressure groups. This is especially likely to occur since it is proposed that labor should be involved in restructuring decisions. In their formulation of this proposal the Council argues that firms with no prospect of long-term survival or without a viable restructuring plan will not be supported. Yet how this will be implemented in practice is obscure.

Recommendation 3 deals with worker adjustment, which is necessary in times of major structural change, of which the Free Trade Agreement is a perfect example. It is an acceptable recommendation, in quadrant one, as it is an indirect, non-discriminatory measure. However, it is only acceptable if it is a temporary program. If it has no sunset clause, it would tend to drift towards quadrant two.

Recommendation 4 suggests worker ownership programs be implemented. This recommendation cannot be evaluated precisely in terms of discrimination or directness, given that the Council does not extrapolate on the exact role government will play. If anything, it is probably in quadrant two. Interestingly, no supporting reasoning is given as to why such a program is necessary for core industries to succeed. Rather than being a useful policy, it is more a result of the "consensus" mentality of the Council.

II. High-Growth and Emerging Industries

5. Tax incentives will be given to firms which engage in incremental R&D expenditures above their previous three year rolling average of R&D performed in Ontario.

This measure is also directly interventionist and discriminatory in nature, placing it in quadrant four. Can this measure be restricted to only a few, selected industries that have high growth potential? Will such tax incentives not lead, eventually, to competitive bidding among provinces? The implementation of such measures should be undertaken by the federal government, not by provincial authorities.

Further, this could be considered an export subsidy by companies in the United States, leading to possible countervail actions which would negate the effectiveness of such incentives.

6. A "strategic approach" by the Ontario government, including Ontario Hydro, to procurement will be introduced to a) develop Canadian firms, especially in the medical and pharmaceutical industries, and stimulate foreign MNEs to engage in R&D in the province; and b) award small contracts to Ontario firms, which would allow them to build up the necessary capacity in technological know-how (e.g., design of prototypes) prior to the existence of a contract to bid on. As a result they may eventually be granted large contracts as the base upon which a strong company can be built.

This measure should be rejected, as it is directly interventionist and discriminatory (quadrant four). It will lead to competition among the provinces at the expense of Canadian welfare. Long-run strategic procurement should not be implemented if other bidders already have the required technology. Who would have the ability to pick out the "winners" who may someday develop a technology which proves to be a strong FSA? This policy would probably lead to continuous shelter for companies identified as the province's "chosen instruments." In addition, the Strategic Procurement Committee developed to match government needs with suitable firms is another level of bureaucracy, creating an impediment for suitable bidders on government contracts whose firms may be arbitrarily deemed not to be "strategic". Finally, international competition would not be fostered by making firms dependent on government contracts for their survival; on the contrary, the development of sheltering behaviour will be stimulated.

III. Risk Sharing with Threshold Firms

7. A risk sharing fund will provide incentives to successful exporting firms when engaging in new product development, prototype placement abroad and the creation of new marketing offices outside North America (up to 50 percent of the project). Repayment depends on the success of the project: no payment if the project fails; above market rate if it succeeds.

This measure again is to be rejected on the basis of its directly interventionist, discriminatory nature (quadrant four). If a company is truly successful and not in its infant stage anymore, why would it need government to directly intervene, providing support in the form of capital? If a project is sound and a firm already established, funds will be provided by the capital market, especially since many threshold companies are former subsidiaries or divisions or spinoffs of MNEs. It is argued that this support would be primarily aimed at 40 to 50 non-resource based firms in Ontario, which are on the "threshold" of becoming MNEs (sales between 40 and 400 million Canadian dollars) but which may be "betting the company" on single new projects. Even if they are not "betting the company", it is argued that they may be confronted with serious problems such as (a) the move from a "cloner" to an innovator, requiring high innovation expenditures; (b) "simultaneous market" penetration which requires them to market new products on different markets simultaneously to beat global competition; (c) the "stuck in a niche" problem whereby growth requires a firm to go beyond its niche and enter new market segments often at high risks. In any case, the choice of which firms are deserving of such support will be a discriminatory process involving substantial bureaucratic or political discretion in the implementation stage.

8. The Ontario Development Corporations (ODCs) should be restructured. Until now they have not been selective in giving support and have in fact provided shelter to small businesses and industries facing difficulties. They should provide funds for R&D and marketing to high-growth industries, especially middle- sized firms keen to export.

This is a direct, discriminatory, quadrant four measure; the ODCs already exist but they provide shelter. If their policies can be shifted towards FSA-development this should be encouraged. However, their poor track record raises the question: would it not be more useful to eliminate them altogether, especially since it is proposed that the ODCs would remain responsible for assisting in regional development (i.e., pursuing distributional objectives)? How would they be able to distinguish between equity-based support serving local needs and support to turn small firms into major exporters? Again, the influence of corporate lobbyists and public pressures cannot be ignored when evaluating the ability of a political organization to choose FSA developing rather than sheltering situations as being worthy of support.

IV. Improving the Entrepreneurial Climate for Traded Businesses

9. Tax exemptions will be given to venture capitalists investing in manufacturing or traded services, to the extent that these businesses (up to a minimum of $10 million in sales in a first stage) have a commitment to engage in substantial exports within five years, and will direct operations from an Ontario base.

While this can be implemented through indirect government involvement, it is still discriminatory, placing it in quadrant two. This proposal could be effective in theory for the same reasons as the former proposal, i.e., if FSA-developing activities are viable. However, the assumption is again being made that the financial market will not support a viable firm with an enticing export opportunity. Further, the exemptions are contingent on certain commitments being made, such as the firm being "committed to achieving substantial export sales over the next five years". Commitments such as these are easily broken, leading to manipulative activities on the part of beneficiaries of the government program, as discussed by the Toronto Board of Trade (1989).

10. Tax incentives will be given to investors in initial public stock offerings of Ontario corporations. These incentives will be more important than the ones provided by the Ontario Recapitalization Incentive Plane (ORIP). The main advantage will be to enhance the liquidity of venture capital investments.

This measure has the merit of being more indirect than most of the others, and aims at decreasing financial market imperfections by improving the liquidity of venture capital investments. However, the difficulty is implementing it in a non-discriminatory manner. If that is possible, then the measure is a useful recommendation, as it could be moved from quadrant two to quadrant one.

V. Meeting the Science and Technology Imperative

11. Government funded R&D should be redirected towards business priorities.

It is useful (a) to enhance clearly targeted R&D efforts in universities and government labs and (b) to promote cooperation with the private sector, (e.g., through "Ontario Centers of Excellence" which will advance basic research and supply advanced technical personnel in the industry). But government should not reallocate substantial R&D resources (20 percent of current in-house research) to industry, for the private sector to actually direct research activities. How would priorities be set to allocate such "gifts" to the private sector? Again the problem of direct, discriminatory intervention leading to shelter arises (quadrant four).

There is an important implicit contradiction in this proposal. On the one hand it is stated that R&D efforts as a percent of GDP in Canada are much lower than in other advanced nations. The primary reason for this is alleged insufficient R&D in industry, which government has attempted to compensate by in-house R&D. These attempts were not successful because selectivity toward particular business needs was lacking. In view of this failure, it is argued that government should

now redirect its efforts towards these industry needs. However, if the private sector is not satisfying its alleged needs itself, how can it be expected that government which already has a very poor track record in this area could now suddenly solve this problem for the industry?

The problem is that:

a) Low R&D results primarily from an industry focus in Canadian firms on marketing, e.g., in resource-based industries.

b) Although R&D is low in foreign subsidiaries of MNEs, this hardly reflects low international competitiveness as these companies benefit from strong FSAs of parent companies, which may have centralized R&D facilities in their home country for micro-efficiency reasons.

c) Increased global competition and innovation even in mature and resource-based industries (and resulting entry barriers) may indeed require an increase of R&D in Canadian firms. But this is better stimulated by substantial selective tax incentives for R&D investments (by the implementation of recommendations 1, 3, 9 and 10).

12. A technical personnel assistance program will be created which will give a subsidy of 50 percent of new employees salaries in the first year and 25 percent in the second year to exporting firms (with less than $100 million in sales) that hire technicians, engineers and scientists.

This proposal should also be rejected, as it falls into quadrant four. In addition to being directly interventionist, this recommendation has the added shortcoming of not being able to separate firms that would not hire technical personnel without the subsidy from firms that would have hired the personnel in any case. Moreover, it seems hardly conceivable that a total subsidy of 75 percent of a one-year wage would stimulate firms to hire technical or scientific personnel, especially since going concern motives are predominant when hiring such personnel. In other words, a comparatively more efficient system would be the introduction of low (or zero) interest loans, e.g., for 5 years, which would cover part of the expenses of new technical or scientific personnel.

VI. Investing in People

13. A "comprehensive people strategy" will be elaborated in Ontario so as to improve the quality of supply of human capital for Ontario businesses.

This is a good proposal which could surely be implemented in an indirect, non-discriminatory manner. It could lead to comparatively higher efficiency to the extent that this implies a redirection of existing government scheduling on education and training toward programs of more immediate use to business.

14. The final recommendation calls for the creation of Ontario Excellence Awards to recognize individuals for contributions to economic progress.

Will the members of the Council be the first in line for these awards? And the critics last in line?

Conclusion

The Premier's Council of Ontario has produced a report with mixed qualities. The strengths of the report lie in the recognition of the global competition and today's key instrument for doing international business--the multinational enterprise. It is a sensible policy prescription to develop the environmental infrastructure which supports the growth of Canadian-owned multinational enterprises and multinational activity in general. Thus, the identification of labor training and

adjustment policies, educational programs and general fiscal investment incentives (if kept non-discriminatory) is to be welcomed.

The problems in the Premier's Council Report relate to recommendations which move beyond the development of the infrastructure and business environment, or even the support of selected firms and industries through preset criteria, towards schemes which include extensive bureaucratic discretion in the implementation stage and which are of a strongly discriminatory nature. The effective implementation of such measures will require insight into the nature of the competitive process, which has so far eluded even the best prepared government officials and politicians in Canada. Recommendations which include important bureaucratic and political involvement in the implementation of such programs as R&D grants, strategic government procurement and discriminatory investment incentives are unlikely to be successful in terms of developing multinational activity in Canada. Unfortunately, the great majority of the Premier's Council recommendations (at least seven) are in quadrant four of diagram I, being directly interventionist and discriminatory; another four are in quadrant two, while only three are in the desirable first quadrant.

Governments, including ones as large and powerful as that of the Province of Ontario, should continue to improve the nature of business and government relations. Policies which improve the climate for business enterprise and contribute to the elimination of natural and government imposed market imperfections are required. There is no need for government to do the job of business through a direct and discriminatory industrial and trade policy in Ontario.

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The Canada-U.S. and GATT Trade Negotiations: Implications for Information Technology

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Introduction

For Canada's information technology sector, today's trade negotiations are of crucial importance. In the current GATT round, three sets of issues bear directly upon Canada's international competitiveness in information technology: namely, protection of intellectual property; rules in regard to trade in services; and trade-related investment policies. This GATT round is based largely upon U.S. concerns about trade in high-tech products, and as such it marks a distinct change in the content of GATT negotiations.

Under the Canada-U.S. Free Trade Agreement several sets of issues remain to be negotiated over a five to seven year time horizon. Of these, at least two will impact this sector's competitiveness. For some firms, the possible restrictions on government subsidies will be of concern. The other relevant issue, referred to as "country of origin", deals with the percentage of product content that must originate in Canada or the United States in order for the product to qualify as Canadian or American under our Free Trade Agreement.

In view of the significance of these current negotiations for corporate competitiveness, it will be in the interests of information technology firms to participate actively in the formulation of Canada's negotiation positions. In view of the importance of information technology for all Canadian businesses and consumers, it will be in the public interest for Canada's negotiation positions to be developed with care and insight.

The relevance of these negotiation issues is being increased by the changing nature of the information technology sector. The rapid growth of software and business consulting services, for example, is raising the relevance of issues concerning trade in services, and it is also increasing the need for a local presence in each of the countries where Canadian firms do business. International specialization in specific product components has made country of origin issues more important. Other high-tech sectors have also experienced similar significant changes. It is probably because of this changing nature of the high-tech sectors that the GATT agenda has shifted to address these new sets of issues. Furthermore, the current international negotiations are of far greater importance to the information technology sector than they would have been in the past because of globalization. To a continually increasing degree, the Canadian market is no longer a Canadian market: Canadian consumers and Canadian businesses are prepared to purchase goods and services from other countries around the world. Consequently, even if a Canadian firm sells only in Canada, it is competing against foreign suppliers. On the other hand, to a continually increasing degree, Canadian firms face new opportunities to sell to consumers and businesses around the world. From this perspective, international agreements will be more important to the information technology sector as time passes. Apart from changes in the legislation and regulations in other countries, it should be noted that the

nature and content of Canadian legislation and regulations will likely also be directly impacted by these international agreements.

Our current international negotiations are also important from the perspective of the globalization of ownership of assets. For several decades, Canadian discussions have focused on the concept of U.S.-based multinational enterprises. As we enter the 1990's, we shall have to broaden this focus to include a far more diverse range of international investments. Residents of countries other than the U.S. will likely own an ever-increasing percentage of Canada's businesses, real estate, and natural resources. At the same time, Canadian residents will likely invest an ever-increasing percentage of their assets in countries other than Canada. This globalization of assets combined with the globalization markets will likely alter our national self-interest in regard to at least some elements of the new international agreements.

The Canadian society as a whole should be concerned about our current international negotiations and their impact on our information technology sector. We have become an information society. The creation and diffusion of new information technology is the foundation for our future economic growth and prosperity. The success of our information technology sector is important not only in its own right, but also as a means of introducing technological progress throughout Canada's traditional economic activities. With the adoption of new types of information technology, Canada's traditional goods and services can become high-tech themselves. Consequently, the Canadian public interest requires that the new international agreements should foster the diffusion of information technology. Of central concern will be the balancing and merging of the interests of information technology firms as producers with the interests of other business sectors and with the interests of Canadian consumers.

The Protection of Intellectual Property

The protection of intellectual property has been a subject of international negotiations for over 100 years. In 1886, the Berne convention provided guarantees that the signatories would offer protection to the creators of certain literary, scientific, and artistic works. Since 1886, a long list of international agreements have expanded the types of things to which the signatories have guaranteed this kind of protection. It was only in 1986, however, that the United States took a strong position that new international agreements should specifically extend the protection of intellectual property to the high-tech sector. On its own initiative, the United States has been considering a policy to offer certain duty-free U.S. import privileges to those countries that protect American patents, copyrights, and trademarks. The United States is strongly advocating that GATT should develop minimum standards of intellectual property protection to which all GATT members would agree. And the U.S. is strongly advocating a shift in GATT rules to sanction retaliation against those countries that permit their firms to violate these standards. In the current GATT negotiations, these issues are often referred to as TRIPs, an abbreviation of the phrase "trade-related intellectual property" issues.

In many cases, only a component of a product is the possible subject for the protection of intellectual property. Yet this component may be the basis for the international competitiveness of the product as a whole. This is often the case in the information technology sector. While the protection of intellectual property may appear to deal only with a narrow range of items in a firm's product mix, that narrow range of items may be decisive in the competitiveness of the broad range of products of which these items are essential components.

A variety of different types of legislation can be used to protect intellectual property, and each of these is important for the information technology sector. There are substantial differences among countries in the degree to which they rely upon these types of legislation.

1. Patents. Patents relate to inventions that can be applied directly in industry. The patentee is given exclusive use of the invention for a specified number of years, in Canada seventeen years. In order to justify the enormous cost of R&D, it is essential that today's corporations be assured that their

results will not immediately be copied somewhere else in the world in such a way that they cannot recoup their investments in R&D.

2. Trademarks. The registration of a trademark generally has no time limit. The ability to create a strong market image and to benefit from customer satisfaction obviously depends upon the protection of trademarks.

3. Industrial Designs. The architecture of information technology products is becoming increasingly important. The design of products may be a significant marketing characteristic quite apart from technical inventions or trademarks. Consequently, in the global marketplace, the competitiveness of a Canadian firm may depend upon its ability to maintain uniqueness in its industrial designs.

4. Copyrights. While copyright protection was originally of greatest concern to authors of books and to artists and musicians, the increasing importance of computer software has made copyright protection a key issue for the information technology sector. Computer software has been accepted as subject to copyright in the United States since 1964, and the United States has attempted to create an international consensus that all countries should extend copyright protection to computer software. Recent Canadian court cases have supported this view, and in 1987 the federal government tabled new copyright legislation that will specifically include computer software under Canada's copyright laws.

5. Trade Secrets. Many aspects of a business do not fall into the above four categories, and yet they may be areas where a company has invested substantial money and effort to create its own commercial success. In many countries legal protection is extended to these trade secrets, which are seen as commercially valuable information. Yet some countries lack the laws under which a firm can sue if its trade secrets have been stolen.

In the past, international agreements have rested upon the concept of "national treatment". National treatment means that citizens of other national signatories can register their ownership in Canada just as if they were citizens of Canada. For example, by signing the Paris Convention, Canada has promised national treatment for patent, design, and trademark laws to the citizens of all other signatories. By signing the Universal Copyright Convention, Canada has promised national treatment under copyright laws to the citizens of all signatories of the Convention. Canada has also signed the Berne Copyright Convention. Participation by other countries has varied, and in the past, many countries have refused to sign these agreements.

Until recently, the central concern of advanced industrialized countries has been to protect their own market against cheap imports that violate their domestic intellectual property legislation. In the United States, for example, the International Trade Commission (ITC) has frequently conducted investigations of unfair competition from imports. With the recent globalization of markets, U.S. firms are increasingly concerned about protection for their intellectual property rights in foreign market places. It is no longer adequate for these firms to rely solely upon U.S. legislation. It is no longer adequate for these firms to rely solely upon U.S. barriers to imports that violate the protection of intellectual property. As the percentage of their sales that occur in foreign markets increases, U.S. firms must increasingly rely upon the laws in those foreign markets. Apart from new international agreements, there is very little that the United States government can do to protect the interest of U.S. firms against the theft of intellectual property in other nations.

At the core of these issues, is the development of new rules and processes for resolving international disputes. The United States hopes that GATT may establish mechanisms to deal with violations of intellectual property protection. In particular, the United States wants approval by GATT to retaliate from time to time against those countries that hurt the export potential of U.S. companies by violating intellectual property rights. It is important to note that for information technology corporations a technological advance may offer a competitive advantage for only a few years. By the time an international dispute is resolved, the inventor may have missed the opportunity

to profit from the invention. Consequently, it will be important to develop dispute resolution processes and retaliatory mechanisms that can be implemented quickly.

Trade in Services and the Right of Establishment

Information technology is essential for much of the service sector, and fundamental changes have been occurring in the ways that information technology relates to trade in services. Robert Stern (1985) has pointed to four ways in which services trade now is dependent upon information technology.

1. The computer-communications revolution has permitted the separation of consumption and production of many services, particularly services used by businesses. This possible separation of production and consumption permits national specialization and international trade.

2. The growth of multinational enterprises and their demands for global service companies has given rise to global-service-networks. In some cases, MNEs have created global service networks within their own firms. In other cases, businesses specializing in services may cater to a customer's subsidiaries in many countries.

3. The importance of service-production units within traditional enterprises has been expanding, together with the tendency to sell these services outside the firm. Financial institutions, for example, have been particularly active in developing new information technology applications, and in selling these services as well as their traditional banking functions.

4. Trade in many goods now increasingly requires trade in complementary services, particularly information technology services.

These developments in information technology are having a profound impact on the way firms operate as organizations, as well as on the way they produce and distribute their output throughout the world. Advances in the computer and telecommunications field are transforming services by increasing their productivity and facilitating their delivery. The key element of this transformation is that many services have become transportable, as a result of the fact that the various types of signals have become digitalized. This permits the use of extensive systems of information processing, transfer, and retrieval.

Information has always been a significant element in the production of services, but its importance has greatly increased in recent years. This is seen to be the result of the development of the types of systems mentioned above, as well as the fact that information can now be embodied in goods, rather than being simply stored in them. Also, new information technologies have resulted in the creation of services that can not be stored by producers—they must be immediately acquired by consumers.

For trade in computer services, the impact of certain non-tariff barriers is an important issue. A sale may include both hardware and software, as well as the provision of equipment servicing, and consulting over an extended period. A barrier to one component can be a barrier to the entire sale. The relationship between the computer firm and its customer is usually a relationship over time. Customers often require immediate and continual service, and this can require the "right of establishment", with foreign computer firms being allowed to create local subsidiaries in Canada, and with the right of Canadian firms to create branches in every country where they hope to do business. It also requires the right of employees to move freely across national boundaries in order to provide computer services. Hence, a barrier to immigration can be a barrier to services trade.

Furthermore, domestic regulations in each country can impact any part of the firm's product line. Domestic regulations can deal with hardware, software, telecommunications, equipment servicing, or consulting. Any one of these regulations may have an impact on a foreign firm's ability to export to that market. Conforming with domestic regulations may be easier if the firm has a subsidiary and domestic employees. Again, this emphasizes the importance of the right of establishment. Con-

versely, opening up a market to foreign firms may automatically mean deregulation, both for foreign firms and domestic firms. New international agreements in regard to services trade may compel the signatory countries to deregulate.

New services trade agreements may also impact each country's policies and procedures in regard to government procurement. In evaluating competing bids, most governments give special preference to their domestic suppliers. GATT agreements have already been implemented to restrict these practices of special preferences for domestic suppliers of certain goods. These international procurement agreements have been somewhat enforceable with goods. However, with services, such codes can be readily violated. When a government receives competing bids for a package that includes hardware, software, telecommunications, service, and consulting, the government often finds that no two bids are identical in what they offer. Domestic preferences can be easily justified on the argument that the bids are not identical in what they offer. Hence, this non-tariff barrier will become increasingly important as computer and telecommunication services play a greater role in the sales package as a whole.

In the past decade, the structure of the telecommunications industry has altered dramatically, creating a new set of policy issues and adding a new complexity to international trade. A wide variety of new "enhanced" services now supplement the traditional transmission of voice messages with the transmission of data and written information. Often these enhanced services utilize the traditional carrier network as an integral part of their production and sales process. Within the traditional carrier network, new telecommunication technology and new employee skills can now be exported as services to other nations. The creation and modernization of foreign carrier networks has become an export market in which Canadians may have a comparative advantage. Meanwhile, satellite technology is offering a new alternative to networks of copper wire telephone cable, both for voice messages and for the transmission of data and written information.

While the traditional basic services, provided by a physical communication network, remain by far the largest component of domestic services, it is the wide range of new enhanced services that forms the major growth component of today's international trade in telecommunications service. The international competitiveness of enhanced services is affected by the pricing and provision decisions of the physical networks that they utilize. Within the traditional sector, these pricing and provision decisions have usually been supervised by government regulatory agencies. Consequently, the issues of government regulation are of significance in the current international negotiations on trade in services. New international agreements will impact corporate competitiveness in enhanced services, even when the regulations focus principally on the domestically oriented, basic communication networks.

There is a significant and rapidly growing set of economic activities where certain computer services are telecommunication services. This trend has linked many policy issues in regard to telecommunication services with policy issues in regard to computer services. For example, barriers to trade in telecommunication services can automatically be barriers to trade in computer services, and vice versa.

A final issue that is common to both computer and telecommunication services is an increasing trend towards the provision of services by corporations that have not traditionally been part of the computer or telecommunication industries. For example, financial institutions have recently created large computer and telecommunication networks through which various types of information and other services are transferred internationally.

Traditionally, a telecommunication carrier was in a monopoly position. This monopoly position was often accompanied by government regulation, with many business decisions concerning pricing, and concerning the geographical provision of services, being influenced by political considerations. In particular, a tendency developed in many countries to cross-subsidize certain rates, with short-distance rates being set below average cost, and long-distance rates being set above average cost. Significant changes in telecommunication technologies are rapidly diminishing the monopoly power of the traditional telecommunication carriers. New competitors are able to take advantage of the

traditional rate structures by entering those segments of the market where the rate structures create the most lucrative opportunities. Recent technological advances have introduced alternatives to the physical linkage of copper wire, thereby opening new business opportunities for new competitors. For example, the impact of fibre optics on pricing structures is likely to be a continuing process. Satellites, of course, enable the transmission of telecommunication services outside of the traditional physical networks. New methods of transmitting information such as the use of facsimile machines, or computer disks, can also significantly alter the market for traditional telecommunication services.

Apart from these changes in the technology of transferring information, significant growth is occurring in the enhancement of telecommunication services. To an increasing degree, telecommunication services now involve the ready access by many people to banks of information that are large and complex. This may entail direct access to information, and it may also include special assistance by the telecommunication carrier, such as the selective retrieval of certain types of information and often the manipulation or analysis of that information. Enhanced telecommunication services include messaging systems, financial transactions, videotex, and augmented communication networks within the firm. In many cases, these enhanced services are specifically designed for the needs of the individual customer.

In recent years, important modifications have been made in government regulations. These regulatory changes have been influenced by the technological changes discussed above. In turn, they have affected the pace and nature of alterations in the pricing structure for telecommunication services. International trade in telecommunication services is affected by prices of these services and the differences in these prices among countries. Consequently, government regulations have a direct impact on the nature and extent of international trade. In fact, regulation is perhaps the most important policy area through which governments affect international trade in telecommunication services. This is quite different from the set of policy issues in connection with trade in computer services.

Regulatory issues cover not only matters of price setting, but also extend into the maintenance of an independent cultural sovereignty. Here telecommunication services are seen by many as having special characteristics that warrant extensive government intervention. Arthur Cordell of the Science Council of Canada has commented on this issue of cultural sovereignty in connection with Canada's communications services. Canada has established the technology and expertise to carry the goods, but it is others' goods that are carried. Cordell, in a recent IRPP Working Paper (1988), notes that "seventy-eight per cent of all television programming has foreign origins—mostly U.S."; that "estimated (book) sales from all publishers, exclusive agents and importers reached $1,028 million in 1981, of which 74% came from imported books"; that "most of the records and tapes sold in Canada (86%) are manufactured in Canada from master tapes leased or bought from an organization outside Canada"; that of 561 new feature films distributed to movie theatres in 1981, 36 originated in Canada; of 53 suppliers with computer software revenues of more than one million dollars in 1981, over half are foreign-owned, and these accounted for over half of the *total* market.

In the regulation of information technology, an important complexity is caused by the division of responsibility in Canada between the provincial and federal governments. Many corporations criticize the current division of responsibility. Changes in regulatory responsibility could impact directly on Canada's trade in telecommunication services. At the present time, the regulatory structure is not uniform across Canada. In Saskatchewan, Alberta and Manitoba, the provincial governments own the telephone companies, and so all decisions concerning pricing and provision of service are determined by the government. In the Atlantic provinces, the governments do not own the telephone companies but they have created regulatory agencies to supervise the corporate decisions. In Ontario, Quebec and British Columbia the governments do not own the telephone companies nor do they have agencies that regulate them, rather the federal government has a regulatory agency, the Canadian Radio-Television and Telecommunications Commission (CRTC), which supervises corporate decisions. All provincial governments are concerned about decisions taken by the CRTC, and from time to time attempt to influence those decisions.

It is likely that regulations concerning telecommunication services will be changed in important ways in the near future, and shifts in regulatory responsibility could hasten these changes. Over the past decade, provincial governments have advocated regulatory changes that would increase competition by opening certain telecommunication services to more corporations. Recent CRTC decisions have also facilitated the entry of new competitors, providing enhanced services. This trend is likely to continue, giving additional stimulus to the expansion of Canadian companies and, perhaps, opening our marketplace to companies from other countries.

Underlying many of these changes is the growing importance of telecommunication services for corporate activities throughout the entire economy. Telecommunication services are becoming essential inputs for all businesses. From this perspective, one can see telecommunication services as playing an essential role in a nation's production efficiency and economic growth. Consequently, government policy decisions in telecommunication services are becoming increasingly important.

The pace and extent of changes in other nations, particularly in the United States, will directly affect Canada's international trade in telecommunication services. Throughout the Canadian economy, businesses can purchase telecommunication services from U.S. firms. The growing importance of enhanced telecommunication services, as well as the new technologies in the provision of telecommunication services, means that Canadian imports could possibly increase substantially. Such a trend could be advantageous in stimulating the efficiency and growth of Canadian businesses as a whole, but at the same time this could hurt the profitability of Canadian information technology firms.

Subsidies and Countervail

As indicated at the outset, the information technology sector will likely be impacted by the remaining Canada-U.S. negotiations under the Free Trade Agreement. In both Canada and the United States federal and provincial governments offer a wide variety of subsidies: investment subsidies to entice firms to locate in particular geographic areas; "bailouts" to encourage firms to maintain plants they would otherwise close; special financial assistance to crown corporations; operating subsidies to ensure that firms engage in particular activities such as R&D or exports; and tax concessions for particular kinds of corporate expenditures. With the projected reductions in Canada-U.S. tariff barriers, such subsidies will become relatively more important as a trade-determining process. If subsidies are implemented to achieve specific objectives, such as the attainment of public benefits that are external to the individual firm, then it may not be in society's interest simply to eliminate subsidies. Consequently, the topic of subsidies and countervail involves more than the private interests of individual corporations.

The Canada-U.S. Free Trade Agreement provides explicitly for the development of new rules in regard to subsidies and dumping, and these new rules will impact the process of countervail:

> Article 1907 provides that the two governments will work towards establishing a new regime to address problems of dumping and subsidization to come into effect no later than at the end of the seventh year. During the course of the current negotiations, the two sides recognized that developing a new regime was a complex task and would require more time.
>
> The two governments agreed in Article 1903 that changes to existing antidumping and countervailing duty legislation apply to each other only following consultation and if specifically provided for in the new legislation.

It is generally recognized that this 5-7 year process anticipated in the Free Trade Agreement will be extremely important. If successful, the new rules in regard to subsidies and dumping will replace the frequent ad hoc imposition of countervail and anti-dumping duties. The process for analyzing and negotiating the projected subsidy, dumping, and countervail rules will be complex, lengthy and difficult. It will involve processes beyond those normally required for tariff negotiations, and it will

require a thorough understanding of individual firms, products, and sectors. For the information technology sector, it will be important to participate in these processes of analysis and negotiation.

Country of Origin

Negotiations pursuant to The Free Trade Agreement will also focus on the rules in regard to "country of origin." Most products include components that have been made outside of Canada and the United States, and these products pose special difficulties in deciding whether they should cross the border duty-free. For certain goods, detailed rules have been included for deciding whether a particular item qualifies for duty-free treatment. However, even where detailed rules are included in the FTA, these rules are subject to interpretation. Furthermore, the FTA explicitly provides for "a process for consultation and revision to ensure that the rules of origin evolve to take account of changes in production processes."

> The origin rules establish the general principle that goods that are wholly produced or obtained in either Canada or the United States or both will qualify for area treatment. Goods incorporating offshore raw materials or components will also qualify for area treatment if they have been sufficiently changed either in Canada or the United States, or both, to be classified differently from the raw materials or components from which they are made. In certain cases, goods, in addition to being classified differently, will also need to incur a certain percentage of manufacturing cost in either or both countries, in most cases 50 percent. This is particularly important for assembly operations.
>
> In practical terms, goods other than those which originate wholly in either Canada and/or the United States, will have to incorporate some significant Canadian or US content. . . .

The Self-interest of Canadians

In the process of international negotiations, the government of Canada will articulate the self-interest of Canadians. However, globalization has increased the complexity of Canadian self-interest, and so globalization has made this articulation more difficult. For example, as consumers, Canadians may desire a lesser degree of protection of intellectual property in order to purchase cheaper foreign-made products. From this perspective, Canadians may share the attitude prevalent among the governments of less developed countries. However, to focus on the relative prices of consumer goods in the short-term may be to harm Canadian interests as high-tech employees in the long run. Canadian job opportunities and Canadian income levels will depend upon a process of continual innovation. Canadian international competitiveness will rest upon our technological advances. Protection of intellectual property by governments around the world will preserve the advantages of innovation for Canadians as employees.

The information technology sector has entered a new era in regard to international agreements. We can be sure that new competitive situations will continually evolve. International agreements will be re-defined and re-interpreted as the years pass. The policies and practices of governments around the world have attained a new importance which shall not disappear in the foreseeable future.

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Part C

International Competitiveness and Policy Issues

Canadian Telecommunications, Trade in Services and the Challenge of International Competitiveness

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The phenomenon of globalization raises in a most acute form the problem of international competitiveness. As more and more activities worldwide—economic, social, political—become increasingly interactive and interdependent, countries must look carefully at their own capabilities and opportunities not only for domestic growth and development but also for enhanced participation in the world system. Canada can be no exception to this rule and, this paper will argue, telecommunications must be a crucial component of Canada's international competitive position.

Why is telecommunications crucial and especially so for Canada? The metaphors developed in an attempt to capture telecommunications' central role in the contemporary world trip easily off the tongue—it is the "central nervous system" for a modern economy, the "missing link" in many efforts towards international development, the "electronic highway" for world trade, etc. (see DOC, 1971; International Telecommunications Union, 1984; Robinson, et. al., 1989). What lies behind these images is a recognition that rapid technological advance in communications and computer technologies continues year after year to generate new equipment options, an increasing array of services, and alternative modes of delivery. Coinciding with this inexorable development are pressures for increased competition in the provision and use of telecommunications which affects countries both domestically in terms of their industrial structure as well as internationally in terms both of telecommunications policy and trade policy (see Stanbury, 1986). For a country like Canada which spans five time zones and at least an equal number of distinct regions and which has always depended so much on its connections to the rest of the world for its prosperity and national purpose, an efficient and well-developed telecommunications infrastructure and services is crucial to its economic, social, and political development.

At the same time, significant changes are currently taking place in Canada's understanding of its international competitive position and, *perhaps*, in the crucial role which telecommunications can play in this area. On one level, there are the broad-gauge initiatives, taken already or on the horizon, which seek to enhance Canada's position within the evolving world economy—the Canada-United States Free Trade Agreement with its services chapter and sectoral annex specifically on telecommunications and computer services, the recently-announced Pacific 2000 initiative, and the response required by Europe 1992. Underlying these initiatives but even more fundamental, there is also a subtle rethinking going on with regard to how Canada can and should use industrial policies to promote the development of the high technology and services sectors of its domestic economy and relate these, through trade and investment policy, to an increasingly globalized world economy (see Conklin and St. Hilaire, 1988; Woodrow and Woodside, 1986). In this regard, domestic and international telecommunications provides the link—that essential infrastructure and range of services—through which Canada's international competitive position can be enhanced or not.

Before proceeding much further, let me attempt to clarify the basic argument which I intend to make and the assumptions upon which it is based. Those assumptions involve three purported

distinctions—which actually turn out not to be very meaningful distinctions at all—relating to how the current telecommunications system is configured:

Assumption 1. The Convergence of Telecommunications and Computers: This has been heralded since the 1960's and is now effectively a reality. Technologically, this convergence is manifest in the fact that modern digital telecommunications can be viewed as much as a specialized computer application as access to modern computer networks can be viewed as a telecommunications service. More significantly, however, there has also been a dramatic erosion of market boundaries between the telecommunications and computer sectors of all modern economies and a significant blurring of product and service definitions (see McLaughlin, 1980). Figure I provides a graphic illustration of that convergence and its market implications. In fact, it is this convergence—both as a technological and a market phenomenon—to which the concept of Information Technology (IT) directly speaks and which greatly complicates any treatment of either telecommunications or computers separately.

Assumption 2. Equipment vs. Services: The manufacture and sale of IT equipment is the prerequisite for the provision and use of telecommunications and computer services. However, the hard and fast distinction between equipment and services is breaking down. Equipment may itself become a service (as with a FAX machine or a LAN configuration) and services can also be embedded in equipment (e.g., software discs). Moreover, the provision and use of telecommunications and computer services within or into a country depends very much on the demand and supply of IT equipment. This makes it increasingly difficult to deal with services as distinct from goods in various domestic and international policy-making fora.

Assumption 3. The Domestic and International Dimensions of Competitiveness: Competitiveness has traditionally been viewed as an international concept related to how well a country or company performs vis-à-vis other countries and potential foreign competitors in exporting to foreign markets and limiting the need for imports into domestic markets. This traditional understanding of competitiveness is also under challenge. For one thing, competitiveness is coming to be perceived more and more as a domestic concept because a country's own domestic market conditions can greatly affect its ability and that of companies resident within it to be competitive internationally (see Porter, 1986). Moreover, the pervasive operations of multinational corporations in areas like IT as well as some evidence of rethinking by many countries—and even by economists—of the pure theory of comparative advantage both suggest the artificiality of any hard and fast distinction between the domestic and international realms.

Drawing upon those distinctions and emphasizing the weaknesses inherent in each of them, I would make the following proposition with regard to its involvement with information technology, namely, *that Canada should highlight the importance of telecommunications services and pay greater attention to their provision and use internationally as one of the keys to enhancing its international competitive position.* Let me now proceed to develop and support that position by making five points.

I. Disintegration of Canada's Implicit Industrial Strategy for Telecommunications

It is not always recognized that Canada has over the years indeed followed an *implicit* industrial strategy with regard to the telecommunications sector specifically and IT more generally. The emphasis must be placed on its implicit character since governments, the industry and outside observers in most cases would deny that any deliberate and comprehensive strategy has ever been in place. Moreover, explicit industrial strategies, either generally or for particular sectors, are currently

a most controversial issue in advanced industrial nations and, at least for the time being, the issue has been resolved in Canada during the 1980's decisively in the negative.

The *implicit* industrial strategy for telecommunications which had been followed in the past is now largely in pieces (see Woodrow and Woodside, 1986, Chapter 1). That strategy had at least *six* components:

1. treatment of the provision of local and long-distance telecommunications as a "natural monopoly" within any given territory and, as a consequence, subject to entry, price and rate of return regulation by the appropriate federal or provincial regulator;
2. acceptance of a considerable degree of vertical integration between service providers and equipment suppliers as in the case of Northern Telecom and Microtel;
3. a modest role for public enterprise through Teleglobe Canada and Telesat Canada at the federal level and on the part of provincial governments on the Prairies;
4. encouragement and support both for public and private sector R&D through an "alphabet soup" of federal support programs as well as through direct government research and innovation projects;
5. effective limitations on foreign access to the domestic Canadian market through an array of measures including government procurement practices, a 17.5% tariff on telecommunications equipment imports, foreign investment review, and licencing requirements for use of the frequency spectrum;
6. export assistance through loan guarantees and promotional activities for the few small Canadian firms attempting to crack the world telecommunications market.

While some of these components may still remain, such as the monopoly over local and long-distance service or licencing requirements, others have been or are in the process of being dropped and no comprehensive and deliberate industrial strategy seems in prospect as a substitute.

What the current government subscribes to is an *industrial metapolicy* which seeks to establish "framework policies"—tax policies, trade policy, competition policy, investment policy, etc.—which set the broad rules of the game for industrial growth and development but do not apply specifically to particular sectors like telecommunications (see *House of Commons Debates*, 1984, pp. 95-104). The "national telecommunications policy" unveiled by the Department of Communications in July 1987 follows very much along these lines by establishing two classes of telecommunications providers—Type I and Type II—which are defined according to ownership, competition, trade, and other framework policy characteristics (see DOC, 1987). Thus, in terms of telecommunications specifically, Canada has moved from an industrial strategy which was implicit and quite restrictive to a non-strategy which is more explicit and somewhat more open.

II. The Need to Look Beyond Telecommunications to an Information Technology or Services Perspective

Telecommunications is indeed a crucial and increasingly important sector within domestic and international economies. However, it is no longer a well defined, clearly demarcated sector as it was even 10 or 20 years ago. Rather, telecommunications is part and parcel of a broader business—information technology or services generally. The information technology concept subsumes both telecommunications and computers—including the increasing array of products as well as services available—and highlights the essential element of value-added to the product, i.e., access to greater amounts of information faster, more accurately and in more comprehensive formats (Conklin and St. Hilaire, 1988, Chapter 1). The services framework, on the other hand, clearly overlaps with the information technology concept to a significant extent but concentrates not on the products but the activities to which they give rise and goes beyond information outputs to include a wide range of other

economic activities spread across all sectors of the economy (see Nussbaumer, 1987). Whatever overarching concept or framework is used, telecommunications must be regarded as an essential component either of information technology or of any services concept. Any new or revised initiatives should look beyond a specific telecommunications sector perspective—however important that sector is—to take account of broader information technology and services issues.

Telecommunications in Canada has developed over the years according to a distinctive pattern. It has followed essentially a single provider model—territorial monopolies in the provision of local and long-distance services, vertical integration in the supply of network and terminal equipment, public and/or private monopolies for the provision of international telecommunications and for domestic satellite communications, etc. That pattern has been changing significantly over the past decade as a degree of competition has been introduced in a number of different areas (e.g., private leased lines, terminal equipment) but many core areas of telecommunications remain monopolistic (e.g., local service, cross-border and overseas telecommunications). Information technology and services both contrast dramatically with telecommunications in terms of industry structure, with most areas of information technology operating in a competitive environment and many service sectors heavily dependent on telecommunications, like financial or information services, also being competitive. Industry structure is also complicated by matters of ownership and control as telecommunications services in Canada, both domestic and international, is overwhelmingly in Canadian hands while many other areas of information technology and a few service sectors are substantially foreign-owned and -controlled (see Woodrow and Woodside, 1986, Chapter 1). Table I provides a summary overview of the information technology/services complex in Canada as of the mid-1980s.

Information technology and many services sectors are increasingly global in terms of the conduct of their activities. One needs only to open up one's personal computer to see the different countries of origin from which the various chips and other components may come. Likewise, the advent of a global financial and securities market where, on any given day, the Tokyo exchange, the London exchange and the New York exchange can be open for continuous trading. Telecommunications is itself subject to the globalization process while also at the same time serving that process by facilitating the manufacture and assembly of those computer components and the exchange of those stocks or currencies. Public and private satellite links, transoceanic fibre optic cables, and cellular mobile radio arrangements are dramatically affecting the globalization process (see State-of-the-Art Institute, 1989). However, whereas the information technology or financial services industries can through multinational corporations and other arrangements be somewhat footloose, the provision and use of basic telecommunications services—though not necessarily the terminal equipment attached to it or the value-added services which it carries—still remains firmly grounded in national policies and practices. The difficult task facing governments nationally and internationally at the present time is to arrive at new disciplines and arrangements—in telecommunications policy, in trade and investment policy, and in industrial policy—which can accommodate the diversity of tendencies evident in the information technology and services fields.

III. Increasing Attention to the Services Dimension of Telecommunications and Information Technology

It has become widely accepted that the provision and use of services, rather than goods production, constitutes the largest portion of the domestic economies in all advanced industrial nations and now approaches 30% of world trade (see Shelp, 1987). Services extend well beyond the realm of information technology to include such areas as health care, transportation or even government itself but information technology is itself highly service-intensive. Data processing, information retrieval, data transmission, the software used to run computers and, of course, the various telecommunications services available to move information are all part of the services dimension of information technology. Likewise, it is also important to identify the services dimensions of telecommunications vis-à-vis equipment or hardware, although one would think that to be self-evident. In this regard, however, it is worthy of note that the 1989 *Fortune* magazine list of the United States largest and most

successful companies shifted AT&T—which, since 1984, has divested its local operating companies—from being #8 on its list of industrial companies to #1 on its list of services companies because the company now makes more money from providing long distance and other services than it does from manufacturing telecommunications equipment (see *Fortune*, 1989, pp. 252-253). Increasing attention should then be directed to the services dimension of telecommunications and information technology vis-à-vis equipment or hardware in fashioning any new or revised initiatives.

The services dimensions of telecommunications and information technology are not only its most dynamic, high growth dimensions but also raise quite different issues especially when considered in terms of globalization. Services have traditionally been considered as intermediate to the production process, not storable and only provided where they can be used, and difficult to monitor and measure in terms of their transactions. This conception of services, which tended grossly to underestimate their role and undervalue their importance, is now changing. The enhanced tradeability of a wide range of services is being recognized increasingly as well as the diverse forms which services trade can take (see Feketekuty, 1988; Premier's Council, 1988). Telecommunications services typify the kind of rethinking which is going on with regard to services generally. For one thing, no longer are telecommunications services viewed as the undifferentiated product which they were when voice telephony and long distance calling more or less set the limits of how the telecommunications network could be used. Today, it is recognized that there are a wide array of telecommunications network-based services which go well beyond the basic services with which we have long been familiar (see OECD, 1989). Likewise, many of these telecommunications network-based services can now be provided across national borders which have until now demarcated the world's telecommunications systems. The concept of internationally-traded telecommunications services is increasingly valid and one which is becoming of crucial importance within the Uruguay Round services trade negotiations.

IV. Building International Competitiveness Through Services

As we noted earlier, competitiveness is both an international and a domestic affair and the one realm is directly interrelated to the other. For a country like Canada to be internationally competitive in information technology, it will have to be domestically competitive as well in the telecommunications services which are the lifeblood of its efficient operation. The competitive position of a country or a company is constantly subject to change as a consequence of technological innovation and diffusion, the relative efficiency of their economies or operations vis-à-vis competitors, changes in structural factors, and the like. It is also particularly important for Canada to focus on the services aspects of information technology and telecommunications specifically because this is where the growth dynamic will come from. Thus, the task of building international competitiveness in information technology and telecommunications must necessarily be a complicated and multifaceted one, requiring not so much an explicit industrial strategy to replace the implicit one of the past but rather an acute awareness and openness to the political and business opportunities of the present and future. Building international competitiveness in telecommunications and information technology will involve action both on the domestic and the international front, particularly with regard to their services component.

Domestically, there are at least two features of Canadian telecommunications which must be confronted if the competitiveness challenge is to be met: the federal-provincial jurisdictional issue and competition in long-distance service. There has been a recognition since the early-to-mid 1970s that divided jurisdiction between federal and provincial governments in the area of telecommunications has required some rationalization. During the 1980's, the detrimental effects of divided jurisdiction on potential telecommunications service providers and the information technology industry has become starkly apparent. The current patchwork of federal and provincial jurisdiction is increasingly viewed as inhibiting Canada's international competitive position (see Information Technology Association of Canada, 1989). It is to be hoped that the Supreme Court decision on the CNCP/AGT interconnection issue and the federal government's response to this judgement will finally provide the context and

impetus for such a rationalization. The other key issue is long-distance competition in Canada which has importance as both a symbolic and substantive issue. Symbolically, it tests all the old shibboleths about the "slippery slope" towards deregulation and "regulatory chaos" of the US experience and, of course, challenges the longstanding platitude of the monopoly telecommunications providers that "if it ain't broke, don't fix it". Substantively, however, long-distance competition is important in introducing new players onto the scene, using their own facilities or new arrangements, and offering a choice of services in the telecommunications market place. Not only will this serve to lower the present high cost of long-distance service for all classes of consumers in Canada but it is increasingly viewed as enhancing Canada's international competitive position in the information technology and services area generally (see Federal-Provincial-Territorial Task Force on Telecommunications, 1988). Even five years ago, the tendency would have been to treat the federal-provincial jurisdiction and long-distance competition issues as purely domestic policy and regulatory concerns but they are also now increasingly viewed as legitimate matters of international competitiveness.

At the international level, it should also be noted that the competitiveness of countries and companies in the telecommunications field is also very much at the forefront of discussion. The International Telecommunications Union has been in operation for over a hundred years and its member states—some 165 in total—establish the administrative and technical arrangements for providing and using telecommunications services internationally. The bulk of international telecommunications services are currently supplied bilaterally as jointly-provided services between the telecommunications providers in the countries involved or through public end-to-end services offered by INTELSAT—the global satellite communications consortium—or over various transoceanic cable facilities. Teleglobe Canada is, of course, Canada's sole provider of overseas telecommunications as well as the country's Intelsat signatory and its participant in various transoceanic cable consortia, while Canada-U.S. cross-border traffic is exchanged through agreements between the major telecommunications companies on either side of the border (see Woodrow, 1988). Like the domestic sphere, the international telecommunications environment is also subject to jurisdictional challenge and pressures for competition. The International Telecommunication Union's WATTC-88 Conference in Melbourne, Australia, as well as its 1989 Plenipotentiary Conference in Nice, France are attempting to accommodate determined efforts—coming largely from information technology and services companies as well as certain countries like the United States and the United Kingdom—to open the international telecommunications system to greater competition and more innovative and flexible use of global telecommunications capabilities (see Pipe, 1989). At the heart of these ongoing discussions, but not always recognized in these terms, is the issue of international competitiveness as countries and companies attempt to rejig the rules of the international telecommunications system and to enhance their own competitive positions.

V. *The Importance of the Uruguay Round Services Trade Negotiations for Canada*

The Uruguay Round services negotiations are a crucially important opportunity for Canada and other countries—both developed and developing—to enhance their respective competitive positions and that of companies operating within their territory. The Uruguay Round negotiations are the first global trade negotiations dealing with issues like services, intellectual property and investment measures and attempting to arrive at a framework of concepts, principles and rules which can have global application. The Group of Negotiations on Services (GNS), established and operating separately from the mainstream GATT negotiations, is confronting directly the enhanced tradeability of many services as a result of technological advance related to their cross-border provision and use and also the increasingly competitive domestic and international environment in many services sectors (see Robinson, et. al., 1989). The recent Uruguay Round Mid-term Ministerial Meeting, begun in Montreal in December 1988 and eventually completed in Geneva in April 1989, arrived at a surprising degree of consensus among developed and developing countries on an outline framework of principles and rules for trade in services as well as a plan for moving towards discussions of the sectoral application of these principles and rules (see GATT, 1988). This was both a significant and surprising result.

Telecommunications services is a prime candidate—indeed a "core service" in the view of many—for inclusion in an eventual services trade agreement and it is coincidental but significant that the GNS has begun "sectoral testing" of the telecommunications services sector.

Providers of telecommunications services internationally have never considered themselves as being engaged in trade activities. Rather, they have regarded themselves as involved in cooperative international arrangements in which there was no direct financial relationship between the telecommunications provider in one country and the receiver of the call in another country. Concepts of trade as cross-border transactions between sellers and buyers in different countries did not seem to apply. Over the past decade, however, concepts of the tradeability of services have undergone a quantum change at the same time that technological advance and increased competition have opened up alternative possibilities for the provision and use of telecommunications services. The concept of internationally-traded telecommunications services is now squarely positioned on the GNS agenda.

It is obviously too early to make any firm judgments as to how telecommunications services might be treated. Nevertheless, a few tentative observations can be made. First of all, telecommunications services is being identified increasingly as a "core service" which, in the context of globalization, is essential for the supply of a whole range of other services and this would seem to suggest that telecommunications services may receive special treatment. Secondly, all countries are sensitive for a number of reasons—political, social and national security—about maintaining control of their basic telecommunications infrastructure, but there is also substantially broad consensus on the opening up of national and international telecommunications systems to greater competition and more flexible use and of treating a variety of telecommunications network-based services as traded services. Thirdly, the crucial point in reaching any services trade agreement applicable to telecommunications services will likely hinge on specifying conditions for network access and use. It is these issues—along with the precise specification of trade principles and rules like national treatment or transparency—which will ultimately determine how telecommunications services are treated within any Uruguay Round services trade agreement.

For Canada and for information technology, the Uruguay Round services trade negotiations and specifically their treatment of telecommunications services must be a high priority item. The Canada-U.S. Free Trade Agreement already includes a services chapter and sectoral annex on "telecommunications network-based enhanced services and computer services". This prescribes national treatment, a right of commercial presence, a substantial degree of transparency, some controls on monopoly practices, as well as specific provisions for "access to and use of the basic telecommunications transport system" in each country (see *The Canada-United States Free Trade Agreement*). At the same time, basic telecommunications services including local and long distance services are not covered directly by the agreement. In general, Canada will likely seek to extend the same basic approach to services generally and telecommunications services specifically from the bilateral to the multilateral services trade context. From the information technology point of view, these efforts and those of like-minded countries should be encouraged and supported. More extensive and less restrictive trade in telecommunications services will spur growth, innovation and diffusion of information technology at the same time that IT promises to enhance Canada's international competitive position economy-wide.

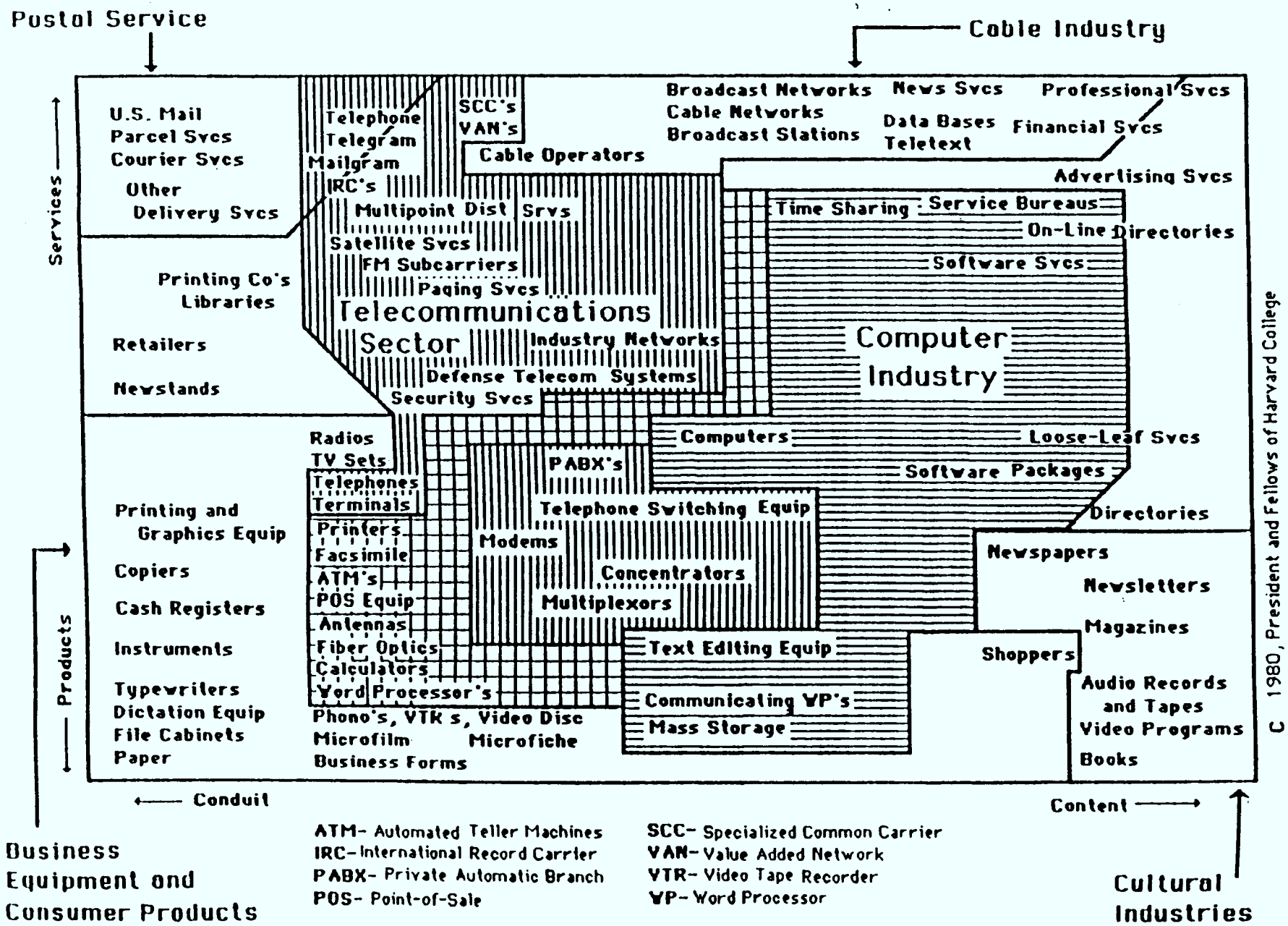
Table I: The Telecommunications and Informatics Sectors in Canada**

Characteristics	Telecommunications Common Carriers	Telecommunications Equipment Manufacturers	Computer and Office Equipment Manufacturers	Computer Services Industry
INDUSTRY STRUCTURE				
* Basic Structure	- regulated monopoly	- vertically integrated	- unregulated, several hundred firms	- unregulated, 170 firms
* Revenues/Shipments	- $8.3 billion	- $3 billion	- $5.8 billion	- $1.35 billion
* Ownership	- 15% foreign control	- largest firms are Canadian-owned	- largest firms are foreign-owned	- predominantly Canadian
* Company Size (Sales)	- Bell Canada, 60% of revenues, B.C.Tel, 12% of revenues AGT, 10% of revenues	- Northern Telecom, $3.3 billion Microtel, $240 million Mitel, $200 million	- IBM Canada, $1.9 billion OEC Canada, $295 million Control Data, $231 million	- 94% earned less than $2 million with Canada Systems Group earning $127 million
EMPLOYMENT				
* Total Employment	- 110,440 workers	- 45,829 workers	- 16,930 workers	- 22,137 workers
* Growth Rate	- approx. 3% per annum	- 4.5% per annum	- 14.4% per annum	- approx. 12.13% per annum
* Wages	- 37.6% of operating revenues	- approx. 33% of revenues	- N.A.	- 39% of operating revenues
* Productivity Growth	- approx. 12% per annum	- approx. 11% per annum	- N.A.	- approx. 9% per annum
INVESTMENT				
* R&D Expenditures	- N.A.	- $614 million	- $80 million (1983)	- N.A.
* % of Shipments	- N.A.	- 20.8%	- 7% of shipments	- N.A.
* Capital Expenditures	- $2.9 billion	- $210 million	- $103 million (1983)	- N.A.
* % of Shipments	- approx. 10%	- approx. 7%	- 9% of shipments	- N.A.
EXPORTS / IMPORTS				
* Exports	- N.A.	- $936 million	- $1.19 million	- 5% of industry revenues
* Imports	- N.A.	- $585 million	- $3.1 million	- N.A.
* Major Trading Partner	- N.A.	- U.S. with 58% of exports & 76% of imports	- U.S. with 90% of exports & 85% of imports	- U.S. but specifics unavailable
* Trade Balance	- N.A.	- $351 million	- $1.9 million	- N.A.
WORLD STANDING				
* Domestic Production	- $8.3 billion	- $2.2 billion	- $1 billion	- $1.35 billion
* World Production	- N.A.	- $45 billion	- $64 billion	- N.A.
* Largest Canadian Company	- Bell Canada	- Northern Telecom	- No world-class company	- No world-class company
* World Ranking	- N.A.	- 7th largest in telecommunications manufacturing but 46th in "information business"	- N.A.	- N.A.

** Based on 1982 statistics

Source: DRIE. Background Paper for the Information Technology Task Force (July, 1984); and DOC, The Supply of Communications Equipment (May, 1984).

Figure I: The "Information Business"



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Telecommunication Innovation: Some Public Policy Issues and Research Findings

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Introduction

Let me begin by stating that in terms of the most recent Canadian budget and as reflected in other national policies, there is no doubt that there appears to be little room for maneuvering or serious concern about information technologies, the telecommunications sector, or research and development (R&D), in general. Let me deal with one example. More specifically, the increase in the federal telecommunications tax by 1% to a net tax of 11% reflects the systematic failure of the Minister of Finance and his departmental officials to understand the crucial role which telecommunications plays in developing a nation's informatics infrastructure. When one couples this with two related national failures, namely the lack of sufficient R&D initiatives and support along with the failure to develop a national information and telecommunications policy/strategy, collectively this provides little hope for those who deal with the public policy aspects or for those who have the even more difficult task of attempting to provide products/services in the information technology sector.

What makes the situation so drastic is the crucial need for Canada to play a major role as an information-based society. Telecommunications is the central nervous system of any information economy. This is a central point. Unless Canada gets its telecommunications policies correct, then little else will count in terms of our being an effective and competitive information-based national economy. If our telecommunications pricing is significantly higher than our international (global) competitors', then Canada will lose out in the short and long runs. This is where the symbolism of the Department of Finance's act of increasing the telecommunication (long distance) tax is so important. It is not the amount or the tax itself, but rather it illustrates the inability of the senior policymakers in the Department of Finance and the Prime Minister's office to understand the information revolution, the crucial nature of telecommunications policy, plus their almost unseemly haste in attempting to tax the future (i.e., the information economy). Such actions make it much easier for our competitors, ranging from Siemens, Ericsson and Phillips in Europe to Japanese and American firms, to continuously beat Canadian counterparts in competitive bidding for major international contracts/sales.

Shifting Order

Just as there was a re-ordering of world powers based upon the Industrial Revolution, so, also, we are now in the midst of the re-ordering of world powers on the basis of the Information Revolution. The two clear early winners are the United States and Japan. A host of other nations, including Canada, are fighting for third place. Third place is vital since it will still permit a nation, or a collection of nations, to obtain a substantial global market share in the overall information technology sector. Such a position will also provide sufficient revenue to continue significant R&D activities and, therefore, some future opportunity to aspire to first or second place. Given proposed activities in Europe leading to the possibility of a "United States of Europe", with 1992 being the take-off year, this

consolidation will give the member nations a substantial advantage in terms of a "show money" finish. (Although, I recognize the clear difficulties in working out common telecommunication standards, etc., among European Community members.)

Other nations fighting for third place along with Canada are: Australia, New Zealand, Switzerland, Sweden, Italy, France, West Germany, England, Italy, The Netherlands, Singapore, Korea, NICs, etc. Obviously, some nation is going to come in third, but also some other nation is going to come in thirteenth, or even worse, twenty-third, by the twenty-first century. Some nations will likely become technological serfs of other more dominant, successful nations. A form of electronic colonialism will emerge to replace the military and mercantile colonialism of the past.

What is going to determine Canada's success will be two central components: first, appropriate public policies at both the provincial and federal levels, and, second, an atmosphere and substantial funding for R&D ventures. This leads us directly to the major theme: Telecommunication Innovation. Basically, Canada faces three major problems in terms of future innovation in the telecommunication sector.

1 The first problem is a perennial problem left over from the industrial era where many of our foremost companies are foreign-owned. Without going into detail, this clearly means that many information and telecommunication firms will likely conduct more and more of their significant R&D closer to their corporate headquarters which are frequently in the United States. This makes corporate sense in terms of locating in an industrial park or affiliating with a major U.S. university in order to form a critical mass as well as utilize the symbiotic research talent/needs exhibited by high technology industries as well as universities with substantial interest in technology transfer.

2 The second problem is more difficult to face: that is, Canada lacks a critical mass market for new technological innovations. Even the rather substantial initiative in the province of Alberta, the Alberta Telecommunications Research Centre (ATRC), pursues high technology innovation for telecommunications products/services which are not designed for the Alberta market, nor, indeed, the Canadian market. The costs of R&D as well as the ability to move to the marketplace rapidly on an international scale now dominates decision-making at both the corporate and research levels. Thus, it is offshore concerns in terms of innovation and the potential for markets scattered around the world, even if they are only niche markets, which dominate decision-making in Ottawa, Toronto or elsewhere. This also suits one of the major themes of the conference, namely globalization, in that it is a global market which Canadian firms must seek to address because not only is this the way the market is moving but also technology clearly knows no national boundaries. Future high technology Canadian sales in China, India, or Latin America is where our future lies and not sales in Hamilton, Red Deer or Baie Comeau.

3 The third problem is that Canada is a major information-based society for several reasons, but a substantial amount of the overall contribution for maintaining Canada's position as a relatively strong leader in the information technology industries has to be connected with Northern Telecom. Northern Telecom is not only a global company which has substantial Canadian presence but also which has provided the R&D as well as a substantial amount of Canadian presence and prestige in the overall telecommunications sector. But, in the future, if for corporate reasons they decide to relocate where most of their market is, namely in the United States, then Canada will quickly find itself without a world-class, major leading telecommunication industry of equal significance to Northern Telecom. Such a move would symbolically, once again and much like Telidon, represent our collective lack of public policy and industrial base to support and foster high technology industries or innovations.

The net effect of the above means that Canada is in a rather precarious position in terms of maintaining any serious likelihood of being one of the major players in the twenty-first century as an information-based society. Unless appropriate public policies, including major commitments to R&D in the telecommunication sector, are undertaken in the next few years by the government at all levels, it is likely that in the twenty-first century Canada will be one of those nation-states which slides into a

technological serf status rather than becoming one of the winners in the highly competitive international information sweepstakes.

United States Issues/Research

The following will briefly review some of the major public policy issues emerging in the United States as well as describe a recent Delphi survey produced by The Centre for Telecommunications Management (CTM) at the University of Southern California. Without going into excessive details, there are two clear indications of major structural changes in the telecommunication sector resulting from deregulation.

The first is that competition is succeeding. MCI currently has slightly more than 10% of the long-distance market share, and they have also been awarded a major federal government installation/service contract. In addition, it is anticipated that by the year 2000 the non-AT&T/Bell system competition will have approximately 25% of the long-distance market share.

Second, innovation in the telecommunication sector is moving at a substantial pace. Fueled by deregulation, a host of spinoff companies and activities has resulted in substantial R&D from a number of firms. It is interesting to note that many of the major firms are locating in cities with major research universities. Another aspect relating to the innovation is the continuing call for further deregulation and the removal of previous restrictions in order that competition be allowed where it was previously not even considered. Examples are telephone companies being able to compete directly with door-to-door newspapers by providing information services in the home; or, another example is cable companies being allowed to provide telephone service in addition to their retransmission of video/audio.

Other studies have documented the U.S. concern about its relative position in the international information sweepstakes. In particular, the study by Robert Bruce entitled *From Telecommunications To Electronic Services*, provides ample evidence of the range of policy and corporate concerns dealing with the United States as an information-based society. In May, 1989, the Massachusetts Institute of Technology released a study which challenged fundamental ways in which U.S. companies operated, particularly with relevance to international competitiveness. The study entitled "Made In America", details the competitive demise of the U.S., and in particular its requirement for U.S. industry to engage in a painful restructuring in order to increase domestic productivity and international competitiveness. Both the above-mentioned studies infer that it is the Japanese who have clearly in the short run and perhaps now in the long run, gained systematic advantage in the information technology and communications related areas.

Michael Rubin in his book *Information Economics & Policy in the United States*, states: "Public policy is our tool in this effort. In these pages is a call to undo the nearly complete failure of our government to address the wide array of problems posed by the new technologies that are transforming this nation into an information society".

Basically, if the United States is worried about its chances as an information economy, Canada should be absolutely petrified.

CTM Telecom Outlook (1988)

The major source of information for this study was a Delphi survey on the future of the U.S. telecommunications sector. This Delphi survey consisted of a round of forty written questions where experts select from a number of options. Five major areas (those being markets, technology, regulation, competition and application) were covered in the original report, and the following are a small sample of some of the findings from the CTM report.

A major question was "Will the regional holding companies diversify significantly as the waiver rules are lifted?"

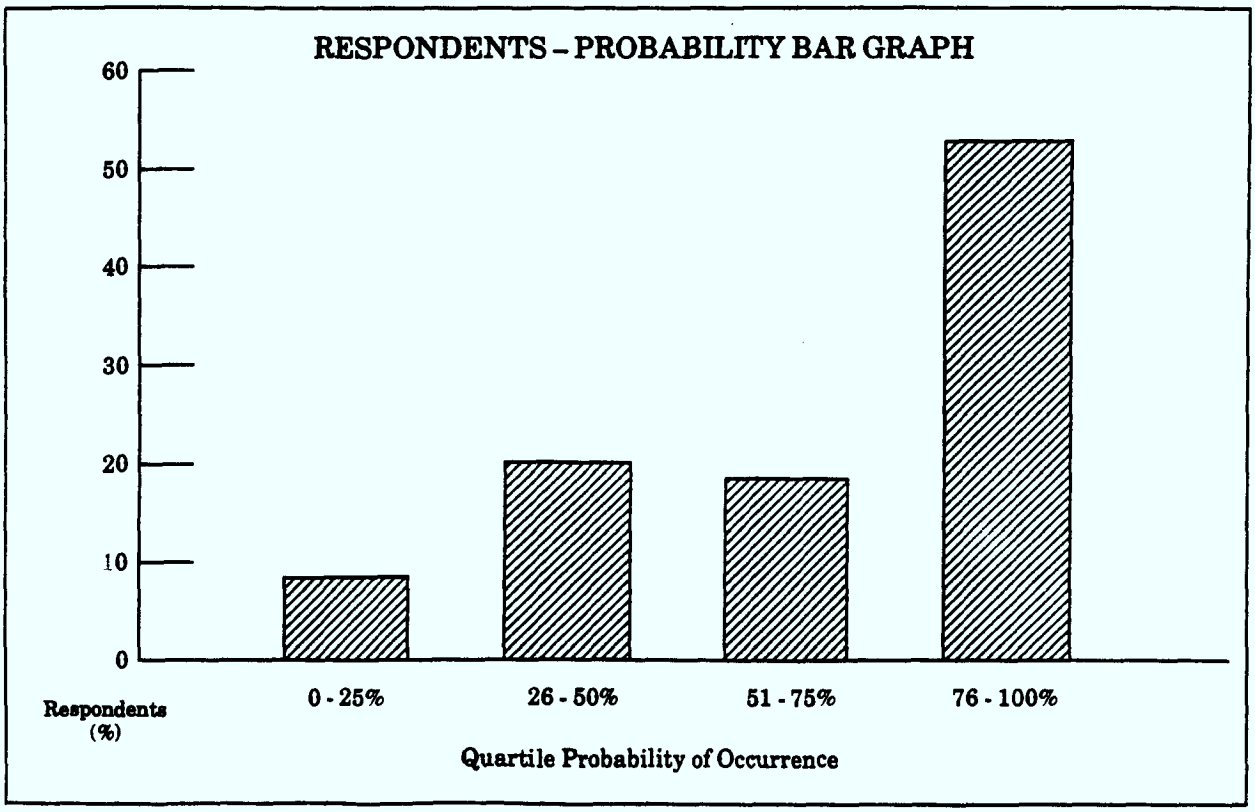
Will the Regional Holding Companies Diversify significantly as the Waiver Rules are Lifted?

Number of expert respondents 281

SOURCE OF INFORMATION:

First-Hand/Direct	30%
Professional Literature	35%
Conferences, Seminars, Symposia	21%
TV, Magazines, Newspapers	14%

Median Probability of Occurrence (excluding extremes) 75%

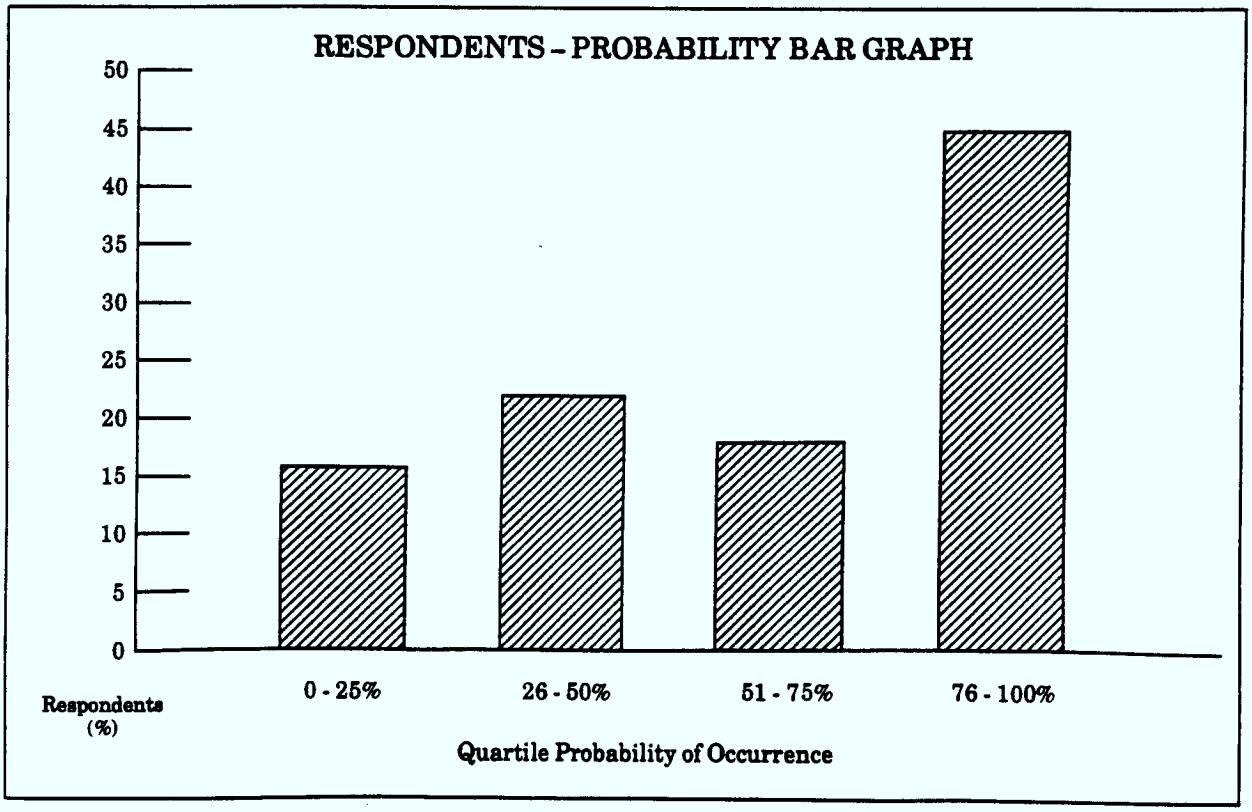


As one may see, the probability of occurrence is 75%. What this basically means is that a vast majority of the experts concede that the probability is high that regional holding companies will diversify in the next decade. In terms of the Canadian relevancy, there are two aspects. First, this may also indicate an attempt of Canadian telecommunication firms also to seek to diversify substantially. Second, some of the diversification of the U.S. Baby Bells may include diversifying into Canada as part of their overall new product mix strategy.

"Will the developed nations of the world agree on one set of standards for ISDN?"

Will the Developed Nations of the World Agree on One Set of Standards for ISDN?

Number of expert respondents	287
SOURCE OF INFORMATION:	
First-Hand/Direct	22%
Professional Literature	40%
Conferences, Seminars, Symposia	30%
TV, Magazines, Newspapers	8%
Median Probability of Occurrence (excluding extremes)	70%

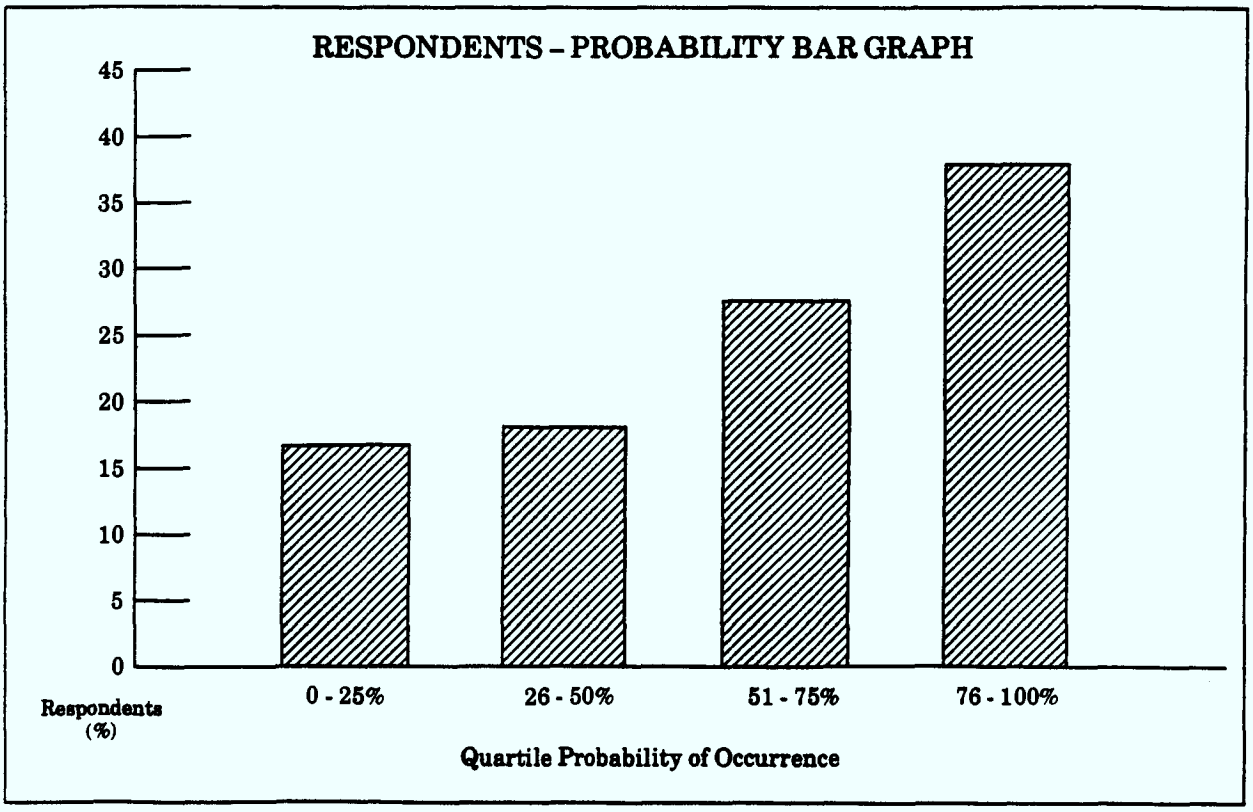


There is a strong likelihood that an internationally accepted ISDN standard will emerge by the year 2000. This is clearly important for Canadian firms since they will have to participate in international fora, as well as the fact that Northern Telecom is a major leader in the installation of ISDN system/technology.

"Will world competition in telecommunications equipment mature, with five firms accounting for at least 80% of the world market for equipment and systems?"

Will World Competition in Telecommunications Equipment Mature, with Five Firms Accounting for at Least 80 Percent of the World Market for Equipment and Systems?

Number of expert respondents	287
SOURCE OF INFORMATION:	
First-Hand/Direct	22%
Professional Literature	43%
Conferences, Seminars, Symposia	17%
TV, Magazines, Newspapers	18%
Median Probability of Occurrence (excluding extremes)	70%

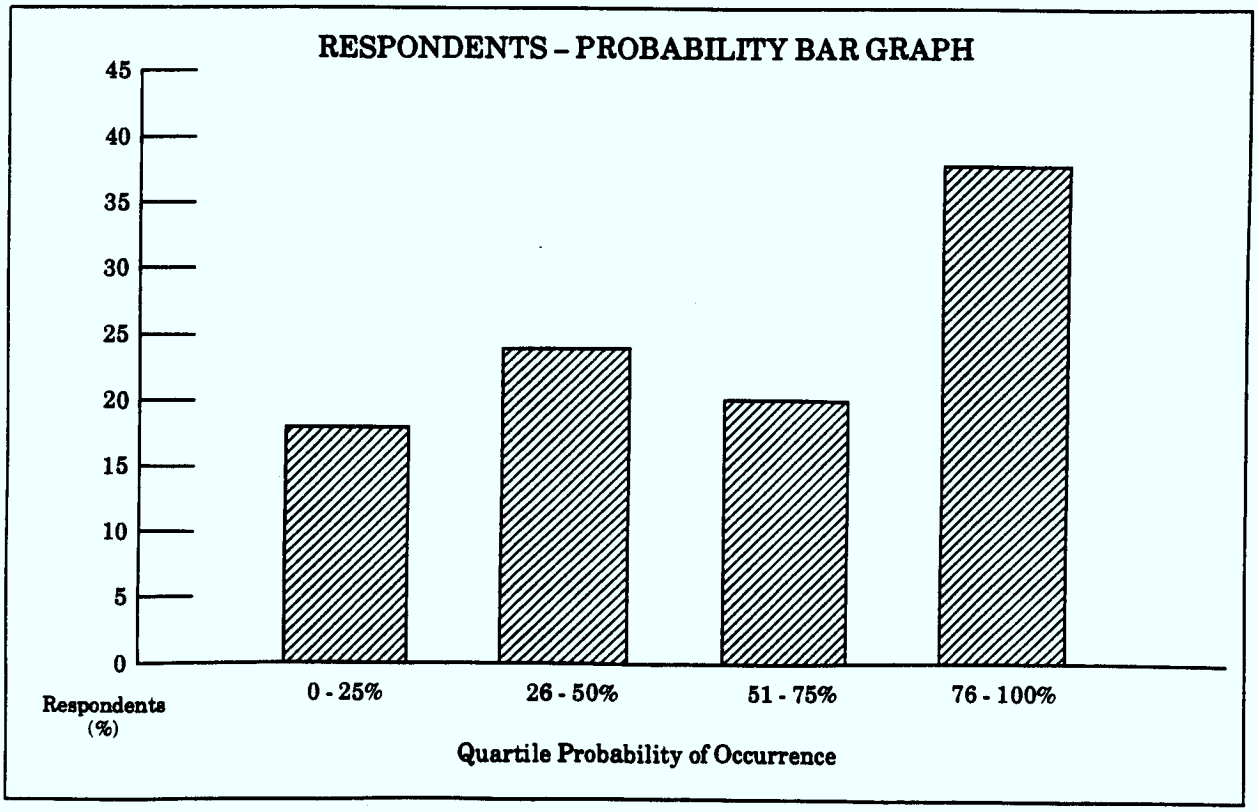


The median probability of occurrence is 70%. This is extremely important because it points to not only global competition but the severe competitiveness among only a few firms at this level. The implications are quite straightforward; namely that Northern Telecom will likely be the only Canadian firm to survive as a major player. There will likely be one or two from the U.S., one or two from Japan and one from Europe. (This also gives additional relevance to the necessary public policy options to encourage Northern Telecom to maintain its Canadian corporate presence rather than to shift its corporate headquarters to the U.S..)

"Will regulatory agencies relax regulations to encourage competition in the local telephone market?"

Will Regulatory Agencies Relax Regulations to Encourage Competition in the Local Telephone Market?

Number of expert respondents	283
SOURCE OF INFORMATION:	
First-Hand/Direct	25%
Professional Literature	34%
Conferences, Seminars, Symposia	25%
TV, Magazines, Newspapers	16%
Median Probability of Occurrence (excluding extremes)	60%



The median probability of occurrence is 60%. This is interesting because Canada lags behind in terms of international trends and fails to provide even competition in the long-distance telephone market, while others are contemplating competition in the local market. I think this particular table illustrates the regulatory lag and indeed some may say the almost Neanderthal approach of the CRTC in terms of either understanding or confronting the reality of the dynamic changes affecting the telecommunications sector from a global perspective.

McPhail & McPhail Telecom 2000 (1985) Study

I would like to describe briefly a current study entitled *Telecom 2001: New Horizons: Canadian Telecommunications 1990-2000.* It is based on an earlier study entitled *Telecom 2000: Canada's Telecommunication Future*, by myself and Brenda McPhail. The original study was undertaken in 1985 under the auspices of the Federal Department of Communications (DOC). It enjoyed a modest success, and a number of individuals encouraged us to replicate this quasi-Delphi study approach to re-examine Canada's future in the telecommunications sector, particularly with concern for the Free Trade Agreement (FTA) as well as concern for the impact of new information-based services commonly known as enhanced services or Type II services, using DOC jargon.

The current study is a little more than one-half complete. It looks at three major areas; namely, technology, market structure and regulatory environment. The technology study has been completed, and it was undertaken by Loecus Informatics and Lapp Hancock Inc. of Ottawa. It is combined with other research materials into a 17 page questionnaire detailing a broad range of aspects relating to the Canadian telecommunication scene to the year 2001. Many of you have probably had the opportunity to see the actual questionnaire. The results will include a series of plausible future scenarios based upon feedback from the telecommunications sector.

Here are the major conclusions from the original 1985 study, *Telecom 2000* by Tom and Brenda McPhail.

1. Technological change in the telecommunications field is the driving force which is affecting all other aspects. In particular, the market structure of future telecommunications services will be determined more by technological innovation than by regulation.

2. Given that technological innovation is increasing the scope of consumer choice, competition is inevitable. It may develop in different sectors or in different regions at different times, but ultimately a competitive model will be the preeminent one in the telecommunication sector in Canada, particularly as Canada evolves into an information-based economy.

3. In light of numbers 1 and 2 above, there is a necessity for a national telecommunication framework that is designed primarily to affect an orderly pace of change in the telecommunication field. In addition, the national telecommunication framework should reflect national public policy priorities which are necessary to attain legitimate government policies and objectives.

4. The above national framework should be accomplished by a joint and cooperative federal-provincial regulatory authority for two purposes:

   i) to affect an orderly change in the Canadian telecommunications industry; and,

   ii) to determine and ensure national Canadian public policy objectives such as: sovereignty, privacy, universal access, regional development goals, and employment opportunities in the high technology sector.

5. In light of international competitive factors and alternative regulatory models, it is necessary that an interim phase be designed to assist Canadian telecommunications manufacturers and service suppliers in the transition to a competitive environment.

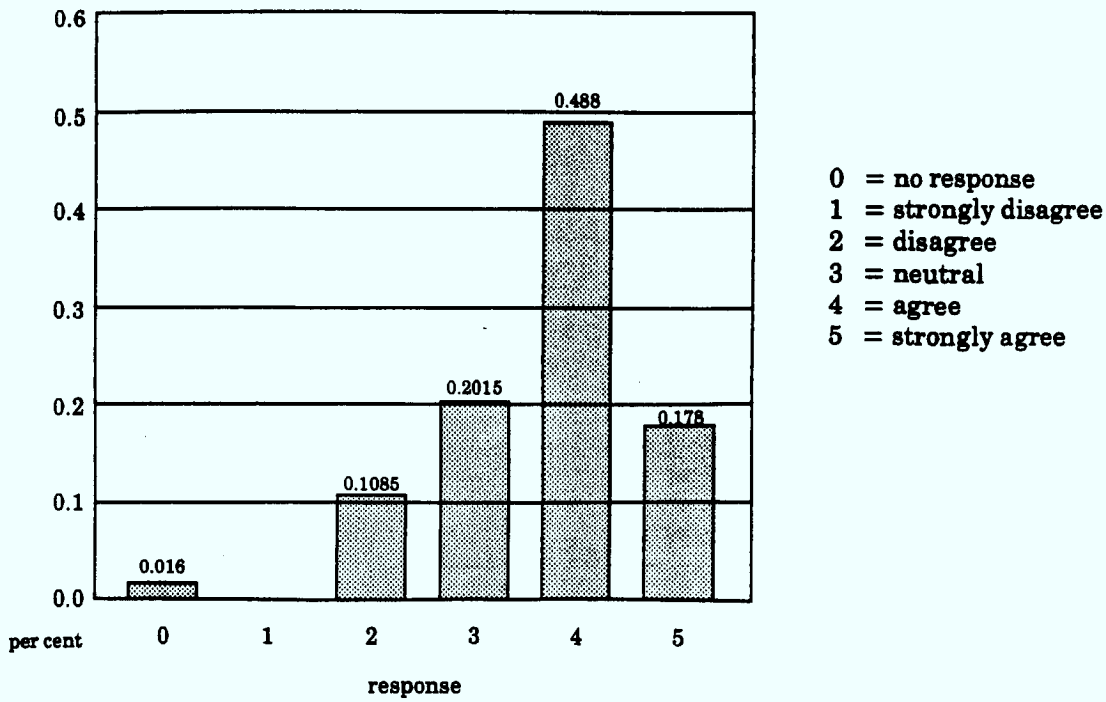
This phase should provide incentive and protection for the Canadian industry in order that it can later function in an open marketplace situation which is determined by international influences. Failure to provide a buffer stage could result in severe dislocations within the Canadian telecommunications industry. In the long run, however, failure to recognize the international nature of telecommunications technologies and markets is also dangerous. An isolationist or restrictionist policy is basically unfeasible and untenable. Such a policy would be to the detriment of both the Canadian telecommunications industry, in general, and the level and quality of services available to individual Canadian consumers, in particular.

McPhail & McPhail Telecom 2001 (1989) Study

The following represents some *preliminary* data from four key questions which were selected from a research questionnaire consisting of seventeen pages. I should also note that the questionnaire was distributed nationally to middle-to-senior management in the telecommunications industry, as well as to regulators and information technology researchers. As such, the data is particularly rich because it does represent the collective knowledge/judgement of key individuals who, in many cases have influence in making their predictions of the future come true, or, in terms of regulators, of affecting the playing field which affects corporations and the public alike.

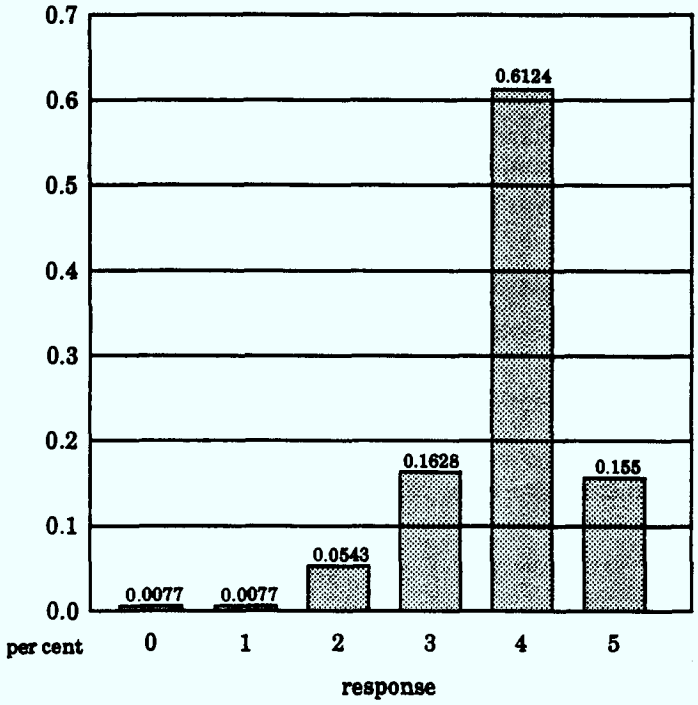
In terms of the first question, access to global markets is clearly perceived to be a major factor in terms of future trade negotiations with other nations.

Table I



In terms of Table II, again there is a strong indication of agreement that Canadian firms will compete successfully in international markets.

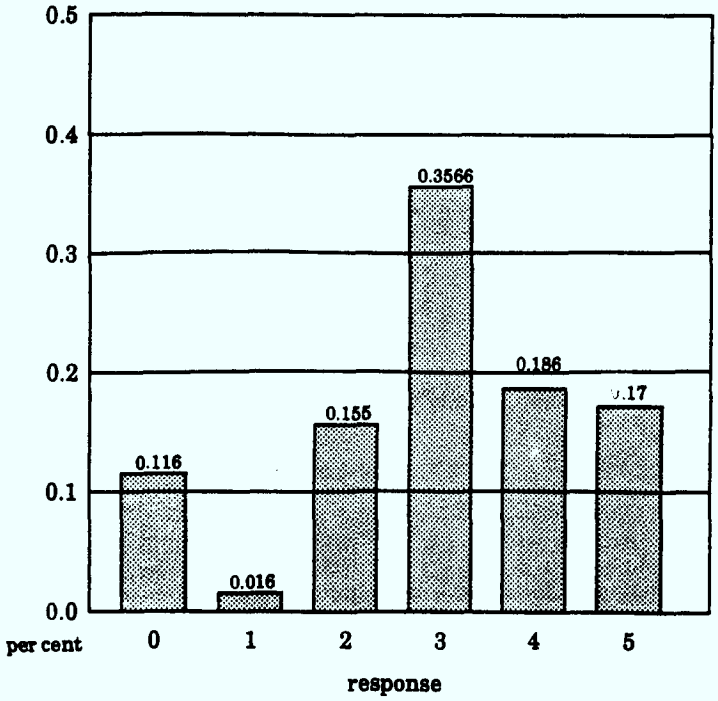
Table II



0 = no response
1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

In terms of Table III, again there is agreement, though modest, concerning Canada creating a Japanese type ministry in order to assist the telecommunications industry.

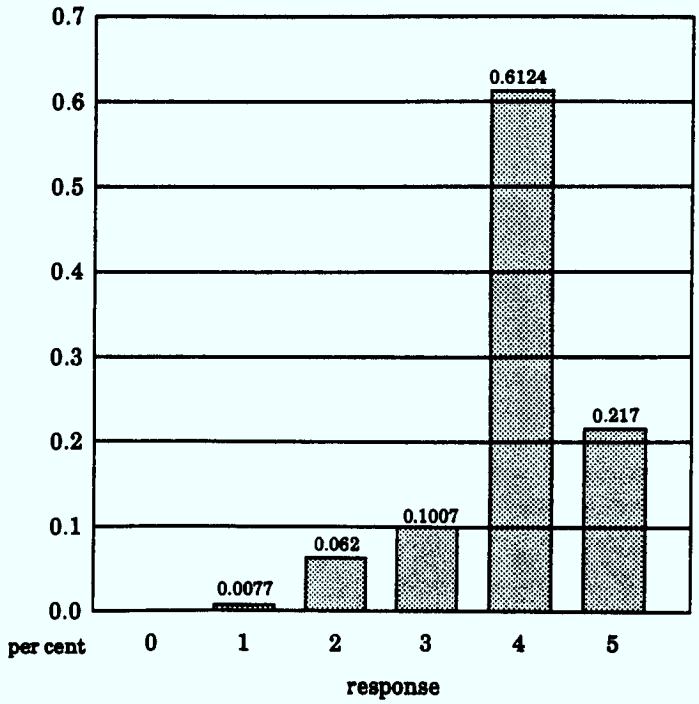
Table III



0 = no response
1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

In terms of Table IV, there is significant optimism about the future of the Canadian telecommunications industry. This is clearly an encouraging Table, but hope alone will not make up for the lack of appropriate public policy initiatives.

Table IV



0 = no response
1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

The overall study and data analysis phase which is currently underway will be completed by late summer, 1989.

The following represents other indications of the responses from the national survey pertaining to the current study. I should emphasize that these are results solely of a perusal of the questionnaires, and the results could shift as additional data is received/analyzed.

In terms of technology, the two preferred Building Blocks are number two and number three; the former being a moderate to high technological innovation, and the third being extensive research and development. These are preferred because of advantages for business, both domestically and internationally.

In terms of market structure, the preferred Building Block is number two, with a dynamic national market structure where there is competition. This is preferred because it is seen as user-oriented and competition in the market place stimulates growth.

In terms of the third area, namely regulation, the preferred Building Block is number two, where more of a national strategy and rate rebalancing is presumed to be widespread by the year 2001.

Other factors which we have noted are as follows:

1. A strong preference for a new national regulatory regime, which consists of a cooperative federal and provincial body.
2. That there is some pressure for reform, but this is clearly not unanimous.

3. Obtaining access to global markets for Canadian firms reflects a strong and positive consensus among those one hundred plus questionnaires received to date.

Finally, a major difference that we see at this early stage, is that in *Telecom 2000* much of the decision-making in telecommunications was technology driven. In terms of *Telecom 2001*, there has been a shift to the decision-making being market driven.

Second, an early difference noted in both literature, as well as in data, is the strong indication that not only is the U.S. ahead in terms of market and regulatory aspects affecting the information technology industries, but also that it is a market place which resembles most closely what Canada is likely to look like somewhere down the road.

Conclusions

The net results of these concerns is to point to the rather dramatic fact that information technology and telecommunication policy do not rank sufficiently high enough on either the political or public policy agenda to attract the attention and type of senior level decision making and commitment which is required. Although there have been encouraging efforts such as "Vision 2000", a recent (May 18, 1989) R&D initiative announced by DOC, it still represents a modest effort. It will likely be a system where ultimately the converted will be talking to the converted. It will be a system designed to enhance and develop a personal productivity network primarily linking universities and industry experts. But it leaves out of the loop, not only the general public which must support and will ultimately be affected by any failure to capitalize on opportunities in the information sector, but it also fails to link other necessary components particularly the Department of Finance, regulatory agencies, provincial governments, etc., into the overall process.

The essential point is that unless we have the equivalent of a Royal Commission on Canada as an Information Society, it appears unlikely that we are going to be able to mount the type of public support, public awareness and commitment of major players for the type of substantial policy changes coupled with significant R&D initiatives/expenditures which will be required in order that Canada truly can legitimately claim third place in the world ranking of information societies. Rather, Canada may stumble and slip to perhaps that almost fatal position of twenty-third on the list where we would no doubt become a technological serf of some other nation-state in the next century.

Competitiveness in Information Technologies

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Introduction

Science fiction has always been a good way to think about how we manage our movement from now to the future. While H.G. Wells or Jules Verne or Gene Rodenberry might do it better, a look at the possible way things will happen in the year 1999 might help focus a discussion of how Canadian public policies could facilitate the global competitiveness of our knowledge-based industries. Some scenarios from a decade hence:

- Professor Margaret Smith of the Department of Engineering of General Motors Universities and Research Division was awarded this year's Nobel Prize for Physics for work in laser-assisted assembly that drew on a new technique produced by a team of research associates working under the Ph.D. (applied) UN funding. The team, consisting of two Japanese, a Brazilian, a Canadian and a Soviet has been working for five years on the project. (To arrive at this point as a society, Canadian decision-makers are going to have to focus on *how research is organized*, what new procedures are required to lubricate the transition to a competitive information economy.)
- The Sanwa-Royal Bank joint venture is offering a new service in accounts management for high school students. The program which features a software application prepared specifically for this project will use interactive video to be financed through educational vouchers under the Educational Privatization Act of 1996. (To arrive at this point, Canadian decision-makers are going to have to focus on *how information is collected and disseminated*, what type of new educational organizations and processes are required so that all citizens can invest in their own skills-development.)
- The fast-growing FAXPHONE INC. yielded the highest return of any TSE-listed stock in 1999. Faxphone's successful technique for miniaturization of the receiver so that it could be carried like a Star-Trek communications device enabled them to combine both information-systems and cellular telephone functions. It is fitted into a solar-powered portable printer which won a design award in 1987 for its ability to be fitted into automobiles. Derided as an over-priced gimmick four years ago, it has now emerged as the dominant player in the Canadian telecommunications market. (To arrive at this point, Canadian decision-makers are going to have to focus on the *regulatory structures* which are necessary to create incentives (or disincentives) for innovation in key technologies, what type of telecommunications infra-structure is required to sustain new industry-structures.)
- Portable environmental monitoring and nutrient-measuring technology is starting to be exported from Canadian producers. It enables health-conscious consumers to assess the contaminant level of foodstuffs and make assessments of the relative nutritional value as well. Through a modelling system stored in a computer system, it provides instant read-outs of all

major chemicals and proteins. (To arrive at this point, we will have to rethink *what we mean by information technologies.* The information industries will not mean simply computer systems that scan wire services for key words and customize information documents, but any form of organizing knowledge for application to market-determined problems.)

The changes in the way information is collected, analyzed and diffused create significant challenges for public policy makers and corporate strategists. The standard science and technology policy debates have to be reformulated if we are to arrive at the 21st century in competitive shape. The archaic debate about picking winners and losers is a waste of time. We must start debating how to create a framework within which innovation is encouraged, a new public policy challenge. The debate about the limits of state and market is equally irrelevant in its 1970's formulation. The central questions concerning public policy and information technologies (as well as other innovation-driven advanced technology industries) are:

1. Should the government's regulatory role in information technologies facilitate the breakdown of conventional technological categories (cellular versus hard wired telecommunications)?
2. Are there key strategic technologies (or enabling technologies) which should be nurtured through periods when there is no market for them? The problem of marketing advanced technology concepts is that frequently technology-driven inventions or applications cannot stimulate a market demand because organizational decision-makers cannot determine how they might be used. How long should a new technology be incubated before being forced to establish a market-presence?
3. If so, how do we identify these strategic technologies? How do we ensure that skilled lobbyists are not using the strategic technology argument to advance protectionist or subsidy-oriented public policies? Could candle-makers or buggy-whip manufacturers have hired consultants to argue that they were "strategic technologies?"
4. In attempting to create globally competitive Canadian advanced technology firms, what policy instruments should the Canadian government use to induce competitiveness? Should we be focusing on enhancing the value of "human capital" through education/shifting the capital markets towards risk-taking activities with a different incentive structure/ensuring that long-term criteria are integrated into corporate and investment decision-making either through incentive-structure in the tax system, risk-sharing or the use of public corporations to galvanize the technological infrastructure?
5. If we use instruments of public investment to create long-term technological infrastructure/ strategic technologies, how do we assure that these instruments have the market-sensitivity necessary to ensure that the public's monies are being spent in an accountably efficient manner?

Proponents of advanced technology industries have to be able to answer these questions if they want government long-term financial support in a deficit-oriented public policy process.

HDTV: Strategic Technology or Boondoogle for a Declining Sector

The case of HDTV pushes the debate over what a "strategic technology" is. Why does it matter if a national economy has an in-house capability in HDTV? The language of the debate is interesting. As in all political environment issues, the debate reveals the attempt by both sides to portray the issue in the strongest possible public policy language. U.S. TV and advanced electronics manufacturers must demonstrate that HDTV is a strategic technology or it will not justify the portfolio of public policy responses to sustain an artificial national competitive advantage. Alternatively, they can portray HDTV simply as a weapon in the Section 301 trade bill sense, designed to create a bargaining chip to force the Japanese to open their domestic markets whether or not they really believe HDTV to be a strategic technology.

Those concerned with avoiding expensive subsidies are left to counter both arguments of the electronics lobby: HDTV is not a strategic technology/strategic technologies are not the right technique for public finance in advanced technology areas, and there is no need to create a bargaining chip of this sort in the broad sweep of U.S.-Japanese trade issues. The language of the debate is informative.

In an editorial on May 15, 1989, the New York Times concluded that "(e)lectronics has too big a future for American companies to have no share in it. HDTV is a good place to try reversing the long retreat." The reversing the retreat argument is not based on the primary importance of consumer electronics, but instead focuses on the cluster of strategic industries revolving around semiconductors, computers, integrated circuits and the semiconductor tooling industry.

The question of the type of public policies required to support the development of HDTV focus both the issue of "what is a strategic technology?" and the question of "what enhances the international competitiveness of industries?" There is a global market in technologies and the balance between enabling technologies and competitive strategies lies at the heart of the real public policy debate on HDTV. The difficulty of cellular telephone exporters in penetrating the Japanese market demonstrates the extent to which the balancing between the strategic technology argument and international competitiveness lies at the core of the Japanese attempt to keep Motorola out of the Japanese market.

David Sanger, reporting in the May 15, 1989 New York Times, demonstrates how Motorola's cellular which works perfectly in Osaka and "becomes useless as you approach Tokyo" depends on a Japanese regulatory system which had allowed NTT one of the available radio bandwidths for cellular telephones. The Times quotes a senior official at the Japanese Ministry of Posts as saying that "the radio bandwidth Motorola demands simply does not exist." He argues that the current generation of car telephones will soon be replaced by digital systems and at that time Motorola will be able to compete in any market that it wants. The regulatory lag will presumably allow a "strategic technology" to be developed by the Japanese.

Some of the debate over HDTV in the U.S. is standard fare. For example, Claude Barfield in the Wall Street journal of May 8, 1989 writes "U.S. regulatory policy should certainly be used to advance national interests (standards are a critical factor in HDTV development), but the government should resist wholesale abandonment of the antitrust laws for manufacturing. Similarly, calls for guaranteed markets, discrimination against foreign-owned companies, and exclusive licensing of technologies should all be rejected. They directly conflict with U.S. international trade goals and will inevitably work against U.S. national and corporate interests."

There is absolutely no reason for U.S. action to become involved in HDTV unless it is a key strategic technology around which other competitive enterprises will cluster. The argument for economic intervention rests on two premises from the consumer electronics lobbyists:

(a) that HDTV capability by the Japanese is more important as a strategic technology than VCRs or colour television;

(b) that there are public policies which the United States government can advance which can either (i) give the U.S. a competitive position if Japanese market-dominance is delayed (the Motorola syndrome) or (ii) provide a technological training ground of such importance that it is worth the expenditure anyway.

A clarification of these arguments is vital if fiscally-constrained governments are to become allies of entrepreneurs focused on the international competitive environment rather than expensive burdens to the overall performance of the economy. Both sets of arguments need to be demonstrated before the case of public policy special treatment of HDTV can be made. My analysis of the debate to date is that the "infrastructure/strategic technology argument" has not been made persuasively by the consumer electronics lobby. However, a lay judgement on this (which is what a political judgement

inevitably must be) involves an assessment of technological capacities and needs that ultimately must be quite subjective. It is on this thin reed that contemporary science policy hinges.

Defining an Information Economy and Knowledge Industries

(a) new sources of competitive advantage

Competitive advantage comes from a variety of factors. The fact that Canadian technology is competitive in water bombers, hydroelectric construction, and nuclear power stems from the mix of public policy, knowledge-base and clear strategic thrust. The application of knowledge, wherever found, creates significant competitive advantage. Knowledge can be materials research on submarines which can produce a new line of recreational products for going beneath the surface or it can be oceanographic data on reefs which could add value to travel consultancy and thereby define a competitive advantage for a travel agency with customized expertise targeted at recreational scuba divers. The capacity to organize that knowledge is what will define the competitive environment. In universities, we spend much more time on the technologies of information industries than we do in deciding what information we put into them. To some extent, our service industry becomes information-technology driven as a result. It is easy to record at a restaurant when people buy hamburgers and when people buy pasta, and control supply and production more efficiently. This is an example of seeking a competitive advantage based on what technology can already do rather than articulating a demand for a new technological capacity based on a specific need.

(b) new sources of strategic organization

We need new organizations to meet the needs of technological advancement. The development of consortia like the Microelectronics and Computer Technology Corporation (MCC) in Texas to pool US R&D efforts in computer research; the relaxation of antitrust law in the U.S. to expand R&D consortia; centers of excellence which encourage cross-disciplinary activities which are difficult to organize within existing institutional structures and incentive-patterns; the evolution of a company like Connaught from a government laboratory to a privatized corporation with CDC investment backing are all examples of creative responses to the problems of advanced technology management. We need to do much more innovation within the organization of advanced technology management.

(c) technological infrastructure, strategic technologies, enabling technologies

The debate over when a technology is crucial to the performance of a national economy has become more and more important in this stage of intense Japanese-U.S.-EEC competition within the international marketplace. While debates about comparative advantage are as old as Ricardo (and maybe the Old Testament), they take on a new dimension in this period of accelerated innovation and global competition. There is no doubt that there are "core technologies", "enabling technologies" or "strategic technologies" which cluster in a way which determines the capacity of a particular technological infrastructure. There is also no doubt that the "technological sovereignty" argument is frequently used as a rationalization for a form of special-interest driven industrial policy which creates an inefficient and expensive economic nationalism. Nothing could be more important for the next generation of industrial policy decision-makers than to be able to differentiate the special-interest driven arguments from the "strategic arguments".

Many venture capitalists and business strategists will argue that the effort is futile and that investment opportunities should be pursued globally wherever there is a prospect. Ideally, this is

an excellent approach, but the history reveals a pattern which is unkind to those who borrow technologies without having an alternative source of national competitive advantage. The argument for technological infrastructure is a form of "pure science" argument. If we lack one, we will not be able to spin off the commercializable new products. If there is no space program, there is no materials research.

But when does a strategic technology become a special-interest driven bailout? Which is HDTV? Which is AECL? Which is the French computer industry? How can we analyze this? There can be no perfect formula for determining this, but an informed and useful public policy debate will try to determine the appropriate borderline.

If we look at the advanced technology core sectors in Canada, we see some interesting clusters:

WORLD-CLASS	Telecommunication, nuclear power
NECESSARY INFRASTRUCTURE	Aerospace
LIMITED STRATEGIC CAPABILITY	Pharmaceuticals
STRUCTURAL WEAKNESS	Computers

This doesn't mean that within a sector, there will be uniform performance. A QUADRALOGICS, a LUMONICS, a COMDEV, a COGNOS can develop some real capability in the Canadian environment, but their individual success does not necessarily mean that there will be a cluster around that particular industry in a manner which will generate a sustained sectoral capability. Other sectors like urban transportation and hydroelectric engineering have already generated a world-class capability that is demonstrated by the performance of Canadian multinationals like Lavalin and Bombardier which have been able to diversify into other activities. Presumably an enabling technology is akin to having physics, chemistry and biology departments at universities. While the dividing lines may be somewhat obsolete, nonetheless, they are significant and identifiable building blocks. A national economy, like a corporation, diversifies with caution.

New Technologies/New Markets/New Public Policies

When we move from science fiction to meaningful strategic forecasting, we know that the industry structure in the information technology sector is in a state of significant flux. In the United States, consortia in the US in the early 1980's to develop videotext consisted of computer companies, broadcasting companies and retailing companies. This is the type of innovation through alliances that was necessary to push the application of information technologies along. How the next stage of convergence will take place is a significant public policy and regulatory question for the 1990's. The relationship between fax, cellular, telecommunications, videotext and other information services, broadcasting and cable television is a cornerstone of strategic thinking in the innovative companies that are located anywhere within the hexagon of the communications industry structure.

BROADCASTING

CABLE	**TELECOM**
CELLULAR	**INFORMATION SERVICES**
	VIDEOTEXT

COMPUTER SYSTEMS

How this convergence is managed will determine the competitive positions and market opportunities of many companies playing within the boundaries of this expanding hexagon.

It is also of crucial importance to recognize that there are new industries and market opportunities growing from technological innovations and their applications and that these are correctly referred to as information industries. The five that follow are industries in which Canada either has a competitive advantage or no significant competitive disadvantage:

(a) environmental monitoring

Environmental monitoring is an information technology. Screening apples for Alar, doing tests on water for chemical contents, attaching an absorbent strip to a peach to measure the pesticide content are all information technologies for which there is significant market demand.

(b) computerized mapping

Computerized mapping is already recorded as a significant new economic application of information. The cost effectiveness for trucking routes alone makes satellite-guidance systems an excellent example of applications of information to commercial practices.

The capacity of computerized mapping to aid in meteorological prediction and geological exploration is well documented by Edward Warner in December 1988 issue of High Technology Business in an article entitled "Smart Maps: New Route to Profits". The commercial potential of this information technology explains the interest of Lavalin in acquiring the technological capacity of the federal government Department of Energy mapping branch two years ago.

(c) educational software

The experiment between Logo-Leggo in Boston to develop a computer application for learning technologies is an example of one of the new frontiers for knowledge applications, i.e., applications at the very heart of learning. Contrary to some, I believe that video games can (in moderation) be a valuable learning technique for children, and the application of educational philosophy to video games creates the potential for a new industry of enormous value.

(d) information marketing/pure knowledge industries

The organization of knowledge has been remarkably old-fashioned. If, for example, I own a company which wants to sell in Brazil, it should, one would think, be possible for me to go to the University of Western Ontario (a living bibliography) and say that I wanted a customized course on Brazilian history, culture, music, politics and economics. Of course, I will pay for this. Or one would think it would be possible to network the various information repositories on Brazil in Canada (a political scientist at the University of Montreal, an economist at UBC, a retired External Affairs official who writes on Brazilian literature, a journalist in Halifax, etc.). This simple use of networking which is increasingly done in an improvised manner by innovative consulting firms and industry associations adds enormous value in an information economy and creates marketable services out of process. Who knows whether or not there could be a marketable service for the Royal Bank of Canada in communicating its knowledge of Japanese financial institutions. Knowledge is increasingly where you find it. And we look for it instead much too often where we think it should be.

(e) video production

The line between information and entertainment is increasingly blurred. More people learn about ethical philosophy and jurisprudence from L.A. Law than from reading Ronald Dworkin. This is not necessarily bad as long as the relative roles of Departments of Philosophy and television networks are maintained in their core functions. Nonetheless, the VCR revolution makes possible a form of customized information-dispersal which is only beginning to take shape.

(f) anticipating markets for undeveloped products—the challenge for advanced technology industries and for Canadian public policymakers

One of the real problems with advanced technology marketing is that the conventional customer focus which applies to product innovations which respond to market signals does not always apply to new technological breakthroughs. The Slowpoke nuclear reactor, the videotext capability of Telidon and the potential market for HDTV are more difficult to assess than a product innovation which is driven less by technological potential and more by market signal. The structure of the national and global markets for solar power has proven to be difficult to read, given the difficulty of anticipating domestic energy costs, international energy supply and the public policy based incentive structure.

Similarly for information technologies, the mix of domestic and global market factors and national public policies produce a strategic dilemma. The investor will bet on delivery capabilities: a cellular/fax customized distribution system versus the videotext capabilities of home computer, and a cable-based distribution system. Information has to be processed and an increasing premium is put on this.

A large consulting apparatus has contracted out the information-processing needs of modern companies to the McKinseys, the Monitors and the Bains as well as specialized consulting services which compile information such as data on the Mexican budgetary process 1982-9 or the Spanish telecommunications industry's capacities. The means by which this kind of information is processed and rendered in an accessible form is a significant determinant of competitive advantage for firms competing in a global information economy. Just as one might appoint as a director for a pharmaceuticals company anxious to expand into the Spanish market a marketing person who has just pioneered a joint venture with a Spanish telecommunications company, the specific character of competitive advantage changes.

For example, Canadians have far more experience managing multicultural and multilingual organizations than anyone else with the possible and only possible exception of the Swiss. We have not yet realized what a potentially significant competitive advantage this is. Canadians also have more experience in running public enterprises and innovative enterprises like the Caisse de Depôt. This provides a managerial dexterity and innovativeness which could again be of significant competitive advantage in helping the Brazilian or Spanish economies establish a disciplined public-private sector collaboration in a takeoff period of post-industrial development. Information, and the manner in which it is processed, is a significant source of competitive advantage as organizations like Southam, the Economist and the major financial newsletters understand. In becoming preoccupied with the technology, we must not assume that the medium is the message.

We cannot totally shape the structure of the information technologies convergence. The market will tell us which lanes are dead end and will create new opportunities and limits as will technological breakthroughs that cannot be predicted. However, the public policy process can facilitate the competitiveness of Canadian information technologies. Canada can build on its competitive advantages and create new ones from organizing knowledge and disseminating information more

efficiently than our competitors. To do so, we must keep in mind the following public policy criteria and initiatives:

- **Creating Incentives for Long-Term Investment**

  Government support for information technologies must concentrate on creating incentives for long-term investment and risk-taking. This can be done, but needs more crafting than instruments like scientific research tax credits.

  The shadow cast by SRTCs hangs long over the Canadian advanced technology industry. Instruments designed to facilitate long-term investment in innovation will have to be designed with tighter accountability mechanisms. Alternatively, the Canadian model of long-term patient capital/risk-taking capital markets balance will have to be tilted more towards public investment models. Contrary to current conventional wisdom, there is nothing *inherently* wrong with this if the public investment models have some built-in market sensitivity. Governments are no worse than anyone else at picking winners (especially over a longer time frame which factors out the quick-flip successes of private investors). Governments simply cannot do a good job of unloading losers compared to the private sector, and on this the bad reputation of government involvement has grown providing enormous ammunition for the anti-government rhetoric of outdated economists. Any public investment model must have a built-in privatization dimension creating a revolving door of crown corporations, but this level of detail is best left for another discussion.

- **Building a Knowledge Infrastructure**

  Knowledge infrastructure is vital and public policy must promote knowledge. The universities should not have a monopoly on knowledge industries any more than Air Canada should have a monopoly on air travel. Universities have developed many bad habits as a result of their monopoly situation and must be encouraged to adapt to the realities of the information economy where there are other sources of knowledge and information to be tapped.

  In practical terms, this means less emphasis on credentialism and more emphasis on quality or excellence. Credentialism and quality have started to run at cross purposes in our knowledge-driven economy. If there is someone working for Paramount Pictures as a consultant on medieval history who is more knowledgeable than a person with a Ph.D. on Thomas Aquinas, who should be responsible for the dissemination of culturally-valuable knowledge?

- **Facilitating the Globalization of Canadian Advanced Technology Firms**

  The role of government is to facilitate threshold firms into becoming multinational corporations so that Canada has a fleet of global multinationals that are capable of leading the growth of the Canadian economy into the 21st Century. Lavalin and Bombardier are models of this type of creative government-industry partnership. This contrasts to the Lumonics-Connaught process of globalization which is taking place in the Summer of 1989. While arguably it is good that Canadian advanced technology firms globalize through such strategic alliances, the inability of the Canadian political process to focus on the key issues of how we maintain such control as we need over key technologies and *how* we globalize could put the Canadian technological infrastructure at risk. A misleading and backward-looking discussion over the FTA in the 1988 election has delayed the necessary questions being put and debated.

- **Building a Consensus for Innovation**

  Public policy makers need to generate widespread equity participation in new ventures. One technique for doing this would be to use compensation/adjustment instruments that governments provide to workers in sectors that are no longer internationally competitive to generate a stake in the technological frontier industries.

Otherwise, in practical terms, the buggy-whip manufacturers have a rational economic interest in attempting to use the political process to block the introduction of the new technology. If technological change produces clear winners and losers, no one should be surprised in a democracy when organized interest starts to try to slow the rate of change.

- **Facilitating the Remuneration of the Inventors of Knowledge**

  We must create intellectual-property dispute funds so that expensive litigation over patents and copyright can be resolved through the infusion of funds to the creators of new sources of knowledges. This must be done on a global basis with policy instruments predicated on the same assumption as workers' compensation, i.e., we have a collective interest in avoiding litigation and remunerating the affected parties.

- **Privatizing and Commercializing the Knowledge Infrastructure**

  As in the mapping branch of the federal Department of Energy, there is much knowledge that has been accumulated through public investment over the last century collected within government bureaucracies. Canadian competitiveness can be dramatically enhanced if a process for commercializing this infrastructure could be developed.

- **Defining Strategic Technologies**

  As in T.S. Eliot's poem, having not ceased from exploration, we arrive at where we started and (with luck) know the place for the first time. The debate over what is and is not a strategic technology will go on. This is part of the creative messiness of democratic decision-making. Someone will come up with a formula trying to demonstrate why X is a strategic technology and Y is just a frill. The history of technology shows us that any attempt at drawing neat boxes and borderlines is folly. The debate will and should continue. Inefficient special interest masquerading as strategic technologies will, in more cases than not, be exposed if the public policy debate is informed and vigorous. A national economy which wishes to be competitive must have certain minimal knowledge capacities (the analogy to Physics 100, Biology 100, etc. holds). Canada's core industries include atomic energy, urban transportation, hydroelectric engineering. Spain's do not. Not everyone should be at the frontier in HDTV. That is presumably what comparative advantage is all about. Everyone should have a capacity in strategic information technologies so that specialized enterprises can grow competitively. Not everyone should produce steel. But everyone should have a biotechnological infrastructure for the development of specialized medical industries. Corporate strategists and public policy makers will make mistakes and squander resources. They will be rewarded with serendipitous breakthroughs. (Why was the Chalk River atomic facility established?) The debate over what is and what is not a strategic technology is, I would argue, healthy and takes us away from the archaic categories of "winners and losers" and "government VERSUS market" which is the product of an obsolete economics and a doctrinaire view of public policy. If we move on and simply start doing things in Canada, our potential competitive advantages exceed even our current imagination.

The Role and Mission of Industry, Science and Technology Canada (ISTC)

Ron Watkins
Director General
Information Technologies Industry Branch
Industry, Science and Technology Canada

ISTC is the department of industry within the federal government, but is also the department of science and technology. ISTC has been formed from the combination of the industry part of the old department of Regional Industrial Expansion and the Ministry of State for Science and Technology. We have a couple of additional parts dealing with regional development in Ontario and Quebec, native programming and tourism. But I think that for today's purposes the words Industry, Science and Technology Canada really do explain our purpose.

The mission of the organization was recently described by the Minister in succinct form as follows: "To act in full partnership with the private sector, the science community and other levels of government to promote international competitiveness and industrial excellence in Canada; to renew and rebuild our scientific, technological, managerial and production base; and to bring together in a concerted way the talents required to generate Canada's place in the first rank of industrial nations." It is a great challenge and a tall order but nonetheless a very appropriate mission for the 1990s and beyond. Behind this is a growing recognition that the determinants of competitiveness are changing. We are facing an ever increasing importance of science and technology and the need to integrate those with industrial development questions. The growing globalization of the market place, recognized in developments like the FTA and EC 92, is very important for our work as well. Competitive companies, and competitive countries, must move technology to the forefront, and in our new programs and services you will witness support for that kind of national transition. However, we cannot just focus on technology, we must integrate considerations of technology with the other factors determining competitiveness, whether they be marketing, financing, management or human resources, or whatever. To do this obviously we will need to work very closely with the full infrastructure in the country, whether that be in universities, research institutes, provincial research organizations, other government departments, other levels of government, and in particular the private industrial sector.

We feel ourselves indirectly or directly as partners with all of these groups. In this connection, it is useful to understand that within our ministerial portfolio, there are additional responsibilities other than the department. Our ministers are also the ministers responsible for the National Research Council, the Natural Sciences and Engineering Research Council, and the Science Council of Canada. We are the secretariat to the National Advisory Board on Science and Technology as well. So, there is a substantial infrastructure within the ministerial portfolio relevant to the subject of this conference.

These are some of the underlying factors and characteristics that will define our approach as we begin to put the new department into place. I would like to turn now more particularly to how some of these activities and directions apply to the information technologies area.

Within our department, we look at information technologies from three perspectives. First of all, it is a major industrial sector, with sales exceeding $25 billion dollars per annum and with direct employment of over 130,000. It is the largest industrial performer of R&D in Canada, and we estimate

that it performs about 45% of the manufacturing R&D in this country. It is a very competitive industry. It exports over three-quarters of what it produces, and in that sense the realities of the global marketplace, the highly competitive international environment, have faced this industry for some time.

Secondly, we see information technology very much as an *enabling* technology, permitting development of new products and processes in almost all areas of industrial endeavour. For example, engineering a comparative advantage is very much an issue in this particular sector and this particular technology.

The third dimension that I would highlight is that we also look to information technology as a competitive tool. It is not sufficient to concern ourselves with just the development of information technology, but we also have to stress the importance of its effective application in all sectors of the economy. Our interest extends beyond simple applications of computers to replace labour, whether that be front office or back office or shop floor. We are trying to encourage Canadian industry to accelerate the process for effectively implementing information technology, and therefore, to close the gap that Canada is experiencing relative to other industrialized competitors. This will lead to improved product quality, to added value in products, to more flexible manufacturing, and as part of the process, to improved business management.

If we look more specifically at some of the programs and services that the department will be offering in this area, I would like to emphasize that not everything is new. While the department has been heavily involved in establishing its new directions, we will in fact carry on with many things that we have been doing for some time already, which are effective and very important to this question of international competitiveness. We have long been active, for example, in questions of trade development, the application of procurement policies, and investment promotion. Within my own area, for example, we continue with the efforts that we have taken in the software industry. We have our Software Agenda for Action which we announced a year or so ago, which is being implemented. We are responsible for the $60 million Microelectronics and Systems Development Program which was part of the federal microelectronics strategy announced two years ago. In another part of the organization, we support the defence electronics industry through the Defence Industry Productivity Program. We support exporters through the Program for Export Market Development, and various other forms of support to industrial institutes and so on.

So there is a lot that we do already within the department that I think will carry on very effectively in our new cloth. I should also point out that our sister organizations that I referenced earlier—NRC, through the IRAP program, and NSERC with its post-graduate scholarships, for example—are all very much part of what we think is important in terms of the programs and services to be offered.

As we look at some of the new activities, I think it is important not to focus on the question of grant or contribution programs. Too often, as we try to describe what governments "do", we end up talking about programs because they involve sizable amounts of money. In fact, we are planning a range of non-program endeavours to facilitate competitiveness and to support industry. They will be in the areas of business intelligence and information, and services to industry. An important part of our job, which we define as advocacy on behalf of business within the government, is determining what is needed to support the development and international competitiveness of our industrial base and working within our own system to support this objective.

Compared to DRIE, you will see in our new endeavours that our ISTC instruments are going to be more sharply focused. We are not going to have broad-brush coverage which programs like the Industrial and Regional Development Program were designed to provide. We are going to be much more selective in terms of sectors, and in terms of issues. We will try to operate with a mixture of policy, business service, and program type instruments.

In terms of our efforts in the information technologies area, I would differentiate between activities that apply across sectors generally but have particular impact in the information technology world, and initiatives that apply to information technology in particular.

I have mentioned earlier the importance of the science, R&D, and innovation spectrum. Our activities and programs involve a range of endeavours which will address various phases along that continuum. For example, there is an important need to develop highly qualified personnel. It underpins the industry, it is very important for applying technology, and it is an area that requires and continues to receive considerable support from the government. The recently announced Canada Scholarships Program, for example, will involve the commitment of $80 million dollars and provide scholarships in the advanced scientific disciplines for upwards of 2,500 people per year. A particular concern in that program is trying to encourage greater participation by women in the scientific and engineering disciplines. We need more Geraldine Kenney-Wallace's, and we are not getting our fair share in these areas that are so critical for industry.

Secondly, there are the Networks of Centres of Excellence. These are also designed to encourage the development of capability, through a process of integrating effort among universities and between universities and business. I reviewed the list of proposals that were submitted. It is incredible, and in fact quite encouraging, to see the amount of work, participation and collaboration that has developed just in the process of developing proposals. There is $240 million available for the program. The total proposals would involve something like 4,000 researchers, and if we could fund them all, about $2 billion. So, we have got about a ten to one call rate on the money, and that will be a very interesting selection process as it proceeds through this year.

Moving along the spectrum to which I referred, we will also be coming forward with what we call "industry sector competitiveness initiatives". And if we are talking in a hurry, we call them sector campaigns. These are our special initiatives which will be developed in concert with industry, universities and others, targeted on specific industrial sectors. The idea is to encourage or develop a joint plan of action with the relevant industry groups, and to organize and integrate the effort from government, from industry and from universities. Many of these campaigns will have a technological dimension, and I am sure that the application of information technology, which is pervasive throughout the economy, will be seen as an important sector in many of these particular initiatives.

We are also looking at a variety of new business services, trying to encourage the application of technology, for example, in different sectors or different regions. We have a number of pilot projects that we have instigated, and we will review them to see what lessons we can learn. The goal of all of these efforts is to enhance our national capability in information technology, but not necessarily to restrict ourselves to the information technology sector. This "applications" dimension is very important to competitiveness in a range of industrial sectors.

Finally, I turn to the new initiatives that we will be bringing forward in the information technology field in particular. I would highlight two programs or activities in this regard. The first is the Strategic Technologies Program. The Strategic Technologies Program applies to three strategic technology areas: advanced industrial materials; biotechnology; and of course information technology. (I continuously remind my colleagues involved in the first two of those technologies that they are nothing without us!)

This program has two streams. It can provide support for pre-competitive R&D, and secondly, support for pre-commercial technology applications development, the idea being to get the users and developers of technology working together at a pre-commercial stage. A second element of the Strategic Technology Program will be a fund to support artificial intelligence development by contracting out the work to the private sector and by using the government as a test bed. It is a small fund, by which our department will co-share the cost of government applications of artificial intelligence. The ultimate goal is to exploit those solutions in the commercial world once they are developed.

The other new program which I will highlight is the Advanced Manufacturing Technology Application Program. While this is a relatively small program in dollar terms, it is an important concept. It is not just a program in our books. Under this program, we will subsidize the cost of consulting studies to review a company's manufacturing process with a view to upgrading it with advanced manufacturing technologies, techniques and equipment. We are not subsidizing the equipment. We are using the small amount of money to get senior management of the enterprise involved in looking at its operations, and how information technology can be applied effectively to improve competitiveness.

In closing, I hope to leave the idea that we are focused on both the development and the application of information technology. We do not see ourselves as pushing technology. We see ourselves as pushing competitiveness in this and in other sectors. It is a very big challenge. The dye is not completely cast, and I am sure that we will continue to refine and develop further initiatives.

Part D

Diffusion of Information Technology and the Pace of Change

On the Use of Information Technologies in Manufacturing: Canada versus the United States

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The OECD defines the term information technology to cover technologies used in the collection, processing and transmission of information. This includes micro-electronic and opto-electronic-based technologies incorporated in many products and production processes and increasingly affecting the service sector. It covers, among other things, computers, electronic office equipment, telecommunications, industrial robots, computer controlled machines, electronic components and software products (OECD, 1987, p.12).

Students of technological change have labelled information technology as a "pervasive generic technology" because it has such a wide range of applications which will affect production and distribution in almost all sectors of the economy. In this regard information technology is comparable to steam power and electric power (OECD, 1988, p.35).

According to the OECD and other observers, information technologies have achieved and continue to produce dramatic improvements in the power to communicate, process and store information. This is, in turn, resulting in:

- improvements in the quality of a wide variety of industrial products
- improvements in industrial processes which save energy, capital, materials and labour
- savings in finished goods and work-in-process inventories
- a reduction in the time required to change product lines and to alter product designs
- the redesign of products to eliminate costly and complex electromechanical components
- demands for new skills and services in design, development, software engineering and microelectronics generally.

In the simplest terms the competitive landscape is being altered. A failure by Canadian industry to avail itself of the benefits of information technologies could have serious implications for its international competitiveness. There is concern in some quarters that Canadian industry has not adopted new technologies in a timely fashion in the past (Economic Council of Canada, 1983). It is, therefore, important to determine whether Canadian firms lag behind their foreign competitors in the adoption of information technologies and, if so, whether there is a public policy remedy.

As a step in this direction this paper presents a comparison of the respective proportions of establishments using various information technologies in four Canadian and United States manufacturing industries (major groups). The data used in this comparison came from Statistics Canada's 1987 survey of Advanced Manufacturing Technology and from the 1988 Survey of Manufacturing Technology of the U.S. Bureau of the Census. The Canadian Survey covers some 4,600 establishments in all manufacturing industries. The U.S. survey covers 10,500 establishments in five major groups. These are: fabricated metals, machinery, transportation equipment, electrical and electronic equip-

ment and instruments and related products. The first four major groups are comparable with their Canadian counterparts and this paper focuses on them.

Respondents to the U.S. survey were asked whether they are using each of seventeen types of technologies in their manufacturing operations. The Canadian survey elicited similar information regarding eighteen types of technology. The percentage of using establishments in the United States and Canada is compared for each of fourteen technology types and four major groups in Tables 1 to 4.

Among the more important features of the results reported in Tables 1 to 4 are:

1. The most widely adopted technologies in both countries and in all four industries tend to be:
   - Computer aided design or engineering
   - Numerically controlled or computer numerically controlled machines
   - Programmable controllers.
2. The proportion of establishments using these technologies tends to be lower in Metal Fabricating than in the other three major groups in both countries. In Canada the transportation equipment, electrical equipment and machinery industries tend to be very similar in terms of their average percentage of users. In the U.S. the electrical and machinery industries tend to rank ahead of transportation equipment.
3. The proportion of establishments using CAD/CAE and NC/CNC machines is higher in the United States in all industries. The average difference is about 4 percentage points or about 10 percent. The proportion of establishments using computers for control on the factory floor is higher in the U.S. in three of four industries and higher on average by 9 percentage points or 36 percent. This is the largest difference between the two countries.
4. The proportion of establishments using automatic sensor-based testing equipment is higher in Canada in all four industries. The average difference is about 10 percentage points or over 50 percent. The proportion of establishments using CAD output to control manufacturing machines is higher in Canada in two of four industries. The average difference is nearly 5 percentage points or 27 percent. The proportion of establishments using flexible manufacturing cells or systems is higher in Canada in three of four industries. The average difference is over 3 percentage points or over 26 percent.
5. The metal fabricating industry is the least progressive of the four Canadian industries relative to the United States. It has a lower proportion of establishments using 12 of the 14 technologies. The transportation equipment industry is the most progressive of the four Canadian industries relative to the United States. It has a higher proportion of establishments using 11 of the 14 technologies. There are some large differences in favour of Canada in the percentage of users in this industry. These include differences of over 12 percentage points for both pick and place robots and computer networks with suppliers and customers.
6. Taken as a whole, the information technology adoption records of at least two of the four Canadian major groups examined compare favourably with their U.S. counterparts. The other two do not compare favourably. Whether the existence of a serious "adoption gap" can be inferred is another matter.

While these surveys constitute the best and most recent evidence available on the industrial use of information technologies, there remain problems of interpretation. For example, intraplant diffusion is ignored. An establishment is classed as a user whether it applies a technology to one or 100 percent of its production. Moreover, adopting establishments may be larger relative to non-adopting establishments in one country (likely the United States) and thus may account for a proportionately greater share of industry output. If the percentage of total production that is accounted for by information technology users could be compared across countries, an entirely different result might be obtained.

Despite these and numerous other problems of interpretation and the crude nature of the analysis conducted here, several tentative policy conclusions might meet with some approval. First, the relatively favourable performance of the Canadian transportation equipment industry provides evidence of the hitherto elusive dynamic efficiencies which economists have often associated with trade liberalization.

Second, the lack of consistency in the differences in the proportions of adopters across technologies points to industry mix and scale explanations rather than information gaps. Statistical analysis of the Canadian survey reveals that establishment scale is a crucial factor in explaining the incidence of adoption. The lower Canadian incidence of adoption can be explained in some cases by differences in establishment scale between the U.S. and Canada. For example, if the average scale of Canadian establishments in metal fabricating were doubled, the predicted probability of adoption of industrial control computers would be 19 percent rather than the 11 percent reported in Table 1. The determination of the extent to which observed Canada-U.S. differences in the proportion of establishments adopting various information technologies are due to establishment scale differences and differences in industry mix (within major groups) is an important item on the agenda for the study of technology diffusion.

Table 1

Metal Fabricating (Major Group 30)

Technology	Percentage Establishments Using Canada (1987)	U.S. (1988)	U.S.-Canada
Computer aided design or engineering	20	26.8	6.8 (1.1)
CAD output used to control manufacturing machines	11	13.1	2.1 (0.8)
Digital representation of CAD output used in procurement	6	6.5	0.5 (0.6)
Flexible manufacturing cells or systems	9*	9.0	0.0 (0.6)
Numerically controlled or computer numerically controlled machines	29	32.2	3.2 (1.1)
Pick and place robots	5	5.7	0.7 (0.4)
Other robots	3	4.4	1.4 (0.4)
Automatic sensor-based inspection on process	10	7.7	-3.3 (0.5)
Automatic sensor-based inspection on product	10	8.3	-1.7 (0.6)
Local area networks for technical data	11	13.4	2.4 (0.8)
Local networks for factory use	11	11.6	0.6 (0.7)
Intercompany computer networks	10	14.9	4.9 (0.8)
Programmable controllers	21	26.8	5.8 (1.0)
Computers for factory control	11	21.1	10.1 (0.9)

Sources: Statistics Canada, "Survey of Manufacturing Technology - June, 1987"; U.S. Department of Commerce, *Manufacturing Technology 1988.*

* Derived from Statistics Canada survey by the author.

Standard error of U.S. percentage using in brackets.

Table 2

Machinery (Major Group 31)

Technology	Percentage Establishments Using Canada (1987)	U.S. (1988)	U.S.-Canada
Computer aided design or engineering	38	43.2	5.2 (1.1)
CAD output used to control manufacturing machines	20	21.6	1.6 (1.0)
Digital representation of CAD output used in procurement	12	11.0	1.0 (0.7)
Flexible manufacturing cells or systems	13*	11.0	-2.0 (0.7)
Numerically controlled or computer numerically controlled machines	49	56.7	7.7 (1.1)
Pick and place robots	4	5.8	1.8 (0.4)
Other robots	7	5.2	-1.8 (0.4)
Automatic sensor-based inspection on process	15	8.5	-6.5 (0.6)
Automatic sensor-based inspection on product	18	9.9	-8.1 (0.7)
Local area networks for technical data	15	18.5	3.5 (0.8)
Local networks for factory use	12	16.3	4.3 (0.8)
Intercompany computer networks	14	12.4	-1.6 (0.7)
Programmable controllers	21	26.8	5.8 (1.0)
Computers for factory control	11	21.1	10.1 (0.9)

Sources and notes: See Table 1.

Table 3

Transportation Equipment (Major Group 32)

Technology	Percentage Establishments Using Canada (1987)	U.S. (1988)	U.S.-Canada
Computer aided design or engineering	35	38.9	3.9 (1.1)
CAD output used to control manufacturing machines	22	16.6	-5.4 (0.8)
Digital representation of CAD output used in procurement	13	10.0	-3.0 (0.8)
Flexible manufacturing cells or systems	20*	12.6	-7.4 (0.8)
Numerically controlled or computer numerically controlled machines	35	37.3	2.3 (1.0)
Pick and place robots	23	10.4	-12.6 (0.6)
Other robots	17	10.5	-6.5 (0.6)
Automatic sensor-based inspection on process	31	12.7	-18.3 (0.6)
Automatic sensor-based inspection on product	31	14.4	-16.6 (0.7)
Local area networks for technical data	21	22.0	1.0 (0.9)
Local networks for factory use	21	18.7	-2.3 (0.8)
Intercompany computer networks	34	21.7	-12.3 (1.0)
Programmable controllers	42	32.0	-10.0 (1.0)
Computers for factory control	29	27.4	-1.6 (1.0)

Sources and notes: See Table 1.

Table 4

Electrical and Electronic Equipment (Major Group 33)

Technology	Percentage Establishments Using Canada (1987)	U.S. (1988)	U.S.-Canada
Computer aided design or engineering	43	48.5	5.5 (1.0)
CAD output used to control manufacturing machines	19	16.0	-3.0 (0.8)
Digital representation of CAD output used in procurement	19	12.8	-6.2 (0.7)
Flexible manufacturing cells or systems	16*	11.9	-4.1 (0.6)
Numerically controlled or computer numerically controlled machines	34	34.9	0.9 (1.0)
Pick and place robots	13	13.1	0.1 (0.6)
Other robots	6	6.9	0.9 (0.4)
Automatic sensor-based inspection on process	30	16.2	-13.8 (0.7)
Automatic sensor-based inspection on product	30	22.2	-7.8 (0.9)
Local area networks for technical data	29	24.9	-4.1 (0.9)
Local networks for factory use	26	21.1	-4.9 (0.8)
Intercompany computer networks	17	16.2	-0.8 (0.7)
Programmable controllers	38	38.0	0.0 (1.0)
Computers for factory control	22	34.5	12.0 (1.0)

Sources and notes: See Table 1.

Table 5

The Difference Between the U.S. and Canada in the Percentage of Establishments Using Each Technology: An Average of Four Major Groups

Technology	Average Difference in the Percentage of Establishments Using: Absolute	Relative to Average Percentage Using
Computer aided design or engineering	4.2	11.5
CAD output used to control manufacturing machines	-4.7	-27.0
Digital representation of CAD output used in procurement	-1.9	-16.8
Flexible manufacturing cells or systems	-3.4	-26.5
Numerically controlled or computer numerically controlled machines	3.5	9.1
Pick and place robots	-2.5	-25.0
Other robots	-1.5	-20.0
Automatic sensor-based inspection on process	-10.5	-64.6
Automatic sensor-based inspection on product	-8.6	-47.8
Local area networks for technical data	0.7	3.6
Local networks for factory use	-0.6	-3.5
Intercompany computer networks	-2.5	-14.3
Programmable controllers	0.9	2.8
Computers for factory control	8.5	36.2

Sources and notes: See Tables 1-4.

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Adopting Information Technology: Fifteen Case Studies

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Last year Woods Gordon was approached by two organizations, the Information Technology Association of Canada (ITAC), and Industry, Science and Technology Canada. Their concern was that Canadian industry was lagging behind the rest of the industrialized world in terms of the deployment of information technology, and they wanted to commission a series of case studies. They had three particular objectives in mind. The first was to identify elements of information technology deployment which lead to success. What is it that makes it successful deployment? Secondly, to provide examples of information technology deployment which might encourage other companies to take the plunge. If these companies were seen to do it and to succeed, other companies might follow in their footsteps. Thirdly, they wanted to identify any barriers to deployment which might prevent companies from using information technology. These are the kinds of issues that were in the back of their minds when they commissioned this work. We at Woods Gordon set out on this project by developing an hypothesis about good practice in deployment. We worked with an expert panel of people from industry, academia, user groups and from government to develop what we considered to be good deployment practice and used that as a check list when we met each one of the companies used as cases. Our research plan was developed to explore the experience of companies in attempting information technology deployment and looking at these sort of areas. We were not out to assess technology itself. This was a process oriented piece of work.

Under the guidance of our steering committee we selected fifteen companies to be profiled. These explored a diversity of experience rather than representing a full profile of Canadian business. That is, the cases were to provide anecdotal information rather than statistical information. With a sample of fifteen it is very difficult to provide comments about all of Canadian business. There was a full range of different features of these organizations across location, technology and industry but basically they were all small- to medium-sized companies. This was done primarily, to provide examples for other companies. We expect that there are a large number of other small- to medium-sized companies that might find these examples to be useful.

Finally, and I think most important to keep in mind as we go through this work, all the deployments that were profiled were considered by themselves to be successes. This was not an objective in selecting the deployments. But in looking for companies willing to go through this exercise we managed to find the ones that were proud of what they had done. We were not successful with companies that were not pleased with the results, and they were less willing to go through this process with us. This, I guess, gave a bias to our sample which does influence the results that we found, but I think not necessarily in the way that one might anticipate. I should also mention that the results of this work have been published by Industry, Science and Technology in a report called *Putting the Pieces Together*. All fifteen case studies and some analysis of this work and this product have now been issued in both languages and they are available from Industry, Science and Technology.

I guess the most startling thing that we found was that our hypothesis did not apply for the cases in our sample. The list of issues that we had developed which suggested good practice in deployment were not the ones that were addressed by the fifteen cases in our sample. There were some that took advantage of some of these issues and approaches, but none of them uniformly covered the whole spectrum. We were somewhat taken aback by this because we assumed that this was commonly accepted as good practice, all the textbooks said so, and why weren't they doing it?

One of the things that we found almost without exception in our sample, was the use of a champion. The champions that we found in each of these fifteen cases were champions who tended to be the chief executive or presidents of these organizations, very senior executives and they also tended to not be computer literate. These were not high technology wizards although they may have been high technology enthusiasts. These were people who did not have a background in bits and bites and what that technology could do for them. But indeed they had a significant influence over the future course of the organization as a whole.

Most of those who had little experience in information technology before this deployment required a leap of faith in order to get this deployment going. A champion was necessary in order to give impetus to this leap of faith. Without the champion, I think that it would be unlikely that the faith would be given sufficient prominence throughout the organization to keep it going. The champion was also important in that he, I say he because all the champions in these cases were in fact men, believed that indeed this project would proceed and gave strength and conviction to this process. It made it possible for the more junior managers to proceed with the definition of deployment rather than spending time on questioning its validity. They were much more concerned with how it was going to happen and spent little time wondering whether or not it would. In retrospect, we questioned, and a number of the champions questioned, whether perhaps more time should indeed have been spent on questioning whether it should go ahead or not. But in terms of the impetus for the deployment, these champions made it happen.

The champion was also significant in eliminating blockers to these deployments. In one of the organizations that we looked at, a small fish processing plant down on the east coast, the champion of the deployment was a young chap new to the organization who was the assistant general manager and he was appointed by the president of the organization to go out and get it in gear and get it running. He did this, but in the course of his deployment he discovered that the general manager, his immediate superior, was not at all interested in computers in the organization, did not trust them, and wanted no part of them. At the end of the day, a significant section of it was not successful and had to be abandoned because this individual could not overcome the objection of that blocker.

The status of the champion ensured that there was some commitment throughout the organization to this project. The staff became actively involved in the development of the project and found ways to make it work. This tended to happen throughout the organization where the champion was in a sufficiently elevated position. What surprised us most in going through these analyses with each of these fifteen case studies was the lack of cost-benefit analysis. And we expected that this was something that these companies in particular would look at because one of the most important issues that they all cited in the justification for doing this deployment was cost avoidance. They all said that we undertake the system in order to save us costs: either by cutting back existing costs or by stopping the company from undertaking greater expenses in the future as expansion occurs. We expected, with that being the reason behind the deployment, they would undertake some cost-benefit analysis to say this is what we might save by doing it, this is what it is going to cost to do it, and balance the two and conclude that it was or was not a good idea.

In fact, only three of the organizations in our sample felt that a post-deployment evaluation was at all appropriate. Some other companies sort of said, "Well we did a good job and why waste our time being bureaucratic about it". Most of the managers involved in these deployments were indeed non-bureaucratic. Often they were entrepreneurs, hands-on managers, who prided themselves in getting on with things rather than humming and haaing about this isn't working. These managers in general

tended to avoid detailed planning of any description and on these projects that approach was carried through.

When we say that cost-benefit analysis was something that was not attempted, I should qualify that somewhat. In the three of the organizations that actually did do a cost analysis, they produced somewhat detailed results to justify their reasons to go ahead. But the other twelve when we asked them whether this was what they did, all said, "Oh no, cost analysis, no, we didn't have time". There were other reasons, but basically they did not undertake this. In actual fact, they did but most of the other twelve organizations did something that came to the back of the envelope type of calculation. One of the cases, a wholesaler, looked at it and said, "Well if we put in this system we should probably save. We won't need those two salaried positions, they are paid about $25,000 a year. So, we would save about $50,000 a year and what can we buy for $50,000?" And that is the sort of cost-benefit analysis that they undertook, hardly rigorous but indeed there was some sort of evaluation which they undertook.

I guess the main reason that most of these individuals had for not undertaking the cost-benefit analysis was that they had incredible difficulty in addressing the soft costs and the soft benefits. The deployment could improve the quality of their product, their service, the speed of delivery, their rapport with their supplier and their customers. But when it came right down to it, they were convinced that they would be able to improve their sales as a result of this, but they were not able to put a figure down, say 5%, maybe even 10%. They were unwilling to do that and felt that that process was really just too difficult. So they shrugged and said "That it is only going to cost so much so let's do it anyway".

Many of them admitted to a sense of intimidation on two counts, that they were intimidated by the technology and they were also intimidated by the process involved in analyzing the situation. So when it came down to it, that coupled with the conviction that information technology was indeed a good thing, meant that a leap of faith was the only way that these organizations were going to get involved. And these organizations had a champion who convinced the company to take that leap of faith. Coupled with this was a lack of technology planning. We expected that many of these organizations would consider technology to be of strategic importance in the organization and wanted to see how they would go about planning the technology overall. In general, what they undertook here was project planning rather than corporate wide planning. And in principle for most of these organizations there was little link between what they were doing with this deployment and what they felt they were doing strategically overall for the organization.

One issue that we tested for was user consultation. Every single one of the organizations that we looked at felt that user consultation was a vital and crucial part of the deployment process. There were two aspects to this. One was that the user through consultation would be given an opportunity to buy into the deployment, and so ensure its success at the end of the day. The other aspect was that users would be part of the specification process to ensure that the system was going to do what in fact it was needed to do and in fact to do it as well as it could be done. In these organizations the former objective was honoured but the latter was not. Most of the champions felt they knew what their system should do and decided on the specifications without consulting the users. So what happened in these cases was that the system was bought and often it was plugged in and then someone sat down with the users and said we have a system for you and you are going to love it. And in some cases there were no problems with the success in the deployment, but in others the management had to take a lot longer to sell the system because they had not consulted with the users beforehand.

I guess it is very difficult to reach conclusions, on a sample of fifteen, about Canadian business in general, but there are a few. Basically, experience counts. The companies with the most experience in IT deployment made the fewest mistakes. They also tended to rely less on the strength and capability of the champion. I think that there is a direct link here between experience in information technology and the role of the champion. In the two cases we had where the champion was less significant, the systematic approach to deployment was much better defined and followed. I suspect that some

managers may be sufficiently intimidated by formal planning procedures and by the technology and by their own inability to quantify the costs and benefits that they never undertake information technology deployment. We spoke to fifteen who in spite of those impediments took the plunge and got on with it, but I suspect that there is a large population of organizations who have not taken the plunge and have been put off for just those reasons.

Finally, and I think most significantly, the good champion is what made these deployments possible and practicable. If it were not for the champion I can say with total conviction that 75% of these deployments would not have been undertaken at all.

Paradoxes of Information Technology Diffusion

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My fascination with the information age has centered much more around the concepts and impacts of the information age rather than in the high-tech field of information technologies which I assume, through a great act of faith in our technical experts, will continue to develop more speed, more capacity, and more universality and utility. My own area of study in Information has tended to focus on the words being used and some of the underlying concepts that often seem to be contradicted by people's behaviour. What's in a word, you might ask? Well, consider the difference between a wise guy and a wise man.

I have been in this business more than twenty years, and I am coming to the conclusion that we haven't the slightest idea about what this information age really means to people and furthermore, I am beginning to believe that customers are trying to tell us that. This is evident in what I like to call the paradoxes of information technology. And just so we're all on the same wavelength, let me define "paradox" as a self-contradictory or essentially absurd statement, or idea, or even behaviour.

The comedian Steven Wright tells a story of a friend who has an answering machine for his car phone. The recorded message is: "Hi. I can't come to the phone now because I'm at home. As soon as I leave home, I'll return your call."

Sometimes examples like this tempt me to believe that the more we progress in the development of information and communications technology, the more impediments to communication we create. Let me offer you some other examples of paradox.

Many large institutions have computer-controlled telephone systems to handle large volumes of inquiries from the public, all in the name of better service. But if *your* inquiry does not fit neatly into one of the programmed categories, *you cannot get service at all.*

In the U.S., more than 25% of the people have unlisted telephones and the number is increasing rapidly. Now why is it so many people prefer to remain anonymous in this age of communication? Is it because they are more concerned about their ability to control communications involving them?

Calling Line Identification Service—where the incoming number is displayed as it rings—despite its obvious convenience and benefits in dealing with, for example, unwanted telephone solicitations and harassments, is running into stiff opposition from human rights and privacy activists here and in the U.S. What should this tell us?

Or take the case of FAX. As far as sophisticated hi-tech, FAX technology is pretty low on the scale. And yet, as you all know, it has been the most stunning success story of the 80s.

Something similar could be said about cellular telephones, where since their introduction demand has consistently outstripped even the most optimistic forecasts. Or on the other extreme, videotext, where even after 15 years of aggressively promoting it, with all its assumed benefits, still

only a handful of people appear to be interested. The banks are finding ATM penetration has hit the proverbial brick wall. And we all know what happened to the picture phone.

Now why such paradoxes? Is it that the user is ignorant and needs to be educated? Is it that people are fickle and really don't know what they want? Or is it that there is something fundamentally wrong with the way we go about developing and marketing information technology?

I tend to think it's the last point, the way we approach the development and marketing of technology, and I think the heart of it is that those of us close to the technology suffer from technological myopia, and for the most part fail to appreciate that the social and cultural changes of the past decade or so have been more profound than any of us technophiles really imagine. This ignorance of the social and cultural context of the information age is why I think we find ourselves confronted with so many paradoxes or seeming contradictions in the diffusion of information technology.

If there is one thing that recent research on innovation has been able to show, it is that innovation is fundamentally a societal process.

Contrary to what we once thought, innovations do not trickle down from science to technology to industry, in an ever decreasing time scale. Historical analysis has shown that innovations come in seasons, something like cherries and that the "central clock" of the innovation system is not research and development spending, not smart marketing, not even price but rather changes in the behaviour of the final consumer. It is becoming clear that innovation and technology diffusion are part of a larger societal learning system. Mysterious as it may seem, societal mechanisms seem capable of switching genius on and off.[1]

This is why I think paradoxes are important. I believe they are trying to tell us what research on innovation has shown, namely that the system is all-encompassing and that a technology that is developed in a vacuum, that ignores its social and cultural context, does so at its own peril. This is not to say that technology is not important today. In fact the same body of research that I just mentioned calculates that we are about a third of the way through a major innovation "season". The key innovations in this season are linked to information management and manipulation, where 80% of the inventions were already made by 1980. By 1984, 10% of these inventions had borne commercial fruit and it is estimated that the remaining 90% will give birth to about 100 brand-new industries and take us on an economic boom lasting till the end of the century.

So yes we are on a technological roller-coaster. But the really important thing is that not only are we in the midst of a technological boom, but taking history as our guide we should also be living through a period of major social and cultural innovation. And we are!

It would not be an exaggeration to say that the social and cultural changes of the last three decades in Canada have been as profound as the technological changes of the entire previous century. As a people we have changed, irrevocably and fundamentally and we have come to see ourselves, and others, in new and revolutionary ways. We have freed ourselves from many of the social constraints, stereotypes and institutions that used to govern our lives. Just look at changes in attitudes toward women, toward racial and ethnic minorities and toward the disabled and the handicapped.

We are also now living at a time when history is compressed. Change that once took decades is now accomplished in a matter of months. Furthermore, we view the world and our role in it differently. There was a time when information was scarce, when it conferred power and when only a few were able to process and use it to shape their behaviour. Today, thanks largely to mass education and the mass, instant media, we all gather our own information, process it, analyze our successes and our failures and (hopefully) take remedial action for better or for worse. Each of us has become our own decisionmaker, as well as our own strategic planner.

As a result, people are much less deferential and much more critical today and neither the marketer, nor the boss, nor the politician can count on old fashioned "product loyalty" anymore. Loyalty has to be earned by showing value and even then it tends to be a fleeting thing. This is not fickle. It is simply better informed choice.

We have also become a much less fatalistic people and much more likely to believe we can be the authors of our own destiny. Particularly since the recession of the early 80's, pollsters have found that Canadians are becoming increasingly self-reliant and self-sufficient, something that we see in the surge of entrepreneurial energy right across the country these last few years, but also in the support given to the signing of the free trade deal with the Americans and also in the surging demand for quality and service.

Finally, due to the mass media but also due to greatly increased travel and a much more open attitude to linguistic, racial and ethnic minorities, we now have in this country a community of values that goes beyond national boundaries. This can pose a challenge but the opportunity—and with our size it could be a major one—is that a niche market in this country could, in fact, be a micro-global mass market. Certainly there are few countries in our world who match our mix of multi-cultural forces and a geography that truly makes Canada a global microcosm.

So the social and cultural changes we have experienced these past few years have been as great, if not greater than, the technological changes we have witnessed. Perhaps because we have in fact experienced them rather than only witnessing them, as we have through the publicity that typically surrounds "sexy" new technologies, we have tended to downplay their significance in the diffusion process. This I think is a critical error, and the reason we find so many paradoxes in information technology markets.

If I am on the right track, then the lesson is that we should learn from these paradoxes. They are trying to tell us something about human behaviour that is brand new. We must learn to become comfortable with them rather than dismissing them. That means accommodating, rather than trying to resolve what appear to be contradictions. Incidentally, the concept of contradiction has no counterpart in Eastern thought. If information technology creates a paradoxical marketplace of seemingly contradictory needs—for example, simultaneous communication enhancement/inhibition, more/less (i.e., better) information—we should respond in ways that attempt to satisfy both sets of needs, or better yet, recognize the new and "higher" need. That, I suggest, will become the key challenge facing all of us as this information age unfolds.

In closing, I would like to draw upon the work of Stanley M. Davis in his fascinating book "Future Perfect" which makes a similar point. Davis thinks that the really powerful thing about information technology is that it can allow us to have our cake and eat it too; it can allow us through a process of "mass customizing" to avail ourselves of all the cost advantages of economies of scale while at the same time customizing products and services to markets of as little as one. What a prospect!

To do this though, he says, we have to break away from the either/or bind that has characterized the industrial model and begin to appreciate that a basic feature of the new economy, "is the simultaneous existence of mutually contradictory phenomena". He further says that we

> "must accept the coexistence of mutually contradictory phenomena without trying to resolve the contradiction. New technologies will permit customized manufacture on a mass basis.
>
> Rather than being limited by the paradox, information technologies seem to embrace and transcend it."

That my friends is the challenge: not to glibly dismiss the real behaviour of the marketplace; not to sell the technology short; to respect the paradoxes inherent in the diffusion of information technology and in the process perhaps learn how to reap its true potential.

Endnotes

1. Cesare Marchetti - Society as a Learning System: Discovery, Invention, and Innovation Cycles Revisited. Technological Forecasting and Social Change. 18. 267-282 (1980).

Key Issues in Becoming a Global Corporation

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I would like to present a brief case study, with respect to three local companies in Ottawa that are now international firms in the software industry. I would then like to reflect on how those companies emerged and what they are doing today with respect to the policy, the issues and the structures that have been discussed in other papers in this volume.

Let me begin by putting in perspective the products and the services, and the customers of these three firms. As we know, information technology comprises a pervasive strategic group of technologies. It is a supply of technology that Cognos offers, and it is a use of these types of technologies that the other two firms offer. The other two firms are SHL Systemhouse and DMR—a consulting firm headquartered in Montreal. But the reason that I want to focus on Ottawa for DMR and the other two is that there was a significant event that took place about ten years ago that, in fact, has propelled these companies into the international arena, or at least helped to propel them into the international arena.

Now as Professor Melody aptly put it, the primary importance of information technology is its ever-increasing uses in all forms of human activity: it is not in fact the technology itself, but rather it is the use of the technology, the value-added you gain, the competitiveness you can achieve. There is barely a laboratory anywhere in the world be it in biology or chemistry that is not involved in using some form of computer based technology.

Increasingly, applications of information technology offer competitive advantage. For example, financial data can be rapidly captured, analyzed and transmitted. Some aspects of this are discussed in other papers in this volume. Slight improvements in response time, and refinements of an analytical technique have created entirely new types of information products for financial transactions and services. As you will appreciate, millions of dollars are wired around the world in seconds to capture an advantage. This would not be possible without information technology. In fact, to a significant extent, the rapid growth of service industries has been made possible by information technology. This growth, along with significant growth in the use of information technology in manufacturing and transportation industries has been the basis of the growth of companies like Cognos. Cognos is, by world standards, a large international software products company. I would like to give you a brief synopsis here for purposes of context. Cognos emerged in the early 1980s from a service-based company which provided consultancy in building software systems, and transformed itself into a products company which has expanded from the local community based in Ottawa, to a firm that now has direct operations in over 15 countries and has through distributors and value-added resellers access to some 48 countries throughout the world.

All three firms, Cognos, SHL Systemhouse, and DMR Ottawa office, which is a very significant operation for DMR, have achieved significant growth through government procurement. Initially all three firms were direct competitors in the procurement process, each vying for customs software

systems contracts. It is important however to note that the procurement process was not strategic, but rather tactical. Simply expressed, the demand for computerized information systems in the 1970s outpaced internal government resources to supply them. The gap was filled by consultancy firms. So from the 1970s to today, we now have three firms that have grown to international stature from a Canadian base, and they all focus in slightly different areas of information technology. Cognos creates packaged software for professionals in major corporations. As a customer of ours, SHL Systemhouse is a systems integrator, buying various pieces of technology, integrating it and providing system solutions for their clients. DMR is also a customer of ours, continuing its main stream of its earlier business where it started as a top quality professional services organization in systems development.

Let me now give a brief perspective of where Cognos is today, again, for this comparative purpose. You might call the company a threshold company. Certainly that would be an apt term as defined in the Premier's Council report. The firm is approximately $110 million in revenues, 1200 employees, we average about 15% R&D expenditures annually, and that is sustained—it has been as high as 22% in the last 5 years. And we have what is very important in comparison to all these companies we have just heard about that have failed, or have become boutique companies, or have not failed but have become acquired. They did not have access to international markets, they did not have the channel, while Cognos indeed has a very significant software marketing channel, quite significant in the whole arena of software companies worldwide.

It is important to realize, however, that all three of these companies, (and in my reference to DMR, I imply its base from Ottawa) have basically outgrown their marketplace, as in their domestic base, their community. They have outgrown it from the point of view of being able to acquire highly qualified people, be they technical or managerial, and they have outgrown their customer base, and so in fact they now have to find other opportunities for growth in markets.

Therefore, it is necessary to seek out new opportunities in more distant markets. To satisfy this growth requires staff, and additional cash. In the case of Cognos the firm went public twice, to achieve additional cash. We went public in Canada on the Toronto Stock Exchange, and then a year later in 1986 we went public in the United States on the over-the-counter market in New York.

So now we have transformed, or transcended from the early 1970s to today. I would like to outline the key issues we face again, from a Cognos perspective because that is where I can speak with a little more authority, but I would presume similar issues arise with the other two firms that I have identified here, and in fact, really all firms that are trying to be successful in the software industry. In our case, the key issues that we face are:

1. **transforming ourselves from a technology-driven company to a market-driven company**

   We are doing this by approaching innovation in a holistic way, and by capturing external ideas—we heard earlier about the Japanese raiding of ideas—we too raid ideas. We take both ideas and technology from outside the firm and bring it in and embed it to work towards future products directly with key customers. In fact, we are capturing the innovation process from the ideas that come in the scientific literature, and then using these ideas to work with customers on future developments, in the form of new products. We use marketing as the hub of the innovation-management process. Therefore, from a day-to-day basis, our marketing has strong technical expertise that deals with assessment of new technologies, new products. Our marketing liaises with research, and development. Of course, our marketing handles traditional marketing functions of sales and distribution and product literature and so on. But indeed, we cover a side of innovation that traditionally is missing in so many firms when they move things over the wall from research to development to engineering.

2. **acquiring highly qualified personnel**

   To do this we work actively with universities. We have research projects with a number of universities underway at this time. We get a channel and a pipeline into graduating students,

we use coop programs, we do all we can to hire but we cannot get all the kinds of people we need. In fact, many kinds of people we need are not even being trained in this country, so we have to look internationally—and we are, we recruit internationally.

3. **adapting to changing policy environments, both nationally and internationally**

I refer of course to public policies. Clearly, three very important groups of public policies have been undergoing major changes in the last few years within OECD countries. You have heard a lot about these in some regard today. (a) The more mature of all three policy areas is business policy, business practice—various laws are being changed or various tax treatments and so on are being modified. That is one aspect as an international operating company. You have to deal with that in all countries in which you operate. (b) More recently, many OECD countries are prime competitors as nation to nation, and have begun a major revamping of their science and technology policies. These have instituted a variety of funding programs, cooperative exercises and so on to try and assist in precompetitive research. (c) And more recently, we are faced with another policy environment that is going through rapid change, relatively new in a modern late 20th century sense, and that is trade policy.

So collectively, we have these three major policy environments all changing at the same time, not necessarily in relation to each other. As we well recognize in this country, the department of finance makes certain decisions that do not necessarily reflect any consultation say with the science and technology policy domain. This is characteristic of all countries in which we operate.

We are addressing this by taking a global view. We are establishing R&D facilities off-shore, we are addressing the highly qualified personnel by in fact hiring people who are for example, products of the Alvey Program. Just two weeks ago we announced the establishment of a research facility in our office just outside of London, England. Dedicated to a particular kind of research and development exercise, that is a direct result of the Alvey Program. And clearly we are also positioning ourselves to be more than just a service and sales organization, and in various key markets we have more than those functions. We are looking to having product mandates in certain countries—in this case Europe is an important one with respect to the 1992 trade situation.

4. **acquiring technology in products which constitute key components of our future product vision, and complement our current product offerings**

Basically, there is a strategic plan of how we are going to achieve this. One of the things that is very important for us, and we believe is manifested in many organizations throughout the world right now is that you cannot invent it all, whether you are the size of GM or you are the size of Cognos. You have to in fact create deep relationships with partners, and in some cases if its so key to your future you cannot afford to have just a relationship, you actually have to acquire it. So we are actively involved in tactical partnerships, strategic partnerships, and acquisitions. And I can assure you that in fact tactical partnerships are sometimes used simply to mask a strategic partnership.

5. **establishing a local identity in the countries in which we operate**

There was a discussion about Northern Telecom and whether it was a Canadian or American company. I can assure you that from the salesman's point of view he wants to say its a company of the country he is selling in. And I can assure you that at Cognos, most of our customers in the United States would view us as an American company. The implications of localization are very important. You get beyond speaking English or French, and in fact we have to hire French citizens to operate our subsidiary in France. So we hire locals—they have the language, they know the market, they have a lot of experience. But it is more than having those kinds of people, you also have to localize your product. You need manuals in various languages. Your product—itself because its software—has some form of communication with people, generally expressed in

language, so it has to operate in the language that the case may be. Our products do operate in a variety of languages. So it is very important to have local support, and that is how we are addressing that.

In conclusion, all three firms have transformed themselves from local operations into international players. They have done this from within. The business climate of the federal procurement process was the vehicle that provided, in part, the training ground for these firms to go international. These transformations have been driven by recognizing opportunities within the emerging IT industry. All three companies were competitors, now they are not competitors, they basically are in different markets. Fundamentally, however, each firm has focused its products and its services and its expertise on its customers. Why have these companies succeeded? Basically, they have addressed a set of common issues—characteristics that are important to any success in business. They have leadership—leadership that provides and sustains a vision with a purpose. They are addressing competitiveness, there is a willingness and a commitment to adapt to a global perspective. There is a dedication to staff, to quality of work, and to career opportunities. And more recently, each of these firms in its own way is taking a role in consultative work with government—at the federal and provincial level, and in foreign countries—to address some of the issues associated with the software products industry. Controlled growth is the key to success and survival.

The Rapid Pace of Change: Its Implications for Public Policies

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Some of the things that I have heard today have impressed me, and some of them I would like to reinforce because I think that they are important. One of the problems that we have in this technology business is that the whole thing is moving very quickly. It is moving much more quickly than regulators and law makers can possibly keep up with. One of the brightest suggestions that was made was some speaker this afternoon who talked about having a Royal Commission. I think that would be a marvelous idea because Royal Commissions go on for a long time and they in fact inhibit any decisions being made. Because this whole business is moving so quickly, almost any decision that we make is likely to be wrong. And I think that this has been one of the key successes of the Canadian government strategy over the course of the last twenty years in dealing with technology. People have been cruel and have said that Canada does not have a strategy for dealing with technology. This is quite incorrect and it is a very negative view, and I hope that you do not support it. Canada does indeed have a strategy. It is one that says that we should not do anything significant either for or against the development of technology because whatever we do will undoubtedly be wrong. And if you look at the initiatives which the government has taken, fairly minor ones, to TCs, the incorporation of the Department of Communications, this sort of thing, which have happened over the years, all of them have turned out to be fraught with difficulty and errors.

What we should be doing of course is changing with time. We are dealing with sufficiently rapid change that what we have to manage is not so much the technology that we see before us today or tomorrow but just the whole idea of managing change. This is much more difficult to understand and to come to grips with than the idea of just saying computers are going to go faster. They sure are going to go faster. Whereas we used to see seven years between generations of hardware, we cut that to three years and then two years and now it is much less than a year. Is there no end in sight? No, there is no end in sight. If you like, the rate of progress is itself increasing. There is a second order effect here. We are experiencing change but then this change is also occurring in many other disciplines as well. If you look at the field of molecular biology, you find that the rate of change is even higher than it is in the technology that we are acquainted with. I listened to a wonderful speech on that topic by a fairly well-known professor in Los Angeles a few years ago and he was asked the question from the audience, how he coped with teaching students and setting exams which were relevant. He said it is really very simple, we set the same exam paper every year, it is only the answers which change. This is sort of what we are dealing with in this area. What I think that we have to look to is perhaps one of those life sciences saying that there really is not a neat, clean solution out there. We are living in an age where the technology that we are developing and working with is suited to the solution of non-linear problems and we exist in a non-linear problem area. So, what we do is just little bits, what we do is experiments, we do small things, nothing profound, nothing big because if we do something big it will most certainly be wrong.

One of the products which we sell as a company is a software system to control the manufacture of semiconductors. And that has been on sale for a number of years and of course it changes quite frequently. We have something like three new releases a year and as the technology of semi-conductor manufacturing is changing, so the control systems are changing. The main change which has occurred during the course of the last eight years that we have been selling this software is that where we once replaced paper in a production facility, about three years ago we started on the replacement of the people in a production facility. So now a semiconductor manufacturing line is built for the cost of about $100,000,000, and it does not have any people. People really do generate a lot of dirt and they do generate a significant reduction in the yield. So if you can get rid of them that is fine.

Why does Canada not have a semiconductor manufacturing industry? Well, we all know that it is because the labour costs are so high. Isn't it? I mean the Japanese and the Koreans are so good at that because they pay people such insignificant amounts of money and they don't have this minimum wage problem that we have. It is labour costs that stop us from being in that business. Ah, I hear you say. You are way ahead of me. But the labour costs are zero. Well, why aren't we in that business then? It is well known that we cannot be in the hardware manufacturing business isn't it? I mean we have convinced ourselves of this over the course of the last twenty years. Who is seriously in, who is planning to be in the hardware manufacturing business? I am not just talking about the manufacture of semiconductors, I am talking about assembly. We, in North America, have opted out of that business because we have moved into the post-industry society, I think it's called, the information age when all these obsolete things like manufacturing can be done by other people while we move forward into the more profitable areas of not making anything that you can put your arms around. Instead of that we have handed over the manufacturing of all of these widgits to other people because that is not profitable for us to do anymore, or is it?

People like the Japanese and the Koreans of course are really stubbing their toes and making huge losses while we are focusing our attention on selling each other information. About what? I don't know. All of the reasons that we gave for changing the direction in which we were moving are today incorrect. What seemed like the right thing to do today is incorrect. Maybe we shouldn't have any hard and fast policies. And I think that Canada is beautifully positioned in that respect. It is the kind of policy decisions that we are well-equipped to make.

By all that is right and proper we should not really exist as a viable economic unit. Yet, the standard of living in Canada is very high, our salaries are high, we have a marvelous time. I live here as a matter of choice, so do you, not because we are constrained to but because we like it here. Why do we like it? Because of our standard of living. We have absolutely no economic justification for existence. None at all. And if you had examined this carefully, say in 1960, you could have foreseen the development of our industry, that we would be out of the hardware industry because everybody knows we can't afford to be in that because of the labour costs. With our computer services industry, we have been losing ground as well. Let me tell you that we are out of that business. We've gone, we've finished. There is no Canadian presence in it anymore. Are we out of the software industry? No, we do have some software companies. Will we be out of that? Probably. And does it matter? Well, I am really not quite so sure about that. That is one of the enigmas that we face that all of the things that should logically point us to our annihilation just do not seem to happen and do not seem to come true. What is obvious is that there are other factors to this thing that we are maybe not aware of. We are using traditional methods to evaluate where we are and traditional methods to make decisions about what our strategies should be. Maybe that is where we are making our mistake. So the more Royal Commissions we can commission and keep our governments and government departments busy doing that kind of thing, then the least harm that they will do. This is reflected quite well in countries like Switzerland. Switzerland has always been a very strong economic entity. One of the reasons, I would maintain that they are so strong, is that the federal government in Switzerland meets for a grand total of nine weeks each year. That is not long enough to do significant damage.

There are perhaps things that we could do just looking at generalities rather than looking at specifics. Doing things like the SRTC program is obviously wrong because it is a particular thing that

we are doing and therefore it can't be right. What we have got to do is to be much more general about what it is that we do. We should be making Canada a more attractive place to live. By whatever means, what does it take to do that? If you make Canada a more attractive place to live then more people might want to live here so you create a bigger population. Well, there is plenty of room. You create a bigger market that way. You might even attract a lot of people who can do a fair amount of thinking, who can do a fair amount of product development. We are after all dependent not on government initiatives but on the initiatives of people, entrepreneurs who will do things in spite of government or because of government or neither, because they want to. That will always happen if you can provide a breeding ground for them. This is what we should be thinking about.

One of the things we could well start an NRC project on is how can we improve the weather. I think that it has significantly improved over the last twenty years. I think that Toronto is a more attractive place to live than it was twenty years ago. So, I stay here and so do lots of other people, and there is this general momentum of people enjoying being where they are. We as a company started in Toronto with nine people and spread out all over the world and we have done some interesting development. One of the really significant things that I think we have accomplished as a company is that we have spawned at least twenty-five other companies from which we derive no particular financial benefit.

I heard an interesting statement, and I am not sure whether it is policy which is reflected in this audience or not. Now that we are out of the hardware business, we are probably getting out of the service business, and God knows what is going to happen in the software business. BUT, BUT, BUT, Canada, we will become the world's leading user of technology. How about that? We are going to buy more VCRs, more TVs than anyone else on earth. Good. Maybe that will make it a more attractive place to live. Because in the final analysis where is the satisfaction out of this whole thing? Go to some place like Taiwan. It is an absolutely awful place to live. Incredibly awful place, not because of its climate but because of the way in which people live. Korea will go the same way, another awful place to live. I have changed my mind year by year as the problem has changed and maybe we have to keep this kind of flexibility. Probably if you were to ask me back next year I will have a completely different solution to our problems because technology will have moved an awful lot in the course of that year.

Part E

Retraining and University-Industry Cooperation

New Skill Development Programs to Enhance Labour Adjustment in a Rapidly Changing Economy

Maryantonett Flumian
Executive Director/Chief Executive Officer
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It is the mandate of the Canadian Labour Market and Productivity Centre to undertake activities designed to improve Canada's labour markets, and to enhance joint efforts between business and labour towards improving productivity. The issues of labour market performance productivity and adjustment are critically linked. It is therefore fitting that policies to manage adjustment should be of central concern to us. Indeed they were the focus of our first business/labour task force on working together to manage change. This task force was established in June 1987. Three members from labour and three members from business undertook to reach a common understanding on policies for managing change. They presented their unique report to a forum of fifty of their colleagues in January of 1989. Their deliberations and subsequent report are the basis of this paper.

Any policy for managing change must be based on a few fundamental principles. First, there must be a balance between the need of the employers to adopt new technology and to respond to changing market conditions, and the need of workers to pursue their livelihood in a reasonable expectation of employment security.

Second, in order to achieve the most appropriate balance between equity and efficiency, the focus of adjustment policies must shift from the firm to the individual. Individuals who suffer negative consequences as a result of change must be given the opportunity to partake in the benefits that change will bring. This is important, not only from an equity point of view, but also from an efficiency one. Reduction of the burden of change is efficient because resistance to change is also reduced. Therefore, adjustment policy should have at a minimum two key objectives. One, as I have just mentioned, is to reduce the burden of change that any individual or group must bear, and second is to give the workers the skills that they will need to maintain their current jobs and win and hold future jobs. The best means to meet these firm objectives is to promote better access to training and skill upgrading. This is the best investment that Canada can make to facilitate this process of change.

It has become a cliche to say that the Canadian labour market in the 1980's has been characterized by rapid change. Most of our economic trends point to the increasing importance of education and training in this country. I refer to the evidence that the demand for skilled and well-educated workers has outpaced the available supply. There are already acute shortages of skilled labour in various parts of this country, especially in Toronto. While there is no official survey of job vacancies, the CLMPC, estimates that the number of job vacancies as a percentage of the labour force averaged 4.7% during 1988. While this estimate is substantially lower than the official unemployment rate it implies that by this measure at least, there are more individuals unemployed because of mismatches than because of a basic lack of jobs.

The number of individuals who leave their employer or are laid off in any given year in Canada is very high. Our analysis of the recently released 1986 labour market activities survey has shown that close to 2.5 million individuals, representing one-fifth of employed Canadians, left a job and either

found a new one or became unemployed in 1986. One interpretation of this high turnover rate is that the labour market is very dynamic and therefore will adjust easily to change. However, in reaching that conclusion, it is important to note that in 60% of these cases, those individuals had been in their jobs for less than a year. This reflects the presence of seasonal, temporary, or in other words unstable employment. The best way to prepare for this sort of mobility is through the acquisition of transferable skills which lead to more security in existing employment, and a better chance of obtaining new employment in the event of layoff. Furthermore, between 1981 and 1988 about two-thirds of the net employment growth in Canada has been in the managerial and professional occupational grouping. Its share of total employment has risen and relative unemployment in this occupational group is very low. According to census data, the fastest growing occupations in this area have been systems analysts, social welfare and community service workers, general managers and senior administrative officials. All these occupations require a post-secondary education. Even though we realize that this trend may be overstated by the inclusion of many so called "McManagers", nevertheless, the continuing employment growth in the professional and managerial occupations does suggest that employment opportunities will be much greater for individuals who are well trained and educated, while those without skills will face increasing difficulty in securing permanent employment. Finally, I would refer to the demographic reality of an aging labour force. Older workers for a variety of reasons face greater difficulty in dealing with change. And employers are also less prepared to hire or retrain older workers. Given our demographic prospects, older workers will become essential participants in this shrinking work force. Given these labour market challenges, our current training policies, as represented at least by federal efforts under the Canadian Job Strategy, fall short of what is needed.

Existing CJS programs direct training primarily towards those who are outside the existing employed work force. Little assistance is made available for training and retraining programs implemented by industry to avoid adjustment problems, to raise productivity, or to enhance competitiveness. In addition, the recently established program for older worker adjustment, known as POWER, is an income maintenance program only, with no attempt to promote any adjustment to retraining or mobility. In essence, the array of measures before us are primarily passive at a time when more active mechanisms are required.

Furthermore, even without dealing with its merits, POWER is an illustration of what our task force believes to be a principal obstacle to more effective adjustment policies in Canada: namely, the jurisdictional fragmentation, balkanization and often competing objectives of Canada's thirteen governments. Negotiations between the federal government and the provinces delayed the introduction of that program for over three years. Now, in the provinces where it is available the administration of the program must be coordinated between several actors. Furthermore, the fact that POWER is the responsibility of the Department of Labour and is thus separated from the labour market programs of the Department of Employment and Immigration or the income maintenance programs provided by Health and Welfare Canada, makes little administrative sense. This fuels the public perception that while there are lots of folks stocking shelves, there is no one really minding the store. It is an understatement that federal-provincial cooperation on an unprecedented level would be a prerequisite for an improved ability to manage change in our labour market. Therefore, the task force called for structural bureaucratic reform.

One of the recommendations of the report was the establishment of a permanent federal/provincial council of ministers responsible for labour market issues, which would include education, which would meet annually with the major labour market partners in order to force-feed the development of better coordinated policies. Much discussion revolved around the need for one federal department with responsibility for labour market issues. Given better coordination, the best continuing investment Canada can make to facilitate the process of change is to promote better access to training and skill upgrading.

Despite the importance of skill development to industrial performance, very little is known about private sector training in this country. We can all name a handful of companies on the leading edge,

IBM for example, but we all recognize that they do not represent the majority. The need for reliable data in this area is compelling. To fill this information gap, the Centre with the assistance of Enderonics Research Group conducted a national survey of the training experiences and attitudes of Canadians. The results were telling. Most Canadians, indeed 67%, believed that the continued success of their organizations depended on the level of the training effort of that organization. At the same time, many Canadians felt that they were not getting enough training to enable them to meet the challenges of technological and competitive change. Despite the strong consensus on the need for training, most Canadian workers received little or no on-the-job training. According to our results 41% received no training over the last two years. The results indicated the average full-time employee in Canada received about four days of training annually. This is higher than previous estimates. We account for this because the CLMPC survey allowed respondents to include all types of training, including informal on-the-job training. Typically, those who received training in the last two years tended to be employed full-time in a managerial or professional occupation. They were inclined to be younger and earn more than their fellow Canadians. Not surprisingly, then, 52% of the unskilled workers who received the least training of any occupational grouping, feared that they were not prepared for a job change. The survey also showed that Canadians believed that training is most effectively carried out in the workplace, and that the federal government followed by individual companies should have the primary responsibility for setting training standards for the workplace. Public policy debate, therefore, should zero in on the appropriate mix of public and private instruments, the relative funding responsibilities, and the appropriate mechanisms.

Any effective training program will also depend on the existence of a sound public educational system. Canadians must have well-developed literacy, numeracy, and basic learning skills if they are to adjust to change through periodic training and retraining. The overall level of Canadian public spending on education compares favourably to that of other countries. However, there is no simple relationship between spending and the effectiveness of our educational system. There is much evidence that a closer evaluation of linkages between education and the workplace is needed. In short, the members of the task force concluded that as a country we need to make a commitment to the development of a coordinated national training strategy with the focus on the skills that are useful to more than one employer and with skill certification that is fully transferable between provinces.

Such a strategy, however, will only be effective with full participation and cooperation of the labour market partners, all levels of government and educational institutions. The major theme of the task force report is that the direct involvement of employers and workers is essential if we are to improve our ability to manage change. The proposition that the two labour market partners should work together is often articulated, but here we see it as the key principle of public policy.

When the minister of Employment and Immigration in April of 1989, announced significant changes to the government's labour market strategy, she committed this government to consult with business and labour and other key interest groups on the nature and the extent of changes needed to both the development and the administration of suitable labour market policies and programs. While it is very clear that business and labour both have concerns about the recent changes to the Unemployment Insurance Program and will continue to express their disagreement, there is a widely held view that the issues related to training are of fundamental importance to all Canadians.

In the spring of 1989, Employment and Immigration minister, Barbara McDougall met with leaders of thirteen national organizations to officially launch consultations on the government's new labour adjustment and training initiatives. During a session held in Ottawa, representatives of business, labour, training organizations and other interested groups discussed a process for consultation and agreed to participate in further discussions to design future labour market programs. With the agreement of participants, the CLMPC will convene five symposia in 1989 to focus on these five areas: first, entry-level training which will include apprenticeship, new entry programs and cooperative education; secondly, programs for unemployment insurance recipients; thirdly, human resource planning which is the only area that focuses on ongoing training related to the work place; fourthly, programs for social assistance recipients; and finally, programs for older workers. In 1989, six

representative task forces will meet to discuss these issues and to prepare reports. Their findings will be presented to five national symposia. Participation will be by invitation only, but the list will be exhaustive and representative of all those who have labour market interests in these areas. The consultations will culminate in a final report expected in 1989.

However, there is a need to begin a process that goes far beyond the government's short-term needs. While business, labour and other parties will be involved in the need to advise and allocate an $800 million dollar pot, their aim is directly tied to the better functioning of the labour market. Canada's competitiveness in the bottom line will be determined by the appropriate role of the labour market partners in continuing discussions about policy making and the general administration of labour market programs. If their role is to be a serious one, signalling a fundamental shift in a cooperative effort in designing and implementing policies and programs, both business and labour welcome the challenge. When the right processes are put in place involving all legitimate parties then we will have taken one giant step forward and, incidentally, we will join most other industrialized nations in developing policies that are based on the realities of the workplace whatever that workplace may be.

The Ontario Ministry of Skills Development: Its Mission and Programs

Jan Rush
Assistant Deputy Minister
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Ministry of Skills Development

I was pleased to see in the description of this conference that training is now being talked about with such other key ideas as globalization and diffusion and innovation. Part of the reason for the creation of the Ministry of Skills Development by the Ontario government in 1985 was to focus more attention on skill development and training, and its relationship to labour market adjustment, industrial adjustment, and competitiveness. What I would like to emphasize today is the human resource development perspective on that, and why we have to dramatically change attitudes about training and retraining.

The Ministry of Skills Development talks about its role in terms of creating a training culture. What we mean by a training culture is a set of conditions where training is considered to be the norm, where it is a normal function of business, where it is related to the business plan, where employers expect to train and employees expect to be trained. That is an interesting way to describe part of our mission. A well-trained work force is fundamental to our ability to compete, and all of the changes that this conference has discussed affect the work force directly.

The issue of basic skills and functional literacy is something that is extremely important to everyone. There have been many reports recently in Canada talking about illiteracy as a fundamental issue in our work force. The Southam Report estimates that 24% of our existing labour force is functionally illiterate. Functional literacy is very difficult to define. The definition that the Ministry uses is the UNESCO definition in which anyone in a Western economy operating at less than grade 9 equivalency is considered functionally illiterate. One task force in Canada estimated that illiteracy costs about $10 billion dollars a year. Let me give you an example of how some of those costs were calculated. One of North America's leading researchers in the area of basic skills and functional illiteracy uses the example of a loading dock operation. What he looked at was how statistical process control has totally altered the nature of that work. In the past, the broad back and the strong back was on the loading dock. Now we have a system with statistical process control where part of the job is reading complicated charts with variances. Loading the truck becomes something that requires a much higher level of numeracy skills.

What has happened is that the complexity of jobs has increased at all levels because of the use of technologies; in particular, information technologies. That will be one of the fundamental challenges in the future and we will be spending a lot of our time and effort on these issues. We also support community literacy groups in looking at these issues. But what is perhaps more relevant here is our work place literacy efforts. At the moment, we are working very closely with three of the major unions to fund them to develop necessary materials and to train the trainers to go into the work place and address the functional literacy issue.

As well, there are other changes we can look at in the labour market as information technology and other technologies come onto the plant floor. One such effect is multi-skilling. Traditional jobs

and the way that work is integrated are changing rapidly. Keyboarding, for example, used to be a skill base for secretaries or support staff. Now managers and senior executives must understand keyboarding. A more complex example is a job like industrial mechanic millwright. That traditional skilled occupation now has to work with electrical circuits. What it means in terms of the workplace is the constant need to upgrade skills and to be retrained, but it also challenges the way that we train. In looking at some of the traditional means of vertical training towards an occupation, we in government along with our partners in business and labour have to look very carefully at how we do that training. In terms of union jurisdiction, and apprenticeship, how can that cross-crafting and multi-skilling be achieved? How will we adapt ourselves, so we do not have impediments and obstacles in our institutions?

Another impact in terms of the rate of change in the labour market is the need for institutions to know what is going on in the business community. One example is what we are doing in terms of the decline of the youth population. Coop education, in all of its forms, is going to be more important than ever in terms of finding the expertise for the on-the-job training component, and in terms of finding the appropriate up-to-date equipment. It is another form of basic skill to have young people, or people entering the labour market at any age, who understand the problem solving and the team work and the new features of jobs. The Ministry is very pleased to announce an apprenticeship system in Ontario where young people can be part-time apprentices and part-time students. This will allow young people to become gainfully employed as registered apprentices while they complete their high school education.

Another significant concern in upgrading existing workers is with small- and medium-sized businesses where it is much more difficult to upgrade because these businesses do not have the capacity of the larger firms to do on-site training. They do not have the scope or the critical mass, nor can they access the equipment and expertise they need in order to upgrade their workers. The Ministry is currently working with the community colleges in an effort to adapt our institutions and our programming as government to try to meet these needs. The Ministry has a program for technicians and technologists, college graduates whose skills are dated within three to five years of their graduation. Under this program they can return to the college and receive upgrading training. Important features were how the training was identified, how the equipment was obtained and how instructors were recruited. The community colleges, with our support, were able to work with local business and find courses that were developed precisely for the needs of the local community. There have been many successes to date. Cable companies learning how to work with optic fiber is one example.

The apprenticeship system is one that we feel very strongly about in the Ministry and in the government, as a key to providing the skilled trades people and skilled occupations for the future. Apprenticeship is an old system that has existed for centuries, a formalized system of on-the-job training combined with institutional teaching, with standards and certification. It is those essential features that we are trying to preserve and promote. In Ontario, we are committed to revitalizing the apprenticeship system. We are looking at the multi-skilling aspects and at being very flexible. In Ontario we have almost 700 apprenticeship systems that are employer-based. That is, we work with the employer to define their needs and then take bits and pieces of trades and skills and put those together. We also have about 66 regulated trades. Those that are most familiar to people are the apprenticeable trades in the construction industry. That model is worth preserving and is working. It is also one that is affected by new technologies, and is an area that we are looking at for mechanisms to upgrade existing journeymen, through our trades updating program.

We are also looking at flexibility in how trainees go through the apprenticeship system. It is primarily a time-based system. We are now looking at the core competencies required for various occupations and how we build those together and take into effect things like multi-skilling. How do we adapt a system that was primarily developed for sixteen-year-old males leaving high school to be flexible in its format, its process and what it teaches, so that it supplies workers of all ages, of varying

backgrounds, and of both sexes? A lot of work has been done and will be done on the apprenticeship promotion side.

One of the things that has been mentioned is the lack of employer-based training that is occurring despite the fact that employers, and employees, are now very aware of its importance. When the ministry was created in 1985, we recognized this issue. Two programs were developed to address this issue. They are the Ontario Skills Development Offices and Ontario Skills Incentive Fund. Through a fee-for-service contract with the community colleges in Ontario, we have a network of business training consultants who work with small- and medium-sized firms to help them develop training plans. One of the keys of this development is that a training plan must relate to a firm's business plan. This has been part of the problem in the past in the amount of money that has been wasted in training and some of the problems that have been associated with training. Training for too long was the add on, or tack on, after the production decision was made, after the technological decision was made or after the marketing decision was made. We advocate that the training plan be part of the business plan. This is a professional expertise that is in shortage like many others. There are 190 consultants scattered across the province who are available to you and your firms to help you put together a training plan. When you have a training plan, either developed by yourselves and validated by the office or developed in concert with the support of the office, there may be eligibility for funding assistance. Most of the training that is occurring with employers is still extremely short-term in duration. It is usually about two weeks at the most and it is highly specific. Looking at the system as a whole we still have some gaps to fill in terms of the spread between short-term and long-term training. Incidentally, within these programs the largest single use is training around information technology.

In summary, we must ensure that we are not causing any impediments, that we are facilitating labour market change, that the governments coordinate themselves, that roles are well understood and established, and that we have a new federal/provincial agreement that allows us to continue with greater certainty and greater, long-term vision than we have had in the past. This issue will maintain a high profile on the public agenda. We have Premier Peterson's Council on Technology which will release their second report, called The People Side, this Fall. We know that the community college system in this province is looking at its future in an exercise called Vision 2000, and it is looking at its role in terms of skill training and skilled occupations. We look forward, in the future, to further discussions about roles in training, to the continuing promotion of its importance and ensuring that the support mechanisms are flexible and adaptable to the needs of the future.

Myth and Reality in University-Industry Cooperation

Dr. Douglas Wright
President
University of Waterloo

One feels at times that the issue of university-industry cooperation has been analyzed more times or thoroughly enough for everyone to be familiar with the issue. But, then again, I get reminded from time to time that some people still unfortunately fail to understand the simple considerations that I think prevail and govern what can be done, as well what might be done in the future.

It is very important I think first to identify clearly the various functions and responsibilities of the different players. University functions are quite simple. Universities exist to do teaching and to do research. Their research interests tend to be fairly long-term, as of course are the processes through which university education takes place. Industry, of course, exists to make money by providing goods and services. Industry usually has interests that are fairly short term. As some previous speakers noted, there is a particular restraint on business in North America vis-à-vis the characteristics and impatience of capital markets. The compulsion to judge performance on quarter-by-quarter results does not give much weight to research and development, or to other expenditures that build future strengths and market shares. It remains that it is no less true in Japan or Germany, where capital tends to be more patient, that industry is not much more committed to long-term research. So there is in fact a complementarity between the longer-term functions of universities and the shorter-term interests of industries.

Government has a vital role as well of course. In most countries, governments support the larger part of university research, and as well governments do research in their own laboratories. It is of interest to note that the rise of the state in Western Europe coincided with the rise of the university. The University of Bologna in Italy, last year celebrated its 900th anniversary. Its inauguration as a university, quite recognizable in modern terms, reflected the need to teach civil and Roman law to provide administrators for the state. For nearly 1,000 years, educated people of the sort provided by universities have been central to the development of the Renaissance, the Enlightenment, and more recently, our modern society.

As well as needing universities to provide supplies of educated people, societies in recent times have discovered that universities are needed to provide knowledge, the most important source of wealth in our times. It is no surprise then, that everyone is preoccupied with policies that affect research, development and innovation, and with factors that relate the sources of knowledge, still primarily in universities, to the instruments, essentially industries, in which this knowledge is transformed into wealth. Notwithstanding the efforts of many countries to promote research in industry, and all the work done in government laboratories, universities still provide the bulk of important discoveries. And it is my confident expectation that for a number of reasons, including the culture of the different institutional systems, that they will continue to do so.

The problems arise because while everyone now acknowledges the importance of knowledge as the basis for the creation of wealth, the three communities, industry, government and universities, do not yet adequately understand how the others behave.

Important new insights are being gained and acknowledged. The Canadian Manufacturers Association, in a recent report, identified very clearly that industry has not done nearly enough research over the past 40 years. The CMA went on to point out that in that vacuum, government tried to provide the kind of research, and even development, that industry was not doing. Not surprisingly, far removed from market considerations, the most conscientious efforts of government laboratories were generally unsuccessful in providing proxies for the missing research in industry. With all respect to the Department of Communications, one of the hosts of this meeting, Telidon was a perfect example of the effort of government to substitute for industry—well intended, but in fact futile.

The attitudes of industry to research are changing rapidly. It is of interest to note that before the decline of the steel-making industry in the U.S. in the 1970s, The United States Steel Corporation had one of the largest corporate research groups in the world. Anyone that was acquainted with them at that time saw that their research divisions were probably more isolated from the people who made and tried to sell steel, than laboratories in universities or government.

The most striking feature of the development of industrial research in the last decade has been the efforts made to couple research more closely to marketing functions, to ensure that research and development is driven by an awareness of customer needs and market opportunities. While industry still retains some centralized laboratories, there has been a major shift toward the decentralization of the R&D function.

A fascinating development is the deliberate effort by many industries to cultivate contacts with universities in order to have an efficient way to gain early knowledge of new discoveries. Because of the intense competition of university scientists for achievement, there is a need to keep abreast of what other people are doing, for it is always futile to duplicate other people's work. Universities and university researchers tend therefore to be very well informed on progress in fields in which they are interested. Industry liaison with universities constitutes a very efficient way to scan discoveries all over the world. What is most striking about all of this, is that even the largest industries, such as IBM and GM, which were once quite autonomous in their development work, are now amongst the most active in seeking liaison with universities.

These new attitudes are transforming the nature of the linkages between universities and industry.

But the problems of understanding are still very much with us.

It is only three years since the federal government announced their system for matching grants which were intended to encourage industry funding of university research. In the first instance, the text of the announcement from the Department of Finance said that industry would make *contributions* to the three granting councils. Well, the people who wrote that must have had breakfast in some very strange place. The policymakers were not well-acquainted with the realities. I remember, in one of my excursions to Ottawa, about that time, when there were rumours that such a policy was coming, I talked with people in the Prime Minister's Office, the Privy Council Office, Finance and other places where policy gets formed or hammered upon. I asked senior people and senior policy advisors what proportion of university research at John Hopkins, Stanford and MIT was financed by industry. Of course they responded that they did not know. But, I said, you are in the process of making policy and you will be deciding what is a reasonable proportion, so I pressed them to estimate. No one suggested less than 30%, and many said that they thought 60% or 70% of the research in those universities was being funded by industry. The fact is that at John Hopkins, which has the largest research budget of any American university, less than half of 1% of its research budget is funded by industry; Stanford has 6% funded by industry, right on the national average, and MIT is quite high with 9% of their research funded by industry. The balance in each case is funded by the U.S. federal

government and its agencies. Incidentally, of course, in the U.S. federal funding of research pays for the *entire* cost including an appropriate share of faculty salaries, and other overheads and indirect costs.

Notwithstanding all that, the program in Canada was launched on the expectation of 50/50 funding. Very quickly, to avoid the failure that would then almost have certainly arisen, the terms were redefined to admit all kinds of non-industry support, and the program continues although it has been castigated by the Senate Committee on Finance. So much for government insights.

Nowhere, except perhaps in Korea, does industry support any very significant part of the primary university functions of teaching and research. Those functions are everywhere carried mainly by government grants and student tuition fees, and only exceptionally carried in part by revenue from endowments arising from private gifts.

In universities, we also still have problems with perception and understanding which are not too surprising. My sense of this is fairly simple. University people who, by the nature of their own research interests, or the nature of their subject, find themselves in contact with people from industry, learn very readily that such people have a respect for knowledge and for researchers and are only too happy to engage in dialogue. Unfortunately, but not surprisingly, the people whose subjects do not lead to such dialogue tend to be fearful that the outside world wants to manipulate the university.

At Waterloo we enjoy quite substantial support for our research from industry. In virtually every case where we do enjoy a good relationship with industry in supporting research, what has happened is that good researchers who already enjoy substantial support from the research councils, doing interesting and exciting work, find industry attracted by the quality of that work. Because of the generally open dialogue which we do maintain with many industries, it is fairly easy to gain this perception. In most cases, industry money is intended to enable us to do more of the kind of work, and more quickly, than might be possible with the support of the research councils. We are, of course, usually very happy to take money under these conditions. Our researchers feel that they control their own research agenda, but it is of course the case that through their dialogue with people in industry, they come to have a more sophisticated view, often, of the nature of the research problem.

The most fundamental issue, as I noted at the outset, is that the time constraints are different in the different systems. Universities, with their interests in fundamental research, do not often produce results that are going to have commercial value in less than five years. Industry, of course, is obliged to seek returns in shorter time. There are occasions, mostly unplanned, where university research leads to discoveries that may be more or less immediately exploited commercially. In my own view, and it is a view that I think is widely shared at my university at least, there is a duty on the part of the researcher, who is primarily funded with public money, to act so as to protect any such discovery through patents or otherwise, and as well to act so as to ensure that the development is exploited for the general benefit of society, and particularly for the benefit of the taxpayers who have funded the work.

The most important aspect of the university-industry cooperation, is that there should be open doors and dialogue on the research agenda. A necessary condition for that dialogue, of course, is that the people outside of the university have to be sophisticated enough to enter into an effective dialogue.

One of the most important features of the Ontario program for the Centres of Excellence is that the organizational structure ensures that there are consultations on the research agenda. That is necessary and appropriate. The design for the Centres was also realistic in not requiring substantial commitments from industry for funding the research, which is long term, and uncertain therefore in anticipated utility. The key to winning the funds, is that the industries involved would be in a position and committed to take up and do the development that would arise from the research. It goes without saying that the cost of such development would be far greater than the cost of the research on which it would be based.

Before concluding, I would like to note that while we usually talk about university-industry cooperation in terms of research, it is in fact only one of a number of instruments for interaction. I won't discuss all the others exhaustively, but let me just note that the general issue, in fact, is dissemination of knowledge, and that the most effective instruments for this are students, undergraduates as well as graduate students.

Undergraduates are a principal source of new technology for industry. A university President in France, a friend of mine, coined a marvelous phrase. Translated into English his comment is to the effect that students are to technology as mosquitoes are to malaria. It is a very apt metaphor. Seventy percent of manufacturing industries in Ontario have no graduate engineers on staff. Even students working in summers or in coop programs provide very important access to new technology for those firms. Although we often think of graduate students as important agents for bringing advanced knowledge to industry, even baccalaureate graduates are very important in the process of technology transfer.

Faculty consulting is another important instrument for technology transfer. At Waterloo we have always encouraged our faculty members to make themselves and their expertise available to industry.

There are of course reverse benefits. We have many advisory councils and committees with members drawn from business, industry and government who assist us and advise in the development of academic programs. We have learned that in such work, as in discussion of the research agenda, their interests are in no way alien or antagonistic to our academic concerns.

Finally, on the issue of commercialization, it is very important as I noted a few minutes ago, to acknowledge the duty and responsibility to protect knowledge and to bring it to exploitation. This is no small task and it requires a good deal of expertise, which itself can benefit from university-industry cooperation.

Before closing, I would like to note the contributions of the Corporate-Higher Education Forum, which has written two or three superb reports providing advice on university-industry cooperation.

University-Industry Cooperation

Dr. H.W. Arthurs
President
York University

Introduction

I have been asked to talk about science parks and about joint industry-university research. As president of a university which is aggressively involved in both—to a far greater extent than is usually appreciated—I am more than happy to oblige.

First, a brief word about York. As most of you will know, we have neither an engineering school nor a medical school, and our science faculty—while outstanding as a collection of individuals—is very small relative to York's overall size. We are therefore not obvious players in the information technology game, nor in the more general field of industry-university cooperation. But we have become significant players nonetheless. Our activities fall into four categories:

- technology transfer
- property-based development
- faculty-based initiatives
- administrative innovation

Let me describe each, at least by way of a few examples.

Technology Transfer

Several years ago, with the assistance of the Ontario Ministry of Industry, Trade and Technology, we established Innovation York—a partnership of our Faculties of Science and Administrative Studies—with the primary mission of moving scientific developments from our university laboratories to industrial applications.

In just a short time, we have had some spectacular successes. Innovation York has established an incubator facility for small technology companies some of which—but not all—involve York scientists. There is a lengthy queue of companies waiting to get into this facility, and we are in the process of developing a new one which can accommodate more of them.

In several areas—lasers, biotechnology, and optics for example—we have managed to provide York scientists with entrepreneurial assistance, find industrial partners and raise venture capital to bring products and processes to market. So successful have we been that despite the withdrawal of the government from the original program, we are on the verge of transforming Innovation York into a wholly-owned self-sustaining—and ultimately profitable—subsidiary of the university.

To generalize from this experience, I believe that it is essential for any university embarking on a program of industrial collaboration to have an appropriate vehicle, one which can provide a high degree of business skill as well as scientific and technological expertise.

Property-based Development

History robbed York of a full-range of technology-intensive faculties: just as we were due to expand in that direction, government embargoed the establishment of new engineering and medical schools and made the expansion of our science faculty financially impossible. But history offered us compensation: six hundred acres of land in Metropolitan Toronto.

The issue confronting us now is how to turn one asset into another, and we think we have found the answer. Through the creation of York University Development Corporation, we have embarked on an intensive and extensive program of land development. The prime motive of that development was to provide us with capital funds to deal with our extreme shortage of buildings for academic purposes, and to enable us to change the physical layout of our campus, through infill, to make it more attractive and convenient.

However, as we studied the problem, it became clear that land development also offered us the opportunity to bring onto the campus a range of activities which were synergistic with, or complementary to, our own academic activities.

The first venture to emerge in our development phase tells the story. This is a software company, owned by a York graduate who was also a part-time instructor in Computer Science. He has recently constructed, on land leased from the university, a fairly large building to house his own company, Computer Methods.

Space in the building surplus to his current needs is subleased to various university-related tenants, principally the Institute for Space and Terrestrial Science which is housed at York, and is a partnership with Toronto, Waterloo, Humber College, and a number of private sector firms.

The university's gains from this sort of transaction are considerable: a rental stream from the land lease; ultimate ownership of the building; and—the special bonus—rapid enhancement of the critical mass of people involved in information technology on our campus. The presence of this private sector firm is already stimulating further cooperation with both our science faculty and our business school.

Faculty-based Initiatives

Obviously, however, the strength of our cooperative relationships and of our development as serious players in information technology, will depend on the depth and breadth of our teaching and research.

Here, I am happy to say, we are making rapid strides. The university as a whole has adopted as one of the objectives of its academic plan to make all faculty members computer capable and all students computer literate in the relatively short run. On the faculty side, we have in fact provided a degree of support that many professors regard as considerably ahead of what other universities are providing. We have not moved quite as fast on the student side, but are poised for the next rapid advance.

Let me mention some of the important developments at York—almost all of them, I want to stress, the result of cooperation with industry.

In the field of Education, we were an early leader in exploring the use of computers for pedagogic purposes. Our "Computers in the Classroom" project, our cooperation with IBM in creating a Microcomputer Resource Centre, our three-way cooperative demonstration project with Apple and the Halton Board of Education, and our recent establishment of a permanent research unit in this area all

attest to the importance that our Faculty of Education attaches to information technology, and the extent to which we are contributing to its dissemination.

Our business school has been very aggressive in ensuring that computers play a critical role in the preparation of the next generation of business leaders. A key cooperative effort four or five years ago with Digital Equipment brought computers into the educational process to an extent which, at the time, was unusual in business faculties. A more recent cooperative project involving IBM shows that the school is determined to maintain its margin.

A host of other projects show a widespread appreciation of the possibilities of information technology. These range from a Writing Workshop—in which computer-based instruction is carefully integrated with academic tutorials—to a Fine Arts computer studio, established with the help of Apple.

I can tell you that the appetite for the use of computing capacity in the general area of teaching is insatiable. And I do not have to remind anyone here that in all areas of research, ranging from the Humanities to the hard sciences, computers are becoming as common as lead pencils.

Administrative Initiatives

Some of the most interesting examples of industry-university cooperation have come not from the academic but from the administrative side of York. The establishment of a Local Area Network linking our top level administration was a developmental spin-off of our decision to acquire an IBM/Rolm phone system. Those of us who were not previously consumers of information technology have become personally involved in it, and much more comfortable with it. Most of us are linked into the campus with modems now, and communicate easily not only with each other but with our colleagues in other campus networks.

Other recent developments in information technology within York's administration involve putting our library catalogue completely on line, and introducing a voice-activated registration system. Such administrative initiatives stem primarily from our desire to capture the productivity gains of information technology. However, they also have two important by-products. First, they involve us in developmental work, often in cooperation with industry. Second, and in the long run more important, they create a context in which computers are regarded as a normal and indispensable tool of administration rather than as an exotic and vaguely sinister presence.

The importance of this last point is easy to miss; let me linger on it a moment. A university which is committed to the use of computers in its administration can never fail to respond to the claims of researchers and teachers that they too wish to have adequate computing capability: we have, in effect, given hostages to fortune. And a university which commits itself to rapid computerization, as we have done, must also commit itself to dealing with the financial and human consequences of such an aggressive policy. This we have done a little less successfully; but we are learning quickly.

Conclusion

I can sum up my remarks to date very quickly: York, like many other universities, is irrevocably committed to the new information technology—to its use, to its dissemination, and to its further development.

But like any other university, we are also committed to thinking about what that technology means. Let me conclude by explaining why this last commitment is in many ways our most important commitment.

The unstated major premise of this conference is that the spread of information technology is an undiluted good, and that university-industry cooperation to promote it is so obviously positive as to

require no defence. In general, I agree with both of those positions, but since I am at heart an incurable academic, I am going to leave you with some questions about each.

First, information technology.

Like all technologies, computing has enormous potential to improve our economic performance—whether as creators, as producers, as consumers, or as regulators. But like all technologies it may also involve unsuspected and subtle risks, not only in the marketplace but in the social, cultural and political sectors. Let me offer as a representative list of such risks: vulnerability to offshore technology suppliers, ergonomic concerns, the effects of political polling, the socio-cultural consequences of decentralized workforces and enhanced risks to privacy, to name but a few.

One of the most valuable things that universities can do in relation to information technology is to keep an eye out for those risks, hopefully anticipating them, but at least being sensitive to their appearance and concerned to alleviate their negative consequences. This is not, I hasten to add, a proposal for latter-day Luddism. It is, rather, a recognition of the university's historic specialty: taking the long view. That long view is particularly necessary when we are confronting a revolution in technology as profound and apparently permanent as the one we are now experiencing.

Second, university-industry cooperation.

Given all the positive aspects of cooperative relationships between universities and the private sector, it is not surprising that there are certain risks here as well. Others will doubtless identify risks from an industry perspective. Let me identify just two which are beginning to raise concerns in the university community.

There is a risk that the potential for cooperation will drive the research agenda. Whole areas of fundamental and curiosity-driven research, projects which demonstrate no commercial potential or which are actually hostile to business interests, may be assigned a lower priority in funding or disregarded altogether. There is no suggestion here that industry will consciously distort the research agenda; quite the contrary: most businessmen realize the need for a broad spectrum of research activity. Rather, the risk is that managers of research, understandably concerned to maximize the returns from applied research and technology transfer, will unconsciously tilt their own decisions in the direction that seems most exciting and innovative.

And, there is the risk that university involvement in information technology may fundamentally affect our financial viability. As everyone knows, Ontario's universities are dramatically underfunded. The real dollar value of our government grants has gone down and down for years. But the cost of information technology—the aggregate cost, not the unit cost—is going up and up. Many of us are now at the point where we can only respond to the legitimate computing needs of faculty, students and administration by cutting faculty complements or library acquisitions or making other very painful economies. We are grateful for the support shown by industry in the form of donations, cooperative projects and so on. But even this generosity produces expensive consequences: staff must be hired and trained, equipment must be maintained and then updated, expectations grow exponentially. In the end, someone has predicted, 110% of every university's budget will be devoted to computing.

These are real issues. They deserve careful thought. They invite discussion today and hereafter. They are issues which it is the special job of universities to raise.

Information Technology and Retraining

J.G. Easson
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IBM Canada Laboratory Education
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Introduction

Retraining is a major topic for information technology; and this paper discusses a successful program that IBM has underway today. It is the Computer Science Certificate Program that was created as a result of cooperation between Ryerson Polytechnical Institute and IBM Canada Ltd. In my job as the IBM Canada Manager located on-site at Ryerson, I direct over 100 employees taking this unique computer science education offering. I have firsthand experience in the running, counselling, implementing changes, problems, and satisfaction gained from this retraining program.

First, a little about my company. IBM is a full-line information technology company operating across Canada. We have had operations here since 1911, and by yearend 1988, we had 12,605 employees working across the country. We operate two major hardware manufacturing plants and a software development laboratory, as well as marketing operations, service, and support functions. For the Information Technology industry, and for IBM, software and services are the fastest growing area.

The Need for Retraining

I quote our CEO John Thompson, he stated:

> "We are in the midst of a major global technological revolution, which is changing the ways Canadians live, work, and do business.
>
> - Canada must compete on its brains.
> - We will face serious qualified manpower shortages over the next five to ten years.
> - We in the Information Industry understand the importance of qualified manpower as we already are experiencing significant skill shortages. As well, our industry is becoming more competitive worldwide than at any time in its history; and we find ourselves relying more heavily on the skills, resources and adaptability of our people. They continue to be our most important asset in a fast-moving and competitive industry."

The information technology industry has always been under rapid change. One very important change currently happening is that the size of the plants and the number of plant employees are shrinking rapidly as technology makes us more productive.

With new technology, the size of computers is also rapidly shrinking. That has several consequences. Less material and energy is required in production, and the significance is that less space and fewer people are needed to produce ever more powerful computers. One of the ways to recognize this is to look at our plant in Toronto where the hardware manufacturing area has shrunk to

half its peak size in the early 1980's while output has grown from $43 million in 1968 to over a billion dollars last year. As a result of these changes, there are employees skilled in manufacturing activities whose jobs are disappearing in this new world of increased automation.

Job opportunities are moving off the manufacturing floor and other disciplines into the software development areas where different skills are needed. Software development—and in particular our TORONTO IBM Canada Lab—is growing rapidly. In fact, the Laboratory has grown from about 300 people in 1981 to over 1,300 today—a significant Canadian success story.

The program discussed here started in 1987 when we had a surplus of 150 people in the hardware manufacturing plant, while, at the same time, the software development lab was to grow by 150. We had an obvious match between the number of employees leaving manufacturing and entering the lab, but a significant mismatch in terms of skills.

Retraining those interested was, and is, the best solution.

The Retraining Program

As just mentioned, we were to move 150 people from areas shrinking into growth areas, and as I shall tell you later, it was not just a simple switch. Nor was laying off and hiring new employees an option.

IBM has a history of commitment to full employment. We have found it better to retrain employees. They are experienced, accustomed to the company processes, have many valued skills and much goodwill. It is so much part of our culture that we do not try to compare the value of retraining to the alternatives. In the over 72 years of operations in this country, there have been no layoffs at IBM Canada.

Therefore, needing education in software skills, and with the help of Ryerson, we developed a formal education package. This maintained our full employment practice, and retrained some 142 people to varying degrees of new and leading-edge skills.

I can tell you that we were apprehensive going into this advanced level of retraining, but it is now clear that many excellent software developers will graduate from those who complete the follow-on program. As well, exceeding our expectations, a recent employee Opinion Survey conducted in the software laboratory showed that the morale rating of these redeployed students in their first year is higher than that reported by their peers.

1987 Redeployment

Now not all 150 people went directly from hardware manufacturing into the software laboratory. With a company like IBM there is a constant process of moving people between functions, so people went from manufacturing into many other areas of the company, and in fact 106 people from manufacturing joined people from other functions in going through the first phase of our retraining program, called Programming Fundamentals (PF).

This was an IBM course taught on-site at Ryerson, using dedicated facilities and Ryerson instructors.

In all, 158 employees attended the Programming Fundamentals. Six classes were run, each lasting 15 weeks. The last group completed their Programming Fundamentals class on June 10, 1988, ending PF with that total of 142 graduates. Of these, 81 joined the software lab and took positions in development areas, while the remainder went to similar work in our Headquarters Information Systems.

Programming Fundamentals' success led to the follow-on Computer Science Certificate (CSC) program, the one that I manage, and will detail now. It started on May 22, 1988, and the entire

program is scheduled to run through to the end of June, 1990. The students are essentially the same group of people that completed the Programming Fundamentals Program.

The Training Programs

There were many factors we believe were key to this successful retraining program:

- The CSC courses are off-the-shelf full credit calendar courses given on a custom schedule. The selection of courses was made by a committee with Ryerson and IBM Development participants. To complete CSC the student must pass 7 core courses, plus two of 5 electives for a total of 9 courses in all.
- These courses have formal exams as for any university credit.
- The students are given Ryerson credits for each course passed, and with completion of both PF and CSC, the employee will have approximately 1/4 of the credits required for a Degree in Computer Science.
- Failure of any two courses requires the student to leave the program.
- Money spent on CSC is mutually beneficial. It gives IBM employees needed education, and expands Ryerson's resources, staff, and ability to offer continuing education.

I am located full time on-site at Ryerson, and am responsible for the success of the students; I interface with our Ryerson instructor team and the managers of the students, and handle an assortment of other activities to keep a smooth operation. My most important activity is to guide and counsel the students, and I shall expand on their needs in a minute. I handle the scheduling of students which can be very time consuming. We have two streams running concurrently at Ryerson.

One option is a part-time 2 days a week at school, and the other option is full-time school for 8 weeks at a time. So, the part-time stream comes to Ryerson two days each week for 8 weeks to complete 1 credit. They work back at the software lab the other 3 days a week. There is a one week break between courses, then they start a new one. These employees will be continuing this cycle, except for the summer break, for two years to complete 9 credits.

The other stream has full-time attendance at Ryerson for 8 weeks while the students complete 2 credits. They then return to the office for two to four months while others rotate full-time and will return periodically until they complete 9 credits too.

Also, we have people taking advantage of selected courses who fit in and out as schedules permit. These employees generally want a topic or two, and either cannot schedule the time to take the complete certificate program of 9 credits, or the balance of the offerings would duplicate their knowledge acquired previously. In that vein, we are currently running a one-time semester of selected courses for our Headquarters Information Systems employees.

I get a lot of satisfaction in optimizing the education benefits without lowering the bar on the academic achievement. Accordingly, the CSC Program has been in a process of evolution since we started it. For example:

- We started the first full-time program in May last year, with a semester of 3 courses to be carried in 8 weeks. The lecture hours were the same as given to Ryerson day students, but we found that the schedule was too compressed. Accordingly, we expanded the semester by 25% and ran the next one as 3 courses in 10 weeks. This allowed more time for lectures, and had the significant benefit of removing Terrible Tuesday, which in the first semester, was an onerous 8 hours of lecture on one day! Still, however, it was clear that completing 3 courses in 10 weeks was too much compression and had an adverse affect on retention and absorption of all the material. By this time, we had encountered the majority of the withdrawals by those unwilling or unable to continue the studies, and we were able to reorganize the balance of the

Ryerson agreement schedule to carry 2 courses in 8 weeks. We have completed one semester of this schedule, and it appears the best arrangement.

- Some of the students had been back at work for quite a duration since graduating from Programming Fundamentals in 1987. We found we needed to refresh some of their academic skills before they came back to class, so we reminded them to review some of the PF topics, and also got them started ahead by issuing the textbooks and recommended preparation lists in advance.
- Another good change was two hour lectures instead of four hour lectures. The normal day now is two lectures in the morning; the balance of the day is free for assignments or study. The assignments are done in a dedicated Ryerson microcomputer lab (PC/ATs on a local Area Network connected to the Ryerson mainframe).

We set up a tailored environment at work, for the students were working on days that they were not on course. Department work schedules had to reflect the fact that students were absent from their department for 40% of each week—for two years. Or they could be entirely absent for eight weeks at a stretch. This absence affects not only workload, but also affects the scheduling of meetings and consultations with peers.

As well, Programming Fundamentals graduates generally required more management attention and help, because of the periodic absences, and the new environment in which they are working. The students' managers must be supportive, even while the department is under pressures to meet tough schedules and cost objectives. In addition, the student must have a peer who substitutes for him during absences, a mentor to turn to solve technical problems, and schedule times for the normal ongoing vocational training that everyone in IBM receives as a matter of course.

It is important that the student doesn't suffer financially for taking these courses, so IBM pays all charges for tuition, pays extra travel costs, texts and materials, while paying full salary throughout.

Finally, the students have salary protection for up to two years during the transition period—after which they are evaluated and receive increases equally with their peers.

Probably most important, the students made major commitments too. The employee makes a significant investment in personal time for the homework needed to succeed, and is not paid overtime for this work. Full-time studies are harder on those with families—and those who have lost the habit of studying. Some students, by the time of the follow-on education, became critical of the investment in personal time demanded for success. However, almost all recognized the unique opportunity to advance their education. Work ethic and peer pressure proved to be substantial motivators. Finally, the student's letter grades attained are translated into IBM performance ratings, weighted for time spent on course, so superior grades do have an effect on salary.

For those students who want to further their education beyond CSC, IBM has a Tuition Refund Program. It allows those interested in proceeding on their own time, say to a Computer Science Degree, to be fully reimbursed for that education too.

Let me mention a few results of the CSC program. As you would expect, not all students succeeded; but those no longer in the program have all found a niche in IBM where they are gainfully employed. So far, 15 who started the full CSC program of 9 credits, have withdrawn or failed (22%).

However, for the balance, results to the end of the most current semester are excellent. Fifty-seven students have completed 113 in 10 months, and 35% of those credits have a Grade Point Average over 3.66 (A-, A, A+). The instructors have confirmed to me that they have in no way lowered the bar, and that they are very satisfied with the results.

Lessons

We have learned a great deal, and here are some things we would improve on the next time if needed:

- Each student should be sponsored by a specific manager who will receive him into his department on graduation.
- There should be a strong procedure to manage the selection of students; specifically, rigid adherence to a list of criteria such as a strong sustained performance record, mathematical skills, aptitude, and a technical background or demonstrated interest in computers. Final approval should be given by a selection committee to ensure consistency.
- Education needs to be an ongoing process; there are fewer job opportunities for the unskilled as technology tools reduce the number of lower-skilled jobs.
- We must set realistic expectations for candidates up front concerning workload, commitment, challenge, and competition. We need to reinforce the fact that people who do not compete limit their opportunities.

Results

Yes, the retraining is definitely worthwhile. This one solved a staffing problem, and it worked. We have a success, and IBM will have a good return on the investment. Two end results are going to be skilled software developers on one hand; and on the other hand, we found jobs for all the other employees with various levels of software skills to work in less technical jobs.

"Would we do it again?" Definitely we would; and we would customize it to fit the time and the candidates. And, in summary, we feel that the Ryerson experience is a mutually beneficial and complementary program. Business and university cooperation certainly is viable.

IBM Canada Certificate Program Video

This was created in June 1988 for distribution to TV news. It was picked up by numerous stations so perhaps you caught it on your favourite newscast.

Appendix: Video Text

TEXT FROM THE TELEVISION NEWS RELEASE

IBM CERTIFICATE PROGRAM. DATE JUNE 7, 1988.

Larry Achtemichuk, Director of the IBM Canada Laboratory:

"Like many companies, IBM finds itself going through some restructuring and changes in its business: in order to be more competitive, in order to react to new technology and so forth. Last year, several IBM functions in Canada found themselves with shortages, and we needed more people in order to accomplish all our workload. So, with the help of Ryerson who put together a formal training program we were able to retrain and redeploy over 100 people."

Announcer:

"Survival and growth in today's marketplace have made it necessary for many companies to reorganize their operations particularly in response to new technology. This restructuring means *change* for the people working in the new environment. Many companies lay off people, and hire others in response to these changes. But one corporate leader has taken a more innovative approach. IBM Canada has chosen to retrain its employees to upgrade and update their skills, and IBM has even created its own Certificate Program to do that.

Since it was formed, IBM has been a company committed to full employment. An IBM employee can expect to have many different careers within the company as it grows. The employees selected for (this) retraining participated in a seventeen week course taught at the Centre for Advanced Technology Education at Toronto's Ryerson Polytechnical Institute. For some, the adjustment to being full-time student was a difficult one. John Panhuyzen had been out of school, and working for IBM for 30 years, when he began the retraining program which would enable him to move into software programming. IBM and Ryerson worked together choosing 9 courses from Ryerson's Computer Science Degree program to create a certificate program tailored to IBM's needs. This spring, over 100 employees will begin a two year part-time program at CATE. There might have been easier solutions in the short-term: laying off people or hiring those already qualified to do the job. But IBM says you can't put too high a price on the knowledge, experience, and insight into company's needs that employees gain through the years. By investing in its employees, IBM believes it is investing in its future."

Part F

Intellectual Competitiveness: A New Realm for the Information Age

Canadian Communications Policy for the Twenty-first Century

Jim Edwards, MP
Parliamentary Secretary
Department of Communications

The themes which you are discussing—globalization, innovation, diffusion and retraining—rank very high on the government's agenda. We are determined to succeed in meeting the economic, social and cultural challenges created by information technology. Certainly there is no lack of talent and expertise. Canadians have the imagination, skills and entrepreneurial drive to succeed in the global economy as our long history of proud achievements in communication and information technology clearly shows. In the last few years we have worked hard to develop policies which recognize and support our strengths, policies which look forward to the new frontiers of the twenty-first century.

To lay the foundation for this initiative, measures were put in place that would free Canadians to compete in the markets of the future, both at home and abroad. The Free Trade Agreement negotiated with the United States opens the world's largest, most dynamic market to Canadian entrepreneurs. It also sets a standard for free and fair dealing that will hopefully be matched in other bilateral and multilateral trading agreements.

The National Science and Technology Policy, jointly adopted by the federal government and the provinces in March, 1987, directly addresses two of Canada's most serious problems—the weakness of our national R&D effort and the slow rate with which new technologies are taken up by Canadian industry. To accelerate the development of strategic technologies and promote their diffusion across the economy, the government created a new department of Industry, Science and Technology, to lead federal initiatives in these fields.

Finally, to ensure that all Canadians have fair and equal opportunities to acquire the skills they need to participate in the information economy, the Canadian Jobs Strategy was established.

The record speaks for itself: in four years, four major policy initiatives for the four themes of this conference. As commendable as the record is, though, I want to suggest to you today that there is room for improvement. The keystone is missing—one element required to hold all the others in place. Without a communications policy for the twenty-first century, there is every danger that the other commendable initiatives taken by the government will not achieve their full potential. Let me explain. Communications technology has created new global realities we are all attempting to understand.

First, communications technology has unified the world economy by linking currency, commodity and security markets in round-the-clock, real-time trading systems.

Second, communications technology is driving scientific innovation at unprecedented speed. The chain reaction breakthroughs that occurred around the world last year in super-conductivity research would have been impossible if scientists had not been linked through computer networks.

Third, in many industry sectors, communications technology has reduced product life cycles from decades to years, or from years to months.

Fourth, there is an urgent need to teach computer and communication skills to both children and adults and to use these technologies to make teaching more efficient, productive and more widely available.

Every other industrialized country has recognized the role that communications plays in creating the world of tomorrow. They have updated and, in some cases, drastically revised their communications policies, laws and regulations to prepare the way for the future. Without exception, they have sought to modernize their basic communications infrastructure and ensure that it remains under national control. At the same time, they have opened their systems to the forces of global competition in the development of new communication services.

In Canada, we began the work of reforming our telecommunications policy in 1987. In July of that year, the Honourable Flora MacDonald announced a new telecommunications policy to guide the evolution of our system towards the twenty-first century. This policy proposed the creation of two new classes of telecommunications undertakings—Type I carriers, which would *own* basic transmission facilities, and Type II, which would *lease* those facilities to provide value-added service.

The framework also proposed entry and ownership rules for each of these classes of carriers. These rules, which were subsequently incorporated into the Free Trade Agreement with the United States, ensure that Canadians will retain ownership and control of their basic telecommunications infrastructure, an essential requirement of national sovereignty in the information age. At the same time, in order to encourage innovation, free and open competition will be allowed between domestic and foreign providers of enhanced services.

In 1987, we also initiated debate on the last major communications policy issue still outstanding in Canada—the question of whether or not competition should be allowed in public long distance voice services. A study of this issue was undertaken jointly by federal and provincial regulators and the results published in November 1988. It concluded that, on average, long distance voice competition would lead to only modest increases in local rates, with some regional variations.

The main issue that remains to be resolved before a new telecommunications policy can be introduced on a national basis is the question of jurisdiction. Regulatory responsibility for telecommunications has historically been divided in Canada between the federal government and the provinces. The result has been a patchwork of conflicting policies and regulations, with more competition permitted in service territories regulated by the federal government and less in areas regulated by the provinces.

This situation has fragmented markets for equipment and services, inhibited innovation, and worked to the detriment of some regions.

Discussions with the provinces aimed at securing agreement to a common set of rules that would apply everywhere in Canada have unfortunately broken down. All parties are now awaiting the decision of the Supreme Court of Canada in the case of Alberta government telephones versus CNCP telecommunications. This decision should clarify which level of government has jurisdiction over telecommunications and in what circumstances it can be exercised.

With these questions settled, Canadians will be able to get on with the important job of building the electronic superhighways of the future, the systems necessary for us to promote Canada's economic, social and cultural growth in the twenty-first century. Whatever the courts decide, we can anticipate one indisputable fact: the communications media of the twenty-first century will be very different from the media of today.

From the average user's point of view, there has been dramatic change in the use of media in the past twenty years. This is true whether we are talking cellular telephones, FAX machines, interactive computers, cable and satellite television, films, videos, data banks, newspapers or

magazines. The list is endless. Twenty years from now, our latest innovations will have changed out of all recognition as will the role of the new media in the information economy. These changes will result from one of the most significant technological trends of our time—the convergence of computer and communications technology. This trend began some twenty years ago when Northern Telecom became the first company in the world to computerize its telecommunications equipment.

Today, the fruits of this marriage have given business and residential customers access to a wide range of advanced telecommunications—everything from automatic dialing and call forwarding, to electronic mail and voice messaging, to cellular fax and telephone, to high speed data and satellite broadcasting.

The convergence movement gathered steam ten years ago when the personal computer arrived on the scene. Industrial designers, graphic artists, musicians and movie makers quickly grasped the extraordinary powers of the PC and the MAC. The results are changing the landscape of cultural creation, whether we are talking CAD/CAM systems, musical synthesizers, three-dimensional simulations, desk top publishing, computer-generated animation, special effects, or video games.

Today, we stand on the threshold of a third wave of convergence between computers and communications. New systems are being devised that are capable of carrying any kind of message—whether it is expressed in sounds, words, numbers, or images—or all of them simultaneously. Imagine a system with a screen so clear that it can display text with the same resolution as a high-quality magazine and be constantly updated as news is written by journalists around the world. We could browse through electronic shopping malls, call up movie reviews before ordering a film, or respond to an ad in the personal column. That's the quality of system on the horizon, one that combines in one easy-to-use package the features of all today's major media. Systems of this kind have been referred to as the "new media" because they provide us with ways to communicate which the world has never experienced before.

This third wave of convergence is bringing formerly distinct businesses into direct competition with each other. Ted Rogers, the head of Canada's largest cable television operations, has announced plans to compete with Bell Canada in providing local and long distance telephone service. Jean de Grandpré, the chairman of Bell, has countered by saying that he would like to compete with Rogers in delivering cable television service. This is only one of the many corporate battles that will be found in Canada and throughout the world for control of the information and entertainment industries of the twenty-first century.

We have already seen alliances and empires begin to form. The recent merger in the United States between Time and Warner Communications was a direct response to incursions into the American market of foreign media conglomerates, most notably those controlled by Robert Maxwell and Rupert Murdoch. Fibre optics, high powered satellites, computers and databases that store every conceivable kind of cultural product are part of the arsenal that will be used to wage these global conflicts.

Fundamental to our being able to use these and future technologies is the growth of our research and development capabilities. In March of this year, the Department of Communications hosted a conference in St. Sauveur which attracted the largest gathering of senior people in the field of communications research since the early 1970's. "Search 20" was the first step in the formulation of a communications research and development strategy for Canada. Conference participants worked to identify a focus for Canadian communications research and development and determine the mechanisms, infrastructure and programs that would provide the best results in public and private sector R&D investment in that area.

The Minister of Communications compared our per capita R&D spending on information technology with some foreign countries—the Americans spend nearly $100 per citizen, Germany over $80, Great Britain $50 and Canada less than $20 per capita. Mr. Masse challenged the participants to help the government of Canada position our country to succeed in the global information economy of

the future. While engaged in this task, we must maintain our cultural integrity and identity. Competing in an increasingly inter-dependent international market makes it imperative that we retain a strong sense of the ideals, values and aspirations which we share as Canadians. Vision 2000, which emerged from the conference, calls for a personal productivity network, tailored to the individual, which will create economic, social and cultural wealth and, at the same time, assist us in nation building.

Participants also saw a need to reform the current regulatory environment and establish mechanisms and processes for collaboration and development. Aware of the resources and commitment other economies are investing in projects such as high definition television (HDTV), conference participants concluded that time is short if we are to position ourselves to exploit the opportunities of this new technology. The action plan developed by the conference called for workplans and detailed studies by September 1989, a follow-up conference in, and the completion of studies by November, 1990. Government action would follow shortly.

Canadians will face many difficult challenges in attempting to harness the explosive power of the new media to our national purpose, but one stands out above all. Speaking in the house of commons on April 14, 1989 in the debate on the throne speech, the Honourable Marcel Masse, Minister of Communications, noted:

> At a time when there is a tendency among the nations of the world to regroup in large economic units, when borders established in the 18th and 19th centuries are being erased to allow for the necessary circulation of goods, services and information, creators and artists, whom we may have taken for granted in the past, are now becoming increasingly important to their respective communities.
>
> We are entering the information society, which throughout the world is bringing about a sameness in our goods and services. Creators, however, are doing the exact opposite. They explore, search and experiment and, in so doing, express what makes them and what makes us unique. Our identity is reflected in their works.
>
> How to reconcile this development of our authentic cultural uniqueness with the imperatives of the information society is the most important challenge we have to meet as Canadians.

Mr. Masse was speaking to all Canadian creators, not just to artists but to scientists, engineers, entrepreneurs—to all of us involved in the creative process of trying to build a stronger, better Canada for the twenty-first century. We cannot harness the benefits of the information society to our full advantage and also retain our distinct identity as Canadians without a first-class communications system that supports our economy, strengthens our society and, above all else, enables us to say who we are, to each other and to the world. In the information age, a strong sense of identity is imperative for individuals, communities, countries and, at the end of the day, for humanity as a whole.

Information Technologies: The New Global Realm

Geraldine Kenney-Wallace
Chairman, Science Council of Canada
Professor of Chemistry and Physics, University of Toronto

This has been a very broadly based conference on Information Technologies and one characterized by a very lively discussion. Facts have flowed, models have been carefully measured, policy issues have been aired and bottled up. Sometimes they disappeared and sometimes they were buried. Mythologies have appeared and they were both celebrated and denigrated. But then they are *our* myths and that is a very important point to remember. Society is shaped by its myths and warrior-heroes. As we all leave this conference, what were the myths, assumptions, or models with which we arrived? What ideas are we leaving with, ideas that will have changed the way we think about information technology? Information technology is no longer a sector but a way of thinking, living and being in the 21st century. Indeed, it has already reshaped the world that we are living in now.

Globalization and diffusion of technology depend on success, on innovative ideas, on education and training. We have explored all of these. Perhaps I could give an executive summary of the conference in the form of a cartoon. Imagine a group of people in a computer-based laboratory, with computers everywhere, and one person is saying to another, "The great thing about the information age is that people don't have to know anything!" I say that the singular message from this conference is that such an attitude is absolutely wrong. People have to know more. Knowledge is the driver of the future.

I am going to give my conference overview in three parts: first of all some personal reflections, that you will recognize; secondly, some questions which you must answer; and then, thirdly, an action plan. How about turning all of this good advice and energy into action? I am not giving the information technologists direction, but issuing a challenge. What is your vision? What are your goals? I will leave you at the very end of my talk with the same words again. A goal is a vision with a deadline. Precisely what are your plans as you leave this room, as we leave this decade. What are *you going to do next?*

The issue of today is competitiveness. Intellectual competitiveness and economic competitiveness are intertwined in the new cultural realm. I want to talk about A New Realm for the information age. Very briefly, that is because I do not believe that this is the first information age. It was just as much an information age in the pre-agricultural or stone age, the time of hunters and gatherers. Those who knew where to hunt and gather had the power, they had the information, they controlled the food supplies. Because of the explosion of computer-power, *what you need to know*, and *how you acquire it*, is totally different now; thus our period of history is called the information age. May I, with your permission, call it *A New Realm*, and then let us examine and reflect upon the characteristics and the features of this microelectronics kingdom.

Some of the reflections are going to be musings, and I am going to trace what I heard to what I did not hear during the discussions, the surprising silences. I believe we are really dealing with the most revolutionary and evolutionary of human activities: the management of transition and change.

To accomplish this we are realizing we must go beyond the borders, beyond the bounds of conventional wisdom, beyond the bounds of isolated academic disciplines, or science and technology, beyond the old divisions of private and public sectors. This is the new realm. Beyond the border everything is getting foggy, lines of demarcation and responsibility at first sight seem blurred. The old rules do not always work. I hope fuzzy logic algorithms will work but not fuzzy thinking, because if we are not clear in our goals, in what we see, we are not going to ask the right questions.

The bounds of time and space are collapsing. Stock markets communicate around the globe in nanoseconds ($10s^{-9}$) and Voyager II, launched a dozen years ago, will soon leave our universe as this remarkable space probe exceeds 4.6 billion miles and passes Neptune on its way to another universe. I am particularly focused on space and time in the new realm because these are the frontiers of research today. I could give you a femtosecond ($10s^{-15}$) summary of what is happening as a pulsed laser waveform carries information while it propagates down the kilometres of fibre optic cable, which link our continents and computers. That is your morse code for the future. The new realm is digital, but culturally we seem analogue in response. In the research world, we are trying to understand what happens to the optical material at the atomic level because the atoms and molecules influence or scramble those pulse waveforms. I am both intellectually engaged as well as philosophically fascinated by the potential of these microscopic molecular morse codes and molecular storage devices. This is the holographic image of nanotechnology—indeed a picoscopic world.

Because of this collapsing space and time, our geographical and intellectual borders are becoming invisible by rapidly changing political, economic and technological facts. The most important one, of course, is the rapidly changing economic dynamics. Globalization of economies as international markets develop and protectionism disappear resembles a new theory of plate tectonic shifts. Old trade routes become frozen into the strata. Continental strategies are subtly distinct, but they are nevertheless embedded in global dynamics. Networks and neurons are constantly moving in an integrated embryonic world system, of which each one of us, consciously or unwittingly, is part.

Another feature of the new realm is the decentralization of decision-making, of manufacturing, of work, of education, of culture. Spin-off businesses emerging from parent conglomerates resemble biological metastasis. Mergers and acquisitions resemble the fusion processes in the sun: hot but inevitable. With changing ownership of firms, and court decisions of ownership of patents and intellectual property of that firm's knowledge, I began to think about the origins of the Magna Carta.

In an earlier age, there was a village common, and I began to think again about a global commons. The new realm must have a global commons, around which the world's electronic cottage industry is clustered. Who are the squires, and who lives in the mansions behind the cottage industries? Who makes the decisions? There are, in the Magna Carta, some very ancient rights. One of them is the right to sunlight. This ancient right has been used fairly effectively in Toronto to stop the commercial push behind the highrise expansion of the turn-of-the-century, residential Annex in the centre of the city. The right to sunlight means the right to have sun on your crops, sun for your clothes to dry. Highrise buildings cast long shadows. The other ancient right was the right to grazing on the village common. Cows, sheep, horses, the common land was the production means for meat, milk, wool and leather. These were attractions that caused people to settle down around the commons, in the village as society became decreasingly feudal. Is there going to be a commons in our new realm of the information age? How attractive is that global village? Who is going to get access to the commons? Who is going to be able to graze? Where is the sunlight? Where is the transition of public good to private good? What is ownership? Ownership of the frequency spectrum, of space, of deep ocean floors, of the environment must all be considered. These are very interesting and important questions which I pose to you.

The same issues in a different context take us back to intellectual property: who decides when there is a transition from protected patents to public know-how? Without protection of intellectual property, which I predict will be one of the key issues in global trade and technology in the coming decade, are we ready to handle the competition? I was curious to look at the history of intellectual

property. A little bit of homework takes one to Article 1 in the original Constitution of the United States. The name of the first patent general officer of the United States was Thomas Jefferson. That is a clear sign of how important patents were then. Patent interest faded somewhat over the decades but now the need is back again. Patents, trademarks, research proprietary data and a whole wealth of software and literary copyright issues fall under the contemporary umbrella of intellectual property rights. How we handle these issues is going to be the answer to the "Global Commons". There are some very important questions which can be raised, but I have not heard them nor any answers as to how they are going to be treated in Canada, or in international society in general, from the perspective of public versus private good.

Without intellectual property, specifically patent rights, few in the private sector or the universities will invest time, money and people on a new project with a high degree of risk. There must be an incentive. A return on investment is absolutely critical. Where is the common good? Is that another invisible border right now? I suspect that it is, but we need to recognize these issues of intellectual property rights in the context of an age whose economic dynamics are driven by the twin engines of technology and trade. Intellectual property then becomes a key issue in science and technology policy, whose impact falls on diplomatic as well as trade discussions. We have to work in concert, and not just individually, because the times have changed from both a global and, in Canada, institutional perspective. Communications is the mandate of the Department of Communications (DOC), Technology of Industry, Science and Technology Canada (ISTC) and Trade of External Affairs and International Trade (DEA). Who coordinates policy in a coherent and competitive fashion, to ensure that interdepartmental mandate issues of the 20th century do not dominate the greater challenge of a national strategy for the 21st century?

Let me move now to the second part of my talk, and discuss some of the social topics that surprisingly I have not heard.

What will we do in a world where the books and the centuries of knowledge stored in the USA Library of Congress, or the National Library in Ottawa, or the Bodleian, library of Oxford, are to be retrieved from a space the size of a sugar cube, because of optical information storage and magnetic information storage techniques? Who has access to the sugar cube? What are we going to do when we can get information out of that sugar cube with a speed that matches or exceeds human responsiveness? There is no time to reflect on what we will do with this information. Do we need the information? Are we driven by needs for information to act, or by need for information to have in case we need to act? What is the rationale for such mega-storage in space or the nanosecond retrieval in time? When will we saturate in information storage, retrieval, response or even motivation to know and learn?

What will we do when clinics and hospitals are routinely operating in the optical transmission regime? Three dimensional holographical images will be sent from hospitals in Vancouver, Edmonton, Montreal or Toronto to specialists in cardiac or genetic medicine in London and Paris, Atlanta and Tokyo. Patients and doctors and all the health care practitioners will consult and advise, on a "global Medi-Net". Who is thinking about the access to treatment or liability concerns of such decentralised advice on medical issues? Who analyses the public versus the public goods, under such multinational circumstances?

What will we all do when the crystal sharp images and perfections of high definition television (HDTV) make the real world seem a little blurred? Compact discs and digital audiotapes have changed our hearing of music. We demand a clarity that is often not heard in a concert hall of real-time performers and reverberating walls. The studio product is perhaps more perfect but not necessarily more real. Are we going to try to image-enhance nature? What will we do with optical computers? Will faster computers help us make better decisions? On what would we be making decisions? SDI, or simulation of Global stock market Change or global Climate problems? The optical computing will merely allow us to do what we are doing now, possibly thirty times faster. But will we do it better? What will we do when robots have three dimensional vision as in yet unmatched

biological recognition? They now can pick up an object but not fully see and feel. Neural networks will permit us to synthesize ideas and arrive at places of thought, where the dividing time between the reality of now and science fiction makes us question our point of reference. Do we understand ourselves enough to cope with this? I am very excited about these new frontiers of human and technological experience, and so is MITI in Japan. It had a line item for neural networks in its budget since at least 1988. These things are happening and they are happening now.

What will be the impact of world-wide, machine translation through optical electronic and information technologies? Will it be as profound as the Gutenberg Bible? If we can just optically scan another culture through its written works, and read in our own language the results, our horizons are dramatically broadened. Of course, there are going to be linguistic jokes, along the theme of "the spirit is willing and the flesh is weak". But that world is imminent and those translation machines are there in more than a primitive form. The problems to solve are ones of software, language and memory, not optical technology.

I hope that fuzzy logic is going to dominate and enhance the speed of our enormous calculations, and not fuzzy thinking. But we have to be sure. Will acronyms for standards and software in the information technology business become longer than the alphabet? Will we have court cases that are longer than the product life cycle? Will we innovate, or are we going to litigate? My question, in summary, is whether or not the human software is up to the competitive challenges ahead. A goal is vision with a deadline. What is your vision in information technology? Your vision must be, however, a very broad one, because it is really a vision of the new realm to which we are moving at the speed of global human innovation.

Let me return to the twin subjects of intellectual property and doing business. I believe that in order to do business effectively, you really have to understand the culture of the people in the broadest possible sense. I could not help reflecting ironically that our cultural ethos in Canada appears to be such that sometimes we cannot even do business with ourselves, let alone with other countries. I am referring to the inhibitory practices commonly grouped under the heading of inter-provincial trade barriers. This is coupled to the quintessential Canadian identity problem that prevents a rich and full national identity. As a quintessential Canadian who has come from somewhere else, I challenge you to forget these barriers of inferiority and 19th century protectionism and have confidence. Get on with the future knowing with confidence who you are. We, in Canada, must learn to cooperate nationally in order to compete internationally. We have to ensure that provincial and federal regulatory practices, for example, offer genuine opportunity for new markets and competitiveness not merely act as a disincentive or a legal barrier to opportunism and what others ideologically perceive as monopolism. That cooperation for R&D ventures underlying new commercial markets might well be manifested as a consortium of private sector firms, or firms and university laboratories, whose geography crosses provincial, national and even international borders. Who gets the credit? Between assigning profits against taxes, financing and intellectual property rights, or assessing fiscal liability for loss, the legal situation could be complex. However, each day brings a new example of such prototype ventures and with the information technologies providing the communications networks as the physical glue that binds remote locations, strategic alliances can be readily set up if the motivation, corporate will and rewards are quite visible. However, when does a consortium become a cartel? And who decides?

While indeed the changing market share conditions and profit status are part of the set of criteria to be used in the decision on a monopoly position or cartel—what about monopoly government? From this line of enquiry I began to wonder: How does a policy grow up? What are the sunrise and sunset clauses of policies that once upon a time created winners and losers in a different world order, or in national or sectoral economic flux. These have a temporal quality, and yesterday's winner in a different socioeconomic climate may look like today's loser. When is it necessary to have a policy-driven kick start to enter a market, a policy to secure a market for the prototype such as procurement, for example? Creating a temporary monopoly for a short period of time may be justified to launch a strategic technology, such as digital switching. Intellectual property rights must be clearly perceived

to be favourable in order to stimulate R&D investment, such as the pharmaceutical and biotechnology industry long argued in Canada prior to Bill C-22. Eventually product and processes appear. Maybe they go to world markets directly (if world product mandate is in place) and this is a public good in terms of wealth creation and jobs. People with jobs pay taxes; there is flow coming back in revenue to the public purse from the "monopoly" firm. But at some point this position moves into that of the private good. We then start talking about the need for deregulation, the fact that tax dollars are going into somebody else's pocket, and so forth. We argue for change, and demand the firm open up to genuine competition. International competitiveness in the 1990's appears to be an enormous swirl of commercial activity, eddy pools in which the currents of former public good/private good arguments are too fast moving for the old policies to make the same sense. We need a mechanism for policy renewal, for pragmatic assessment on a regular basis, *without* the disruptive consequences which result from inconsistent policy.

These are very complex decision-making issues. Do all of the key policymakers understand today's dynamics of technology and trade, and the extraordinary competitiveness in particular of the information technologies as an enabling technology across so many other sectors? Do they apply old notions of private and public good? How are economies of scale superpositioned on economies of scope? How is increasing one's world market share (which needs viable international distribution networks) going to happen for firms in Canada when the cost and availability of capital or seed money is so prohibitive? Who looks at fiscal tax and regulatory policies to ensure that they are "au courant", future oriented, and that they do reflect our resource-based culture of the past or yesterday's economic surplus facts? How does a company grow up in Canada to become a multinational from that threshold firm? Mergers and acquisitions are a natural way of becoming part of the larger existing nationals and multinationals. The question is: How can you be internationally competitive in Canada and still be Canadian in terms of ownership, or at least have your corporate headquarters here? Foreign capital will always be needed, foreign ownership in some cases may be inevitable. We need performance in Canada, and our policies must put teeth into that statement. These policies influence the attractiveness of the climate for capital, management, marketing and the production of innovative ideas, of people with knowledge and smarts through investments in R&D.

Policymakers are climate makers. As an R&D scientist, I had little idea of how historically loaded certain phrases and words were in the Canadian policy world. In an R&D laboratory, within a university or government or private company we *plan* research projects with goals and reasonable time scales, have an intellectual *plan*, and a business *plan*, a *plan* for R&D strategy. Nature does not always show her tacit agreement with these plans and time scales, thus leading to the notion of serendipity and curiosity driven research. But even the most curious have to intellectually have a well thought out hypothesis and *plan*. It is easier to change tactics rapidly based on new evidence within a good strategy. I rapidly learned that, in the economic policy lexicon, plan has a Chaucerian flavour to the word. Using such a phrase as a *planned economy* produces visceral gut reactions and catechistic responses. Having learned the depth and weight of earlier policy baggage, let me throw the challenge back to all of you. What baggage are you carrying around that you might not realize? Who would disagree if I were to suggest that the old economic paradigms have indeed shifted, but some of our economic model assumptions have not. Let us move beyond the old policy "winners and losers" debate. Let us change the music, let us change the steps in the dance, let us learn to move in partnership to those economic rhythms that make pragmatic sense and wealth for the century ahead. If we do not, while we argue the debate, others will earn the bigger world market share.

Centuries of observations, hypothesis and continual testing have led to the establishment of profound and beautiful relationships correlating energy, matter, light and time which we encapsulate in the laws of nature, and our axioms. Nature has never heard of the science and technology models. Nature's laws are discovered or read by mankind interpreting the evidence. Scientists are used to having new evidence and rigorously assessing or refuting models of atomic and molecular behaviour. Does the market respond to very tidy economic models? The value of any model is that it gives a coherence to our thoughts, uncertainties and our conceptual thinking. Models allow us to correlate

unexpected events that we might not have seen otherwise. We can test and refute ideas. But in reality, human nature and human responses are very rich. We are untidy in our thoughts, impulsive, cunning, smart, lazy. It is not surprising that economic models cannot predict market confidence or mistrust! There are, however, some constants of the motion in this new realm of the information age. They are primarily linked to *needs*, to the demand of the clientele.

What do we need to do and know; how are we going to fulfil this need, in order to see accomplishment? These are the human motivators. During the conference, I reflected upon the human attraction, the instinctive sense of survival, and also of fairness. We are multidimensional, pulled by the drive towards prosperity, the inevitable greed and lust but balanced by the moral, legal and cultural imperatives to survive as a species, to survive in our new realm. *We* are the uncertainty in this model, although other assumptions may abound. Let me thus conclude my remarks and address the issue of turning policy advice into economic action, given the constraints of nature, the boundlessness of human action and human thought, and our personal uncertainty.

This is an action-oriented list that I believe far transcends action for the sector called information technologies. It is a generic 7-point list.

At the top of the list I would put *people*. Education, training, retraining, quality of education and life-long learning are building blocks for the new realm. Science, engineering technology, management, economics, languages and law are hallmarks of the leaders of the new realm, with interdisciplinary strengths and appreciation. Business and culture is all part of the training of the private sector strategists who will have understood not only how to do business in another culture, but how to fold in a cultural sensitivity, an understanding of the history, more reminiscent of international diplomacy.

In chairing the Canada-Japan Complementarity Study, launched in early 1988 at the request of the two Prime Ministers, I have been doing a lot of work with Japan recently. I was fascinated to find out through my Japan experiences that the Samurai were responsible for the educational system in earlier Japan. When they were not fighting wars, they had to find something honourable for the Samurai to do. Education became the key task. The values taught in that early education in Japan as part of the intrinsic response to their culture are now intergenerational. They have centuries of respect for education as a public ethic. In this country, when I hear so often how people and human resources are the most important resource that we have, how can I rationalize the lack of government initiatives in managing our own educational affairs? Education and training, skills, quality and life-long learning are also so important that they must play interesting and coupled variations on a learning theme. Why is it that we are so concerned about learning in society but we still have as many literacy problems as we do? I think that the real challenge in education is to rekindle the desire to learn, and in order to keep that motivation alive and fresh, the people must see the incentives, a personal reward for personal commitment.

My second point would be *ideas*. Research, whether long-term research in the universities (that is their scholarly mandate) or short-term targeted research, which may be found in consortia of university, industry and government, is the source of new ideas. "Partnership" means together one can achieve something a little faster than independently. Nevertheless, a focus on excellence in research, regardless of its time horizons, is essential because mediocrity is not a good argument for any venture. There must be also a balance between basic and applied research. Excellent fundamental research, must be the beginning of a chain or cycle of innovation. Technology transfer demands a smart receptor to take prototypes to manufacturing, where it is appropriate to be fully developed. We cannot rely only on what is already known in order to develop technological research initiatives, because the competitive edge means learning to run with the unexpected. That is one of the most important arguments for maintaining a core base in the country for basic research. Who knows from where the unexpected will come? Furthermore, we need to identify excellence and critical mass, and focus on fully developing our intellectual strengths. To focus on a few areas, we must still

be a smart employer of innovation, ideas and knowledge. If you know *what* you do not know, you will be a smarter thinker.

The third point is *opportunities*. R&D is an investment. R&D is equity. With information technology, all of the people involved are building substantial investment. How can you as a group of inventors and investors in information technology get this vitally important message back to the many other companies and industries and resource sectors in this country? R&D is equity and not debt. We have got to invest more in the future. You have success stories to show return on investment. As good corporate citizens, bring those success stories to a wider public to help stimulate entrepreneurship. From a public policy point of view, we are conscious of having to create a climate with incentives for entrepreneurship and for the sharing of risks where appropriate, and a climate for longer-term results through a continuity of policy.

The fourth point is *markets*. The markets are driven by globalization, the Free Trade Agreement, 1992 in Europe, the rapid expansions across Asia Pacific. What I did not hear in the debate was the U.S.S.R.. I was really surprised because glasnost and perestroika is being driven not by ideology but by economies. I was in Moscow last September. In various laboratories, they would say to me, what do you think of this machine? Have you seen some like this before?—a particular type of instrumentation for opto-electronics? And part of me wanted to reply, yes, in the 1960s, that is what such machine designs looked like then, rather old-fashioned. But the other part of me thought, no; with a quality of education and singleness of mind, and the absolute societal push that is evident now, this machine is going to look like the 1990s model in about a year or two. There is tremendous social, political and even spiritual change going on in the U.S.S.R.. None of us know how their new realm is going to turn out. They have eager, restless people, and people with ideas. Both we and they should be watchful even anxious for those markets, which are one day going to open up enormously. When I was in Moscow, I discovered with great interest that one of the U.S.S.R. senior science and technology advisors had just gone to Tokyo, and a senior advisor from Tokyo had just arrived in Moscow. There are several messages in that exchange. In Japan, of course, the principal focus is on getting the largest market share for the longer-term, not just the short-term.

I would like to move to my next and fifth point in terms of *time scales*. We really have to have a different view of the time scales of investment and return on investment in this country. A quarterly shareholders' time scale is for one particular set of accountabilities and responsibilities in a company. But it is neither long nor flexible enough for real results. The Japanese have what I think is a rather attractive floating phrase, because it does not pin you down in a digital sense. Of course some people might term "the day after tomorrow" legalistically awkward. But it is sufficiently flexible, it can stretch from a day to decades. Competitiveness is a dynamic concept. In the electronics business, the markets respond to one set of competitive time scales; there is quite another one if you are trying to put in a new chemical plant; and a third one if you have to go through reforestation. The new biotechnology however can genetically accomplish rapid growth. New technologies should make you realize that your time scales just collapsed, to a few months or years, and no longer is a hundred years the time for a developing nation's economy to emerge: witness the Pacific Rim countries.

I was talking to a senior vice president of a major Japanese company a few weeks ago. They invested about 9% of their sales for 1988 back into R&D, and that investment will go up again next year. What are their strategies in certain quite different areas? We were talking about times scales again and he replied tomorrow for electronics might be next month. The day after tomorrow might be 1992. Tomorrow for biotechnology however may be two or three years. The day after tomorrow is probably close to the year 2010. In other words, built into the strategic and corporate thinking is an understanding that you must match your time scales for investment and production, with that which you have to accomplish in the market place. All the infrastructure could be in place, but if the time scale is wrong, you either miss the opportunity or you try to force it before you are ready to run and be competitive in those global markets.

If you ask North American management on what their performance reviews are based, you are going to get two responses: quarterly shareholders reports and annual profits. If you ask the Japanese management on what their performance reviews are based and enquire about the role of an annual fiscal performance, they will look very surprised. They will say politely, why annual? The management are not driven by quarterly shareholder reports and the annual report. They expect their performance to be assessed not only on a continuing basis but also on the long-term, to match the time scales of the task in hand. A lower profit margin to achieve greater market share, and a long-term view, both amount to a sustained, single-minded strategy on western markets by three decades of technologically and market smart management in Japan.

My sixth point is the *cost and availability of capital.* The difference in size and flow between capital markets here versus capital markets abroad influence the time scales of response. Thinking about R&D as equity not debt, obviously in a climate where the control of the national deficit is the major policy issue in this country, is like swimming upstream. Thus it is time to also talk about the reallocation of existing funds, and spending smarter. There is already some discussion about where the $4.2 billion federal science and technology expenditures are invested right now. You will remember the substantial part of R&D investment in Canada is in the federal government laboratories, and relatively small amounts in the private sector and the universities. The universities perform about 23% of R&D on distinctly leveraged dollars, because full cost funding of indirect costs is not yet a reality here in Canada. The private sector is a reluctant partner in R&D in too many sectors, and seed and venture capital certainly does not appear in large pools, nor does venture capital like risk. And so, the reallocation of existing funds is essential to start new ventures, in other words, we need to search for more leverage and get more value-added results for our money. What should be the criteria by which such reallocation might take place? Who decides to establish risk sharing funds, built upon a public policy understanding that risk is tied up with capital flows and with management of technology? Here we go around the policy circle again. I believe it is people, ideas, markets, opportunities, and capital, all with technological uncertainty matched to the appropriate time scale for results, that describes the equation for global competitiveness.

In conclusion, I want to highlight a point which came up fleetingly. I want to add this as a grand finale: it is the care of environment. Let us all think and plan to act in terms of sustainable development. There is an enormous public commitment at home and there is an enormous global commitment slowly building up within the general concepts of sustainable development. The concept must be translated into measurable targets, not just poetry. Sustainable development in today's competitive environment seems to me to offer a phenomenal opportunity for that enormous umbrella called information technology to play a very important leadership role. As we see the visible merger of microelectronics, photonics, lasers, optical fibres, robots and artificial intelligence, it becomes quite clear that there is no sector untouched by information, thus enabling each one of us to perform in a superior way. Do we need national goals and targets to ensure we build on our strength in a coherent and constructive way, and do not fritter away the time and effort as the competitiveness time scale begins to collapse around us? Whether it is in education, whether it is in managing energy demand and developing more efficient uses of energies, or whether it is in heightening the awareness of forests and streams and wildlife, whether it is communicating by satellite, whether it is holographic imaging or communicating by sonar, *we must have an action plan.* Whatever it is, I cannot see a world without environmental peacekeeping at the core of global harmony.

The challenge I leave with you is to articulate your vision. What is your leadership role going to be? Goals are visions with deadlines and I think that this is an excellent conference to start bringing together an action plan, to take us into the New Global Realm with a shared vision and strategy.

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Canada's Information Revolution

edited by David W. Conklin and Lucie Deschênes

Canadians are in the midst of an information revolution. New information technologies have been evolving rapidly, causing changes in job descriptions, production facilities, management procedures, and decision-making processes. This information revolution is changing our way of life. It is also shifting traditional patterns of international trade and investment. Today's globalization process—with its intensification of international competitiveness—is placing greater urgency on ways to increase Canada's rate of technological progress. Both GATT negotiations and the U.S.-Canada Free Trade Agreement are adding to the threat of dislocation, for both corporations and individual employees, and adjustment has become a continual requirement. Information technologies have become a key determinant of Canada's future place in the world, and of the role of the individual within the Canadian economy.

Is Canada keeping up with the pace of change in other countries? What future developments shall we have to cope with? How can we stimulate and facilitate Canadian innovation? What should our governments be doing to support the adoption of new technologies? This volume contains answers from leading Canadian authorities on this subject.

For Canada to adjust successfully to this information revolution will require university-industry cooperation to support both education and research that will lead to productivity improvements. It will also require a much greater emphasis on retraining to assist individuals and their employers in developing the new skills necessary for new job descriptions. Public policies will have to be revised to better support the adjustment process, both for individuals and for corporations. This book analyzes Canada's information revolution, and it recommends specific actions to deal effectively with the challenges presented by this revolution.

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