SECOND THEME SOURCEBOOK

VOLUME ONE:

POLICY PAPERS ON COMMUNICATIONS FOR CANADA'S GROWTH

Prepared by:

Technology Policy Branch
Telecommunications and
Informatics Sector

May, 1986

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PREFACE

The papers that make up this volume are divided into three sections designed to raise the following questions for discussion:

SECTION A - ISSUES

- Why is growth a key issue in Canada and internationally?
- Why are communications and information central to growth?
- What factors condition Canada's response to the issue?

SECTION B - PRINCIPLES

- What approaches are useful for analysing the relationship between communications, information and growth?
- What principles should underlie Canadian policies and programs designed to link communications, information and growth?

SECTION C - PROPOSALS

- What should be DOC's policy and program priorities in the next two years for linking communications, information and growth?
- What should DOC's policy and program implementation strategy be?

Throughout this volume, the term "communications" is intended to refer to means for creating, processing, storing, transmitting or displaying messages, while the term "information" is intended to refer to message contents. The ambiguous term "software" could therefore fall into either category. If it refers to machine language, systems software, or applications programs, it is

"communications" in this definition. If it refers to a product analogous to the content of a book, newspaper, report, diagram or model, then it would be "information".

"Growth" is approached from an economic perspective and is viewed as the creation of new goods, services and employment opportunities which, when distributed by public or private sector mechanisms, provide individuals and groups with the means of achieving their goals for social and cultural development. It is neutral as to the content of these goals.

When the Department of Communications was created in 1969, it was given a mandate to "promote the establishment, development and efficiency of communications systems and facilities for Canada". In discharging this mandate, the Department's predominant concern has been to encourage the supply of communications goods and services through research and development, industry support programs, telecommunications policy, regulation of the radio frequency spectrum and the operation of government telecommunications. Since 1980, when responsibility for the federal government's arts and culture program was transferred to the department, it has also become deeply concerned with the supply of information goods and services, particularly through the cultural industries, but also through the more traditional forms of cultural expression.

For a number of reasons, it is timely to review this supplier orientation. Some of these reasons relate to profound changes that have taken place over the past fifteen years in the political and economic environment, both in Canada and abroad. Others stem from lessons learned through the assessment and evaluation of past departmental policies and programs.

The principal conclusion of the papers contained in this volume is that departmental activities must undergo a "Copernican revolution" in which the supplier orientation, so dominant in the past, is complemented and increasingly absorbed into a user perspective. The rationale underlying this conclusion is two fold:

- First, the strategic significance of the communications and information industries to the Canadian economy lies less in the direct consumption of the goods and services they provide than in the contribution these make, as intermediate products, to productivity and competitiveness throughout the economy, in the primary, secondary and tertiary sectors. This is a particularly critical issue as we enter an era of heightened international competition and move toward freer trade, both with the United States and other industrialized countries.

- Second, the instability of industry and market boundaries in communications and information creates significant problems for traditional approaches to strategy formulation. A focus on needs provides a method of analysing the hardware, software, system and service components of communications and information activities, identifying tradeoffs and substitution effects, and developing integrated strategies to benefit both users and suppliers.

These conclusions, which are derived from an analysis of general trends in economic and social science, are supported by a very extensive body of practical analysis undertaken in the Department of Communications in the past two years. Reviews of trends in communications and information technologies, the contribution of communications and information to the Canadian economy, the results of major departmental policies and programs mounted over the past fifteen years, and Canada's historical experience with communications and information all point to the same general conclusion - that the focus of departmental activities must shift from supply to use.

Although this change in perspective raises a number of important and difficult issues, there is encouraging evidence in the areas of research, industry support, telecommunications, regulation and government operations that work has begun on this strategic shift. If there is broad public and political support for these new directions, the main task of the next two years will be to complete these tasks and to launch new initiatives to complete and firmly implant the user orientation in communications policies and programs.

It is important to note that the scope of this volume is limited to questions surrounding the development and diffusion of communications, technologies, products, systems and services, and the use of information as an "intermediate" product to achieve economic, social and cultural goals. Questions relating to the production of "final" information goods and services are therefore excluded from the present review.

OVERVIEW OF PART A

ISSUES

This section contains three papers:

- The first, "The Global Policy Environment" attempts to outline at a very general level why growth is a key short- and long-term issue for industrialized and developing countries alike and why communications and information are central to this issue.

- The second, "Communications, Information and Growth: Patterns and Linkages", sets out one possible framework for analysing the relationship between the three factors.

- The third, "Communications, Information and Growth in Canada: Past, Present and Future" outlines the main features which have typified the relationship of these three factors in Canada's past, and describes our contempory challenge.

THE GLOBAL POLICY ENVIRONMENT

1. Economic Transformation

The past decade has seen profound changes in the world economic order.

The successive waves of inflation and recession triggered by the oil shocks of 1973 and 1975 shook the economies of industrialized countries and dramatically altered the policy agendas of western governments. As their economies ground to a halt, unemployment rose and government deficits soared, the leading industrial powers grappled for measures which would halt recession and restore growth.

At the same time, the crisis engendered by the oil shocks focussed the attention of industrialized countries on structural changes taking place in their economies and in the world economic environment, changes which had important implications for their long term growth and employment prospects.

- One of the most significant of these factors was the increasing interdependence of the world economy. The rapid expansion of international trade in both goods and services in the post-war period, the growth of multinationals, the increasing volume and speed of international capital movements had "globalized" the world economy to a very considerable degree. The principal effect of this change was to make it impossible for any country to solve its growth and employment problems, in the short or longer term, in isolation from its international partners.

- Important changes in the structure of industrialized economies, which in most cases had begun twenty or thirty years before, became a matter of widespread recognition and concern. The progressive automation of primary and secondary manufacturing in developed countries - which entailed the shift of most new employment opportunities to the services sector of industrialized economies and to labour intensive manufacturing off shore - raised concerns about how jobs and wealth would be created

in a "post-industrial" or "de-industrialized" society. Even the strongest proponents of the "information society" could not entirely quiet these concerns, particularly given the success of Japan and other Pacific Rim countries in penetrating western markets for both capital and information intensive goods. Restoring the competitiveness of established industries in the new global environment became a central concern and recognized as an essential element in restoring growth.

- In all industrialized countries, the thirty year wave of prosperity that came to an end in the late 1970s was accompanied by fundamental changes in the relationship between the state and the economy. During this period, governments took ever growing portions of national wealth to fund services for their citizens, and increasingly intervened through a variety of means in goods, services and capital markets, in pursuit of a wide range of policy objectives that were not always entirely consistent. The economic crisis raised questions in every country about the scale and direction of government intervention and its effect on economic growth.

- The role played by science and technology in effecting economic and social change also became the subject of widespread recognition and concern at this time. As people sought explanations for the profound economic crisis of the industrialized countries, the part played by technological change in the mercantile and industrial revolutions seemed to provide promising analogies. Economists joined historians in exploring how "core technologies" affect economic and social transformations. Communications and information technologies attracted particular attention, since they were so obviously linked to the changes that had taken place in the economic and social order of the world. The rise of trade, global economic interdependence, the automation of primary and secondary manufacturing, the development of the services sector, and the growth of "big government" - all were directly related to developments in communications and information technology.

- The significant role played by technology in the restructuring of industrial societies raised questions about the ability of individuals, organizations and institutions to adapt to changes that potentially involved a profound cultural transformation affecting both work and leisure, as well as the economic and social changes that were becoming visible for all to see. At the heart of this cultural transformation was a rapid expansion in the need for information and the capacity to create it in all fields of human endeavour. In this sense, the oil shock was deeply symbolic. Energy was the key strategic resource in building the wealth of industrial nations, and energy precipitated a general economic and social crisis in these nations. The more carefully people examined the causes and consequences of this crisis, the more apparent it became that, in future, information would begin to substitute for energy as the key strategic resource for economic and societal growth - just as energy gradually substituted for the forces of nature in the transition from agricultural to industrial society. This implied that people's ability to create and use information in the pursuit of their economic, social and cultural goals would be the prime determinant of future growth. This in turn had major implications for the whole process by which individuals are acculturated - education, training, patterns of work and leisure time pursuits - and introduced a new set of very complex variables into the growth equation.

2. Global Implications

The concerns of the industrialized countries for restoring growth and ensuring their future competitiveness were situated in a larger picture:

- The economic prospects of the developing world were equally affected by the oil shock and the period of inflation and recession that followed. A number of countries, particularly in the Middle East, profited directly from the dramatic rise in prices and accumulated large stores of capital whose subsequent investment in Europe and North America has significantly altered the pattern of economic power in the world. Others profited indirectly as labour intensive manufacturing migrated

from industrialized countries, where it could no longer be done competitively, to the "newly industrialized countries" of South America and the Pacific Rim. Still others profited not at all. Much of Africa remained mired in poverty and actually lost ground over the decade, the victims of rising costs for energy and manufactured goods and falling demand for primary products.

- The worldwide preoccupation with restoring economic growth diverted the attention of developed and developing countries alike from some very basic issues relating to the quality of life on earth which had become subjects of international concern during the period of pre-shock prosperity. Concerns for population growth, the production and distribution of food, the quality of the natural environment, the husbanding of non-renewable resources, global literacy and respect for cultural differences advanced very little on the global agenda, particularly where these concerns appeared to conflict with short-term economic imperatives.

- The preoccupation with economic growth - which focussed the attention of industrialized countries on butter instead of guns - contributed to a period of relatively stable superpower relations and the military and political fronts. However, the inability of global institutions to sustain growth and to redistribute some fair portion of the world's wealth in the satisfaction of basic human needs contributed to continuing conflict at the regional level. Ironically, instead of contributing to a lessening of international tensions, the recovery experienced by industrialized nations in recent years seems to have had the opposite effect. It has given the superpowers the economic margins required to become more actively involved in regional conflicts and to drastically raise the stakes in the global game of deterrence and defence.

3. Political Response

In general, industrialized countries have followed a two-pronged strategy in responding to the economic crisis triggered by the oil shocks of the early 1970s:

- In the short term, they have relied on restrictive monetary and fiscal policies to combat inflation and reduce government deficits, at the same time as they have encouraged the private sector to combat recession and restart the engines of economic growth through selective use of tax incentives and reduced government intervention in the marketplace. Although causal relationships are never clear in economics, this strategy appears to have succeeded with inflation down and growth up in most countries. International trade is once again booming and the protectionist defences which many countries erected in reaction to the recession, if not universally breached, are under attack on a broad front. In a worrying footnote to this generally healthy picture, unemployment remains unacceptably high in most industrialized countries. It is as yet too early to anticipate the general impact of the recent collapse of prices for energy and agricultural commodities, although it seems evident that they will have important repercussions for at least the Canadian economy.

- With respect to longer term, structural concerns, the response to the industrialized countries has been less uniform and less clear. The industrial powers have, without exception, made significant attempts to analyse the structural questions outlined in the previous section. In some cases, governments have adopted a proactive stance and launched policy initiatives on the results of this analysis, aimed at equipping their people with the technological and institutional resources required to grow and compete in the emerging international order. Japan and France are perhaps the leading examplars of this approach. In other cases their response to the prospect of profound structural change has been reactive - to draw back from the technological, economic, social

and cultural forces at work in order to allow their people to reshape their environment without government guidance. This is the approach which has been adopted in the United States and the United Kingdom.

Canada, like Italy and the Federal Republic of Germany, as well as a number of smaller industrialized nations, has set a course somewhere between these two extremes. The rich endowment of our energy resources and the complexity of our political culture initially sheltered us from the forces released by the energy crisis. While these factors may have prevented us from acting in haste, they arguably made our ultimate reckoning all the more severe. It is only in the last two years that Canada's rising deficit and declining performance at home and abroad forced Canadians to face up to the new realities and to begin coming to grips with the consequences of structural change. Although the adjustments now facing us are among the most difficult in our history, we at least have the benefit of learning from the successes and failures of other countries.

There are already a number of landmarks that clearly delineate the broad lines of our policy response:

- The election in September 1984 of a government committed to economic renewal through private sector leadership - in harmony with the spirit of social justice, national reconciliation and constructive internationalism that are fundamental to Canada's political culture - showed that Canadians were prepared to change the policy orientation which had guided the country for the previous twenty years. In its Economic Statement of November 1984 and in two subsequent Budgets as well as in a series of important decisions about economic, social, external and defence policy, the government has begun the difficult task of translating these broad political orientations into action.

- In August 1985, these new directions were endorsed by the report of the Royal Commission on the Economic Union and Development Prospects for Canada. This report was based on the largest policy research effort ever undertaken in Canada, as well as extensive consultations with Canadian citizens. It recommended fundamental changes in Canada's

industrial and trade policy, in the relationship between the state and the economy, in our political institutions and in our approach to human resource development and social support, with the overall goal of making Canada more competitive in the new global economic environment.

- In March 1986, the report of the Ministerial Task Force on Program Review mapped out a plan for completely overhauling the operations of the federal government with the aim of improving the quality of service to the public and eliminating inefficiency, waste, overlap and duplication.

- In June 1986, the Ministers responsible for science and technology policy in Canada unveiled a national policy framework with the aim of ensuring that activities designed to promote the development, acquisition and diffusion of scientific and technological knowledge in Canada contribute to raising the productivity and competitiveness of Canadian industry.

Beyond the industrialized world, there has been no clear pattern of political response to the events unleashed by the energy crisis. In large part this is due to the number of players involved, the heterogeneous nature of their political goals and the absence of effective coordinating mechanisms - all features that stand in sharp contrast to the situation of developed countries. Perhaps more importantly, although the oil shock reshaped the pattern of economic power in the world, it did not fundamentally alter it. While developed and developing countries alike recognize that prospects for global peace and security ultimately depend on achieving a more equitable balance of economic power between North and South, effective means of achieving this have yet to be invented. In the absence of effective multilateral institutions, industrialized and developing countries court each other on a bilateral basis in a highly competitive game in which individual players from each side attempt to secure maximum economic advantage for themselves by playing off suitors from the other.

4. Policy Tools

As well as requiring new policy approaches, it is becoming evident that the structural changes brought to light in the past decade require the development of new approaches to policy analysis and new implementation strategies in both the public and the private sectors. In the past few years, evidence has accumulated in Canada and in other industrialized countries that established management practices no longer work as effectively as they must if we are to compete in the new economic environment, and that success in attaining long term growth objectives is vitally dependent on devising innovative ways of understanding the world and acting on it:

- To date, the most progress in developing the intellectual tools required to understand the new economic environment has been made in the "harder" social sciences - most notably economics and organizational theory - with the "softer" fields of moral and political theory lagging.

- Economists have begun to recognize that many factors besides price determine the productivity and competitiveness of firms, and that the performance of an economy as a whole is more than the sum of its parts. Although comprehensive theories have yet to be developed to explain these phenomena at the macro- and microeconomic levels, considerable effort is being devoted to analysing the impact of such factors as technological change, institutional arrangements and "human capital" on productivity, competitiveness and growth.

- In recent years, organizational theory and the body of management literature derived from it has undergone a similar change in perspective, shifting its primary focus from quantitative analysis to qualitative evaluation. Initially popularized by widespread western curiosity about Japanese management practices, the view is now widespread that corporate success depends more on such factors as leadership, vision, corporate culture, shared values, treating people right and a host of other human concerns than on the single-minded pursuit of the bottom line, correct organizational forms or market analysis.

The central notion that appears to be emerging from this intellectual ferment is that successful strategy - for firms, industries and national economies - depends on having a clear understanding of fundamental goals and capabilities, an accurate perception of the environment, shared vision and values, good two-way communication and rapidly adaptable structures. Accompanying this is the notion that these variables must be understood and expressed in human terms, not simply in the formal language of systems theory and market analysis.

In addition to these general intellectual shifts, it is becoming recognized that the traditional tools of economic analysis - which divide the world into distinct sectors and markets - although necessary underpinnings to the policy process, may in themselves be insufficient to understand the field of communications and information. This is largely because of technological developments.

- The convergence of communications and information technology and the progressive substitution of electronic media for more traditional forms of creating, processing, storing and transmitting information has blurred the lines between such diverse industries as telecommunications, data processing, office equipment, broadcasting, film and publishing. Mapping techniques and a number of other innovative approaches are beginning to take their place as tools of analysis alongside the more traditional techniques of market and industry segmentation.

- As well as blurring the lines between established suppliers, technology is gradually obliterating the line between the communications and information sector and the rest of the economy. The diversification of General Motors into software and satellites and the rapid emergence of microcomputer-based electronic publishing represent, at opposite ends of the economic spectrum, trends which to some extent confuse the two sides of the equation on which economic analysis has been traditionally founded.

While not negating the validity of sectoral analysis, these trends point to the need to develop complementary techniques for understanding the relationship between the communications and information industries, and between this sector and the rest of the economy.

5. The Challenge for Communications and Information

A number of conclusions flow from analysis of these developments.

- The experience of other countries shows that governments have an important role to play in the process of economic and industrial adjustment - in part by ensuring that it is linked to the acquisition, development and diffusion of "strategic technologies" such as communications - even if their basic stance is non-interventionist. For example, the governments of both the United States and the United Kingdom actively support the development of communications and information industries, both because of their intrinsic importance and because of the central role they play in raising the productivity and competitiveness of all economic sectors. In devising strategies, they have had to take account of the fact that other governments, for example those of France, Japan and a number of smaller industrialized countries, have adopted highly interventionist approaches to developing communications and information resources and diffusing them throughout their economies. Canada must do the same if it wishes to hold its place among the industrial powers.

- Canada's response must follow the broad lines of government policy, which aims to create a climate within which the private sector can lead the process of economic renewal, within a framework that respects the requirements of national reconciliation, social justice, constructive internationalism and the promotion of cultural sovereignty.

- The complexity of Canada's policy orientation, and the central role which communications and information play in all aspects of it, suggests that we must look beyond the immediate challenge of restoring long term

growth to the Canadian economy in a highly competitive international environment to broad issues of global development. In this light, it becomes possible to visualize a synthesis between the needs of the developed and developing countries - whether they are expressed on an economic, social, cultural or political plane - a vision in which the capacity to use information and to communicate will contribute to the management and eventual resolution of many of the structural issues which have come to light in the last decade as a result of the oil crisis and its aftermath. Technology plays an important part in this vision, since it promises to give us the power to renew long term growth in all economic sectors and to combat the oldest enemies of people everywhere - disease, starvation and war. But communications and culture, taken in the broadest sense to include the patterns and content of interpersonal interaction that surround each of us at every moment and in every aspect of our lives, play the preponderant part. If technology is increasingly recognized as a necessary condition of global growth, communications and culture are surely sufficient conditions.

COMMUNICATIONS, INFORMATION AND GROWTH PATTERNS AND LINKAGES

1. Technology Trends

In examining technology trends, it is useful to distinguish between generic technologies that underlie developments in a large number of areas, and technology applications which are specific to a particular field such as communications.

Insofar as generic technologies are concerned, hardware and software developments in the following areas have important implications for communications applications:

- at the user interface - the point at which information is entered into or retrieved from a communications system - voice recognition and optical scanning technologies are expected to take their place beside the telephone and the keyboard as information input facilities, while high resolution displays, voice synthesis techniques and laser printers improve the quality and accessibility of information output;

- in broadcasting, higher definition cameras, recording equipment and television receivers will significantly improve the quality of broadcast programming and pre-recorded video materials;

- optical disks will provide much greater mass storage capacity than current magnetic memories;

- in the set of disciplines commonly referred to as 'artificial intelligence', research and development programs are beginning to produce hardware and software devices which emulate human intellectual capabilities by employing 'fuzzy logic' instead of rigidly mathematical programming structures, by reasoning about new situations through the application of rules based on a body of knowledge (expert systems), or by replicating mental structures and processes (parallel processing);

- in microelectronics, the speed of microprocessors and the capacity of memory chips will continue to increase, in part through the development of optical and opto-electronic devices, permitting larger and larger amounts of information to be processed in ever smaller units of time;

- all these hardware and software innovations will be supported by the new developments in communications technologies, particularly fibre optics distribution, broadband switching, and new networking technologies.

Taken together, these technologies provide the foundation for more intelligent communications systems. That is to say, systems which are increasingly dependent on software and content, and which transmit, process and store information in ways more closely resembling human communication processes. There are two points which it is particularly important to bear in mind in formulating a policy to promote their development and application:

- while the coming decades will almost certainly see the physical capabilities of new communication technologies gradually approach human dimensions - for example as measured in processing speed or storage capacity - it by no means follows that their ability to emulate human perceptual, intellectual, organizational and cultural skills will be equally enlarged, or that we will be able to make effective use of these technologies to enhance the quality of our economic and social life. To achieve these goals, we will have to invest these technologies with hardware and software capabilities that increasingly correspond to the higher human faculties, particularly those concerned with representing reality by finding patterns of meaning in the mass of available information. In the 'information age', perhaps the greatest challenge is to cope with information overload;

- as the history of office automation and artificial intelligence illustrate, many advanced technologies will find their initial

application in standalone or small scale systems. While accomplishments are in some cases already visible at this level, the real challenge is to evolve beyond this state and to build new communication paths, connecting individuals, groups and larger organizational units. This is an area of high potential risk, because advanced communication systems at this point largely lack the single most important achievement of the traditional telecommunications infrastructure - common standards which make it possible for devices to talk to each other. Until a similar connectivity and interworking is developed for advanced communication technologies, their promise will go unfulfilled. Insofar as business applications are concerned, local area networks - serving work groups, offices, buildings, campuses, factories and farms - are emerging as a logical strategic target for the development of new, more intelligent communication infrastructure. These systems will integrate a number of previously separate functions, such as office automation, telecommunications, security, and energy management. There is already considerable interest in the emergence of "smart buildings". In a similar fashion, the next few years may see the development of smart homes and apartment buildings. As well as providing a possible focus for DOC program activities, it should be a policy objective to ensure that these systems are properly integrated with established communications infrastructures. If this is not done, key elements of broadcasting and telecommunications policy may be undermined by new forms of technological bypass.

For their significance to be fully appreciated, these technological trends and the two dominant thrusts to which they give rise - towards greater machine intelligence on the one hand and greater integration on the other - need to be mapped against broader economic and social forces.

2. Patterns of Development and Application

Advances in the fundamental hardware and software technologies identified in the previous section for creating, processing, storing, transmitting and

displaying information present opportunities for powerful new communication systems which could improve the productivity of primary, secondary and tertiary industries, the efficiency of government and public institutions, and the quality of social and cultural life. However, there are risks associated with these technologies, risks which stand in the way of realizing their full potential. The following model has been developed to illustrate emerging patterns of opportunity and risk, at the technical, industrial, individual, organizational, economic and social level.

a) The Model

The analysis which follows is based on a two-axis model:

- the horizontal axis measures the scale of communication systems on a range from big to small. Communication systems are defined very broadly in the model. They include the facilities and services offered by the various communications media (telecommunications, broadcasting, publishing, etc.) as well as the communications patterns that characterize industry, government, economic and social institutions at the "big systems" end of the scale, in addition to individual and group interaction at the "small systems" end;

- the vertical axis measures the attributes of communication processes, ranging from a dominant or exclusive concern with the carriage of information to a dominant or exclusive concern with content. The technological drive towards greater integration corresponds to the former thrust, and the drive toward greater intelligence to the latter.

From this brief description, it should be obvious that both axes of the model have economic, social and technological dimensions and that these factors are part and parcel of any communication system, whether it be the dedicated, highly visible processes channelled through the media, or the less visible and more intangible communication patterns that underlie our social and economic life.

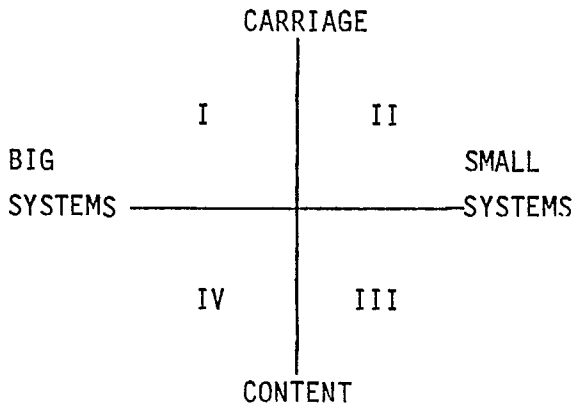


FIGURE 1

b) Economic and Social Trends

The following appear to be the most important long-term trends in the economic and social environment:

- the big systems of our society are undergoing profound structural changes which are typically characterized in the following kinds of terms:

  . industrial restructuring - the progressive shift of traditional primary and secondary economic activities to the developing world, as developed economies increasingly centre around intelligent production processes, the growth of the services sector and a greater dependence on information-related activities;

  . economic renewal - the need to ensure that Canada participates in this process through greater R&D, technology innovation and diffusion, and that the private sector leads in this process;

. social and cultural revolution - the changes brought to our fundamental social and cultural institutions by these economic transformations particularly those resulting in a redefinition of individual rights and freedoms, the nature of work and employment, requirements for education and training, methods of ensuring an equitable distribution of social benefits, cultural identity and national sovereignty;

. political reconciliation - the need to reform our political institutions and processes in order to improve our society's ability to respond to the aforementioned trends;

- in the face of these major structural upheavals, small systems are dominated by concerns for individual and small group survival, security and self-expression. In particular, this is reflected in concerns for:

. economic equity - with traditional full-time employment apparently in permanently short supply, what rules will govern the creation, distribution and preservation of wealth in the information society, and what new means can be found to ensure that people have access to a fair share of the economic pie;

. cultural expression - how can the opportunities for self-expression and fulfillment offered by technological change be reconciled with the requirements of economic and social order.

As numerous popular works (e.g. In Pursuit of Excellence, The Next American Frontier) attest, reconciling the competing claims of economic efficiency and human rights is our society's biggest challenge.

c) The Impact of Technology on Communication Processes

To date, technology has had a selective impact on communication processes in advanced industrial societies:

- the main effect of telecommunications and mainframe computer technology has been to improve the efficiency of information carriage, and to set up centralizing forces in big economic and social institutions (quadrant I in the model);

- the main effect of information and microelectronic technology, on the other hand, has been to improve the quality of information content, and to set up democratizing and decentralizing forces in our society (quadrant III in the model).

A number of new technologies are emerging to reinforce these established trends, fill the other quadrants, and establish linkages between them. These developments are illustrated in Figure 2. The convergence of telecommunications, computer and information technologies into advanced communications systems, which unite these countervailing thrusts toward efficiency and centralization on the one hand, and quality and decentralization efficiency and centralization on the one hand, and quality and decentralization on the other, appears to provide the technological basis for synergistically achieving big and small system goals in Canada's economic and social communication systems.

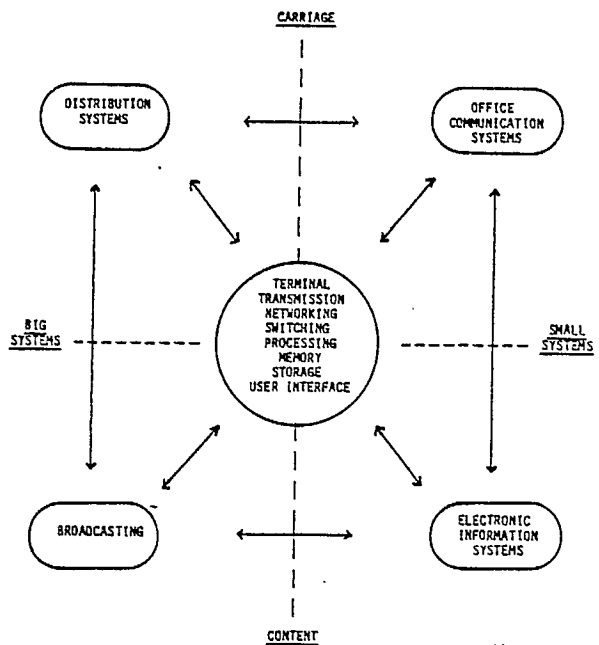


FIGURE 2

COMMUNICATIONS, INFORMATION AND CANADA'S GROWTH: PAST, PRESENT AND FUTURE

1. Introduction

The world economic order is changing and Canada, as one of the top ten industrial powers, faces with the major challenge of her second century - continued growth through success in global competition.

Our major economic partners are redefining and establishing the trading relationships that will guide economic development in the next generation.

Canada is faced with the opportunity to overcome its tenuous hold on foreign markets. We export 30% of our GNP, and yet we are the only major industrial country without guaranteed access to a geographical market of at least 100 million population.

For years we have seen the United States as the market place of opportunity, and with a series of bilateral agreements we have, with success, managed to become the major, if largely invisible, trading partner of the U.S.

This situation will not necessarily persist, and we would be making a grave mistake if we assumed that what was, will be.

We have a potentially strong and dynamic economy, we have enormous natural resources, many of which are renewable, we have one of the best educated and adaptable work forces in the world. We have a proven record of success in the most competitive areas of high technology. And we have an infrastructure capable of building on these successes.

We have a political and social infrastructure capable of providing both vision and resources to encourage and strengthen the development of the culture that has served us so well in the past.

The challenge we must accept lies in:

- Realizing that the environment is changing and that we must adapt;

- Recognizing that policies for future growth must be founded on an understanding of who we are;

- Through understanding our gifts and skills, developing complementary goals and aspirations for our society;

- Accepting we can no longer afford to assume that we will continue to "muddle through", since the world is full of countries willing to stake their future on a strategy of economic growth through draconian competition.

In short, we must develop a vision of the integrated use and development of all the economic, social, cultural, and political realities that make up Canada and forge them into the dynamism that will propel us into a new era of international competitiveness and opportunity.

With one of the world's great resource based economies at our disposal, we must manage and develop its growth with a more mature understanding of who is competing for our markets and how to beat them. We must use our capabilities in areas of technological strength to enhance our competitiveness of our traditional industries.

In the past the raw materials on which we build our economic strength were dug out of the ground, or cut down human resources were imported.

We have, now, in addition to the physical resources of the land, the incalculable benefits of a population well educated, well informed and well adjusted to the rigors of technological change and innovation.

It is this resource that will be mined by the challenge of the competitive world economies, and it is this resource that must be brought to bear on the development of our traditional industries.

In order to ensure that the people resources that we have so painstakingly developed continue to grow and produce at the rate needed for our promising future, we need to continue to develop the social and cultural infrastructure that has served us so well up to now. In particular, the education system that has given us one of the best work forces in the world must continue to be supported at all levels, since it will provide the foundation for the research and development infrastructure upon which our ongoing success will depend.

We must focus the efforts of both the private and public sectors on increasing the "technological intensity" of our industries and society, knowing that our competitors have been doing this for longer than we have.

If the competitive synergy that develops through the use of information technologies in support of established sectors is to become stronger than the serindipitous accidents of the past, we must plan and develop the inter-relationships between the capabilities of the emerging and the growing demands of the old.

We must develop a better understanding of the inter-relationships between use and capability.

With the trade negotiations with the United States on the horizon, the Department of Communications must look to its own roles, responsibilities and capabilities, in order to work closely with our private and public sector colleagues, so that we will be prepared to provide leadership and support in an effective and dynamic fashion.

With this in mind we should examine opportunities for initiatives from the Department of Communications in support of the private sector, the secondary education system, other federal departments and agencies, and the levels of governments, through new and innovative uses of our policy, research and operational mandates. The Department of Communications is unique in the fact that it has these three interconnecting components, any one of which is substantially weaker without the other.

2. The Historical Background

2.1 Discovery and Exploration

Canada was discovered, the the last time, by people desperate to decrease communications time and costs between Europe and the far east. Our presence was not only a shock but by its very existence across the route to power and redemption it changed the nature of Europe's economy, and power overnight.

The fact was, those who controlled the communications routes between Europe and the Americas became the leaders of Europe. Control of the delivery system created access to the raw materials of power, though it soon became clear that one did not need to control the end points of the network in order to profit from them as long as you had access to the network.

Spain and Portugal, and then England, France and the Netherlands exerted their powers to the fullest in order to acquire both the trade networks and the raw resources that fueled their national aspirations.

Smaller or less sophisticated lands tried to develop specific resources for exploitation with little to show for their efforts. The Scots and the Swedes in Central America, Russia in the North West Pacific are examples of countries realizing that the economy was changing and leaving them uncompetitive but did not have the cultural or the capital infrastructure to compete in the developing economic culture of Europe.

After having overcome the general disappointment that the existence of the American Continents created, the European powers began to first exploit and then develop all the resources the land and people had to offer. Since the most generally available communications route was the water, and the most highly developed technology was the ship, those lands either close to the ocean shore or accessible by navigable rivers were the areas to receive the deepest attention from the first several generations of migratory entrepreneurs.

Canada was abundantly supplied with easy maritime access, the ocean and the great rivers, the St. Lawrence, the St. John's, the Restigouche and the Ottawa brought the French and English into the depths of North America. Since France and England's physical and economic access depended upon these rivers as the most effective intra-continental communications network, Canada's economic, political and social life developed with the growth of these great trade and communications networks.

The fact that the communications with the home lands were easy, at least in terms of the 17th century, kept New France and New England outward looking and it was not until the communication patterns with the original cultures were broken did a parochial, and perhaps introverted view of North American life take over, broken only when our communications capabilities has spanned the continent and lifted our vision.

The completion of the Civil War in the United States, established a whole country from the shores of the North Atlantic to the new states of the Pacific coast, linked by railways and telegraph. The area in between waiting the three generation influx of European emigration that peopled the central stage of Canada and the United States.

Canada having a less geographically hospitable or accessible centre took a generation more in time and much greater expenditure of national will and effort in order to connect its narrow and long population. The fact that the development of our second great communications infrastructure occurred for fundamentally different reasons then did the development of the American railway system highlights basic differences in our views of communications and the framework required for their development.

While some of our first railways were built to develop access to the American markets our great efforts were devised to connect the extremes of Canada, in order to create Canada. Without the railway the prairies and the Pacific coast would have used the generally better north-south communications patterns and would have created an economic entity that in no small time would have become a political fact. The first national effort by the central

government of Canada was to provide the communications infrastructure that would allow culture to overcome geographical convenience. The first use of the incomplete railway was to establish the presence of the national government in the North West and preempt any thoughts of annexation or invasion.

Throughout our past we have relied upon consortium of public and private monies to overcome the vastness of our land, whether it was the Compagnie de la Nouvelle France, the Hudson's Bay Company or the Canadian Pacific Railway, development of our communications underpinnings have been seen as a joint responsibility of all the sectors that make up Canada, and it is understood by all that the size and limited population of the country makes the achievement of major national projects only marginally profitable at best requiring the joint efforts of the private and public sectors to develop the essential infrastructures that will allow and encourage the type of growth needed to support our hopes for the land.

We long ago learned that communications cannot be seen only in the light of economic determinalism but it exists also as a tool in the political and cultural development of the land.

2.2 Social and Cultural Patterns

The imperatives that created this country, people, geography and history have by their very existence given us skills, experience and a view of living that is singularly Canadian.

We are a conglomeration of needs and aspirations deposited along the narrow habitable portion of the second largest country on earth.

We have matured alongside the most vibrant culture of the twentieth century, without losing an underlying more conservative view of the state or its relationship with the people.

We have accepted the fact of our distances and merged them into our lifestyle.

We have learned how to distribute services, governmental and private over a greater distance than any country on earth.

We have the most sophisticated and extensive national telephone system in the world.

We developed and installed the world's first and most reliable packet switching networks.

We are one of the few countries self-sufficient in the emerging world of fiber optic design, manufacture, installation and utilization.

Per capita we have more satellite experience and capability then any country in the world.

We have world class experience in distance education.

We are as experienced as any country in the world in the delivery of health care services to remote areas.

Our construction industry and the associated engineering firms are world leaders in hostile environment construction and major project management.

Our experience and success in the design and manufacture of communications hardware and software is one of the few areas where our world reputation is as advanced as our capabilities.

We are the world's leaders in developing telecommunication services and standards for the disabled.

We have developed the knowledge and will to build, both the cultural and physical infrastructure need to expand into some of the most challengingly inhospitable land in the world and to bend it to our needs. Because of this, Canadians have world class capabilities in many areas. Unfortunately, as a country we do not either appreciate this, nor, as a consequence, do we generate a profitable international profile for these invaluable achievements.

All these skills and resources are the direct outcome of our land, people and history, and their imperatives. We are not exploiting either our skills or developing a reputation from which to build our new industries.

Historically, we have not invented the tools of our economic development, but we have, used, adapted and refined them to meet our specific needs. The steam engine as developed to pull hundreds of grain cars from the prairies through the Rockies is a specific product for a specific need that those original designers in Birmingham could never envisioned.

But because of our understanding and access to the original technology, we refined and interpreted it until it met our needs, and then we sold it to those other markets with matching needs but less experience or insight.

We have done the same with airplanes, tracked vehicles, farm equipment, microwave technology. We have invented and marketed medical technology and genetic engineered plants for generations without making the breakthrough into the development of major world respected industries.

If we expect to develop the orderly progress of the Canadian economy we must understand who and what we are, what do and can do, and where do we fit in to the complexity of the international economies.

2.3 Reflections

If by understanding our past can we better understand what are the unique properties of Canada and Canadians that has created the present environment that has placed us within the increasingly small group that comprises the world's technological powers. Will these attributes serve to keep us competitive as we move into the twenty first century.

If we can identify these social, cultural and geographical foci around with the country revolves, can we then develop the tools and processes that will support the development of a stronger and more competitive economy, or will the technology by its very march to homogenization change these attributes and

render us less able to prosper in our drive to develop a more soundly and broadly based economy and society?

Considering that communications technology is both a tool and a product, can we, by better understanding the dynamics of the concept and its associated industries, better use the panoply of our communications skills to increase the competitiveness of our other industrial sectors; resources, primary and secondary industry and the services.

If having understood and achieved the former points, can we develop industries based on the export of this understanding and these skills?

If the argument is correct that we are already well placed to become the refiners, developers and interpreters of technology, can we raise our profile so that we are more easily recognized as a prime international resource in this area?

Can we also develop these capabilities of interpretation and refinement so that we can use them to enhance other economic strengths and through this synergy give both of them an ever increasing international competitiveness.

Again, if the argument runs true, and the fact that we are Canadians has given us these strengths, does it also hold true that any dilution of that which makes us Canadian dilutes these great strengths. If this is so, then there may be a closer inter-relationship between Canadian cultural policy and Canadian economic development then has previously been defined.

The consequences of this argument have led us to think seriously about the role of the Department of Communications in development of communications and information technology and our need to strengthen our competitiveness.

3. The Challenge of the Present

3.1 The Rise of Trade

Technology has reduced the world to one large trade area. Between 1950 and 1980, the share of goods and services that it exchanged among nations has nearly doubled, passing from 11% to 21% of the world's gross product. This rapid growth resulted from revolutions in transportation and telecommunications which broadened human horizons and reduced spatial and temporal obstacles and differences.

Until 1950, the bulk of intercontinental travel proceeded largely by sea and, outside Europe and North America, radio and telegraph were, by and large, the only means of intercontinental communications. During the sixties and seventies, the coming of age of jet air aircraft drastically reduced intercontinental travel time and the advent of large capacity intercontinental telephony via cable and satellite made possible rapid and reliable communications anywhere in the world dramatically altered the world trading scene.

Business no longer needed to access markets from afar using dated information from relatively unknown sources. Distant point were only hours away and on the spot report from knowledgeable employees were changing the mode of management. Economic boundaries fled before the onslaught of aggressive firms who rapidly developed into the major multi-national corporations that dominate world trade. These firms established patterns of operations which were soon imitated by smaller businesses, and the dawn had risen on the age of the multi-national corporation.

Intense international competition spawned by the rapid advance of Japan, and the rise of the newly industrialized countries of south east Asia and Latin America, countered the carefully orchestrated trade agreements of the previous 20 years, through the imposition of non-tariff barriers of sophistication and deviousness. They are all the more effective as they are often disguised as incentives to local producers, or of quality or safety requirements for the

local markets; and they have served to promote the world wide resurgence of protectionist policies.

The United States and the EEC feel that the pressure of this new world trading order. Their respective shares of the world trade has contracted, notwithstanding the fact of their shares of the gross national products attributable to foreign operations have been relatively maintained. The underlying fact remains that the growth of these economic entities have not kept pace with the advances of Japan and the newly industrialized countries.

The problem of the two leading markets of the western world must, however, be kept in perspective. Both involve fairly homogeneous economic areas with populations in excess of 200 million people, where reliance on external trade, apart from access to strategic necessities, is seldom a dominant factor.

3.2 The Challenge for Canada

Canada shares in the current trade tribulations of the United States and the EEC, but experiences, in the process, more anguish because of its significantly on its greater reliance on external trade and the fact that it stands alone among major industrial countries in that it does not have access to a market numbering at least 100 million people.

Between 1960 and 1980 Canada has seen the share of its national income earned abroad rise from 20% to 30% but also witnessed during this period, its share of world trade decline from 5.5% to just over 4%. The implication is that, although we sell abroad more then we ever did, we are becoming less competitive in the world's marketplaces. This paradox, if indeed it is one, needs to be examined and the potential options open to us need to be identified.

Contrary to the perceptions that we are still the "hewers of wood and drawers of water" of legend, 75% of Canada's exports are merchandise, in the form of finished products or fabricated materials. The remaining 25% consists of non-eadible raw materials, agricultural or fisheries products. Our

transactions with other countries in this area currently result in a surplus of some $20 billion. We are much more vulnerable, however, in the area of services where our transactions with other countries currently sees us in a $20 billion deficit.

We must make significant gains in this area, because it is in services where the growth area of world trade lies; it has been expanding at nearly three times the current rate of merchandise trade (15% vs 6%).

Our major problem in attempting to come to grips with this issue is that, as a nation, we are overly on fragile trading relationships. For example, the United States, who accounts for almost 75% of our exports, is extraordinarily strong in the service industries and unless we can prove to be more productive, they are unlikely to buy more of these services from us than they do presently.

This is the challenge that is facing Canada: we need to become much more ingenious and adept at packaging and marketing our skills and services. We need to give much more thought to the development and maintenance of the distribution and support infrastructure for our exports.

Canadians have proved, as we have pointed out, to be as good as any in the world in developing expertise and services with exceptional market value. We need to intensify our efforts in this regard, to broaden them to include the artistic and cultural offerings which other countries so successfully sell in all corners of our world.

To embark on such a course, it is essential that our general ability to produce be as good as any of our trading partners. We have fared badly in this regard between 1974 and 1982 when our rate of productivity growth fell to less than 0.5% (the OECD nations averaged 1.5, and Japan gained 3.0).

The situation has recently improved and we posted advances of 2.5% and 2.1% in 1983 and 1984. Unfortunately, this gain was mirrored by our partners and customers. There are several shortcomings that need to be addressed if our performance is to be maintained, much less enhanced.

Foremost, among these deficiencies is a pernicious lag in the rate of diffusion of new technologies in both the public and private sectors. Productivity is enhanced by an adequate rate of technological advances, which require that new technologies be acquired and absorbed in a timely fashion by the economy.

The evidence suggests that Canada has a continuing problem in this important area. The reasons can be many, but it would seem reasonable to attribute it in part to the structure of our industries. Technology in this context does not relate only to products and processes but to organizational structures as well. This deficiency needs to be addressed and overcome and the government has an important role to play in this regard.

> "There is considerable agreement that new ideas and techniques do not diffuse across international boundaries as rapidly as deemed desirable. Thus the government has clearly a role to play in Canada just as in Japan and certain other countries, to ensure that the knowledge of new ideas, products, and processes that have already been developed elsewhere and are already in commercial or practical use abroad, is more widespread domestically then would be the case if the discovery of their existence were left simply to profit motives."

(Economic Council of Canada, "The Bottom Line", 1983, pp. 33).

Another important shortcoming rests with our inability to move quickly to fully explore the service potential of new products or services. We must become more aggressive and more willing to simplify and sandardize those regulatory processes that hinder new developments. An important objective would be to reach a consensus among the governments of this country that would facilitate the coast to coast implementation and exploitation of new products or services.

3.3 What Now

This half of the twentieth century has seen technological innovations in transportation and communications transform the world's economic activities. For better or worse the planet has become one large marketplace where any significant change in normal supply and demand relationships has profound implications for all nations, as the current petroleum situation has made clear.

While all this has been achieved, the latest advances in communications technology remain to be ingested. These advances have provided the individual with power tools for technical, cultural and economic development and for a greater involvement with and control over the forces that shape their day to day lives.

Strengthened by our mastery and use of these new technologies we can develop the expertise and skills needed to generate market and sell the services which feature so prominently on the world's trading scene and on which our economic growth is coming in depend upon.

4. The Promise of the Future

Communications technology permeates all aspects of human endeavors. Evidence of its ever widening presence is found in the sophisticated network and terminal facilities which can be accessed almost everywhere in the course of our daily activities, whether in the home, office or other place of business, or even as we move from location to location.

We spend more time communicating as ever more information is being produced, processed and exchanged among the regions of the country, and of the entire world through the impulses of electronic impulses. We are soundwave and lightwave bystanders to events that are occurring thousands of miles distance. To the extent that information is allowed to travel freely, the world is indeed shrinking to the dimensions of the village.

When the telecommunications infrastructure carried only voice communications, the scope of the services it provided was, for all practical purposes, restricted to the conveyance of social and business messages. Because of this limited capacity, it served more then the interests of the larger economic and institutional interests then those of the individual.

Times have changed as the same telecommunications infrastructure underwent major changes in the last fifteen years that dramatically altered the nature and scope of its service offerings. Through massive infusions of computer technology, it was transformed into a powerful digitized highway capable of handling large volumes of data from a variety of widely separated sources.

In other words, it became an all encompassing information carrying medium, capable of being used for educational, technical and cultural purposes as well as for narrower social, business liaison activities. A major technological breakthrough of the late seventies, the advent of the personal computer, brought the new information pathways to the doors of the individual.

Computing power which, heretofore, had been the domain of the professionals, with large, cumbersome and expensive equipment, could now be bought and used directly by anyone with the interest. The full power of modern telecommunications became available and accessible to the mass of society.

As a result of these changes, the individual can today tap directly into the growing stock of electronic information which is readily overtaking paper recorded documentation. Technological advances in space and fiber optics transmission have already extended the reach and reliability of communications bringing every part of the planet in instant contact with any, or all others.

With the convergence of computer and communications, the full potential of the long heralded information society is coming into reach of the individual.

Man is becoming every more integrated into a developing comprehensive network that will provide him with a rich variety of political, cultural and artistic information.

OVERVIEW OF PART B

PRINCIPLES

This section contains three papers:

- "Communications, Information and Growth: Understanding the Links", surveys alternative methodologies for analysing the communications and information industries and relating them to other sectors of economic activity.

- "Designing the Future: An Overview of the Telidon Impact Assessment", presents the lessons learned through the Telidon program about introducing informatics in Canada.

- "Guiding Principles", summarizes the achievements of previous DOC programs, analyses the problems they encountered and suggests criteria for future action.

COMMUNICATIONS, INFORMATION AND GROWTH: UNDERSTANDING THE LINKS

1. Introduction

1.1 Purpose

The purpose of this paper is three-fold:

- to review the intellectual tools which have been used to analyse the linkages between communications, information and growth;

- to summarize the evidence gathered by the Department of Communications in recent studies to quantify these linkages;

- to identify gaps in theoretical and empirical knowledge, in order to suggest directions for future policy research.

1.2 Some Preliminary Definitions

In this paper, the term "communications" will be used to refer to the means for creating, processing, storing, transmitting or displaying a message, while the term "information" is used to refer to the content of a message. The ambiguous term "software" could therefore fall into either category. If it refers to machine language, operating systems, or applications programs, it is "communications" in this definition. If it refers to a product analogous to the content of a book, newspaper, report, diagram or model, then it would be "information".

"Growth" is approached from an economic perspective and is viewed as the creation of new goods, services and employment opportunities which, when distributed by public or private sector mechanisms, provide individuals and groups with the means of achieving their goals for social and cultural development. It is neutral as to the content of these goals.

1.3 Method

There are a number of different intellectual tools available for relating communications, information and growth.

- On one dimension, they range from approaches which may be termed conventional - in that they view communications, information and their various subclasses as distinct segments of economic activity, against the backdrop of the traditional three sector model of the economy - to radical approaches which attempt to revise the framework of economic analysis to take account of what are perceived to be the transformative effects of communications and information.

- On another dimension, they differ in whether they approach the problem from the demand side or the supply side.

At the risk of oversimplifying their richness and diversity, this paper will attempt to categorize a number of current approaches on these two dimensions.

2. Alternative Approaches

2.1 The Sectoral Matrix

The supply matrix is the approach which has most commonly been used in the Department to analyse the economic importance of communications and information. It is also the approach which is most congenial to other economic departments, such as DRIE.

	TELECOM	INFORMATICS	CULTURAL INDUSTRIES	ARTS	
COMPONENTS					CREATION
SYSTEMS					PRODUCTION
FACILITIES					DISTRIBUTION
SERVICES					EXHIBITION

Figure 1

As Figure 1 illustrates, there are two axes to this matrix.

- The horizontal axis is divided into a number of distinct industry sectors, running the gamut from well established categories such as telecommunications and data processing, to new endeavours such as knowledge processing, through the cultural industries of broadcasting, film, sound recording and publishing, to more traditional forms of cultural expression including the performing arts, the visual arts and heritage activities.

- The vertical axis includes the various stages of production at which value is added in these industries. Although terminology differs between sectors, three or four basic activities are common to most of them and could be said to demarcate vertical industry subsectors. In telecommunications and electronic data processing, these elements would be referred to as the production of components, the assembly of systems, the provision of facilities and the provision of services. In the cultural industries, they would be called creation, production, distribution and exhibition, or some such set of terms.

Section A in volume two presents a paper prepared by M. Behan of the Department of Communications' Industry and Economic Development Branch which contains the most up to date analysis of these industry sectors and subsectors. The "bottom line" is shown in the following figure.

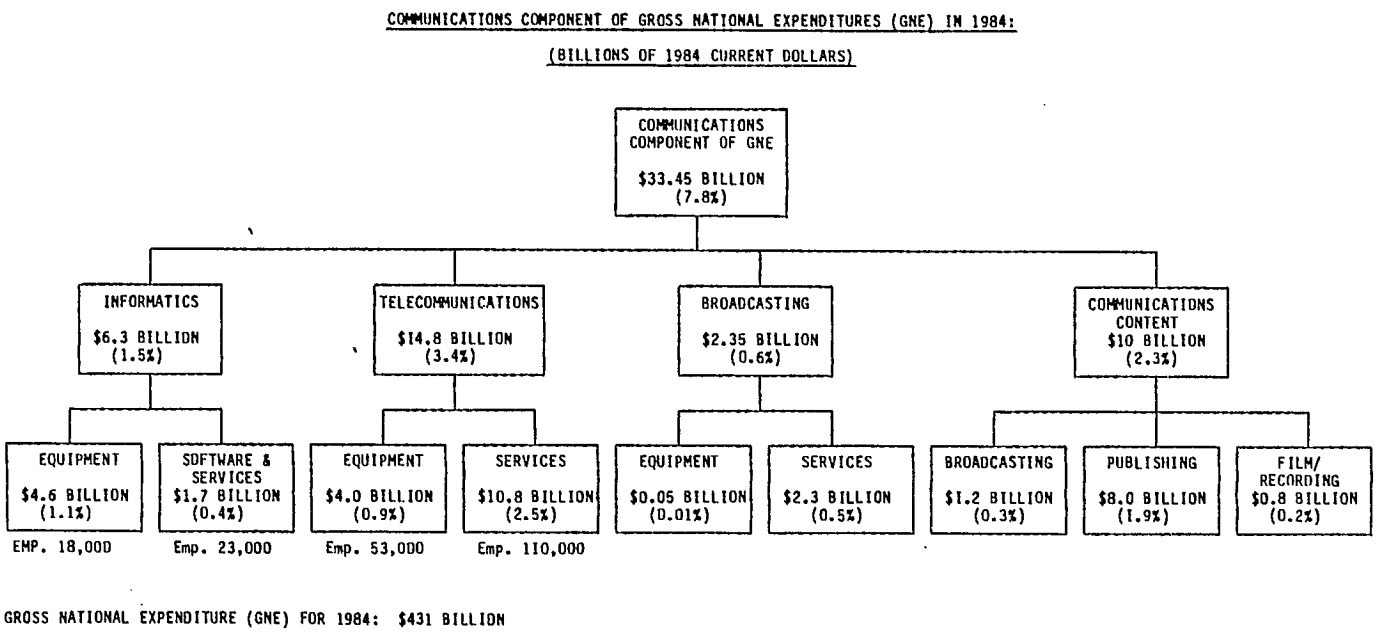


Figure 2

While it tends to produce a readily recognizable picture of the economic landscape because it mirrors the way firms are actually organized in the marketplace, there are two main weaknesses in the sectoral matrix approach as a tool for analysing the role of communications and information in economic growth and in formulating strategy:

- First, the sector matrix approach has an inherent supply side bias that leads very easily to arguments about import substitution which may not always be very solidly founded in economic analysis. For example, in most if not all of the industry subsectors defined in the model, Canada runs a deficit on balance of payments. That is to say, the value of what we produce and consume domestically or export is exceeded by the value of imports. This fact, in conjunction with assertions about the essential role that various industry sectors or subsectors play in growth or sovereignty, is taken to justify the argument that more or whatever commodity is being discussed should be produced in Canada and consumed domestically. In its extreme form, this argument extends to the proposition that our future welfare or survival depends on achieving a positive balance of trade in the area of interest. While such conclusions may be true, the sectoral matrix approach, in itself, is in principle incapable of proving the case.

- Second, the sector matrix model does not take sufficient account of the impact of technological and industrial convergence, the principal forces shaping the communications and information industries today. There are two dimensions to this convergence, corresponding to the two dimensions of the matrix:

    - On the horizontal axis, the convergence of telecommunications, computing, storage, recording and production technologies in eroding the distinct technological bases that once underlay the telephone, EDP, broadcasting, film, record and publishing industries. This technological convergence has been reflected in recent years in a spate of corporate mergers that has carried old players into new businesses and introduced competition into previously benign relationships.

    - On the other dimension, various factors including technological convergence and competitive pressures from domestic and foreign sources have strengthened trends to vertical integration. For example, the need to have secure sources of supply of

microprocessor devices and other critical components has led service providers to integrate backwards down the scale toward component production, at the same time as telecommunications system and facility providers have found it in their interest to integrate forward into new service areas, in order to maintain strategic positioning.

All these factors point in the same direction. In order to develop an adequate understanding of the role that communications and information play in economic growth, it is essential to do two things:

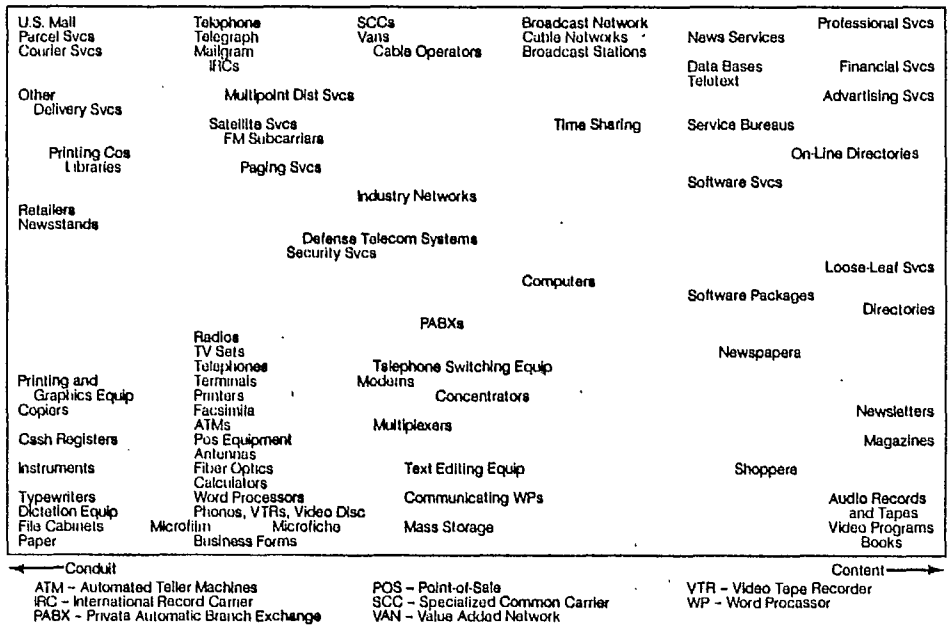
- to look beyond the static forms of analysis generated by the sector matrix approach in order to examine the dynamic forces which are reshaping the relationship between the various components of the communications and information industries;

- to look beyond the boundaries of the communications and information sector in order to determine its relationship to and strategic significance for other industrial sectors.

The next three sections of the paper will examine models for achieving these goals.

2.2 Information Mapping

The Harvard University Program on Information Resource Policy has developed what is essentially an enhanced version of the basic sectoral matrix called "information mapping". In this model, the field of communications and information is bounded by two continuums which run from products to services and from content to conduit. These axes are used to plot the positions of the various industries that make up the field, as illustrated in Figure 3.



The information business in 1980. *Source:* John F. McLaughlin with Anne E. Birinyi, "Mapping the Information Business," in *Understanding New Media*, edited by Benjamin M. Compaine (Cambridge, MA: Ballinger, 1984). ©1985 Program on Information Resources Policy, Harvard University.

Figure 3

One of the advantage of the information mapping approach is that it permits a dynamic presentation of how the general shape of the communications and information industry, and the position of various players within it, has changed over time in response to technological change and socio-economic forces. The mapping approach facilitates strategic thinking by identifying trends and market opportunities. Its principal disadvantage is that its boundaries are defined by the supply characteristics of the communications and information industry. Thus, although it provides an approach which is sensitive to the impact of technological change, it remains a superficial tool for understanding the role of communications and information in the economy as a whole.

2.3 Information in the Economy

One tool which has been used with some success in an attempt to gain a

better understanding of the strategic significance of communications and information in the economy is input-output analysis. In 1984, Can D. Le of the Department of Communications, Technology and Policy Assessment Branch, analysed time series data using an input-output model developed by Statistics Canada in order to estimate the contribution of four industries, telecommunications, informatics, content/broadcasting and content/non-broadcasting, to forty-four sectors of the Canadian economy. His report is reproduced in Section B of volume two.

As well as identifying the relative "information-intensity" of industries in the primary, secondary and tertiary sectors of the economy, this study demonstrated that the economic benefits of additional expenditures on informatics, content/broadcasting and content/non-broadcasting would be much higher than those that would accrue from similar expenditures on the telecommunications industries. Both sets of findings provide valuable insights into strategic opportunities for communications and information. One deficiency of the approach is its reliance on data based on the 1970 Standard Industrial Classification, which may not fully or accurately reflect the impact of technological change on industry structures, both within the communications and information sector and outside it.

2.4 The Information Economy

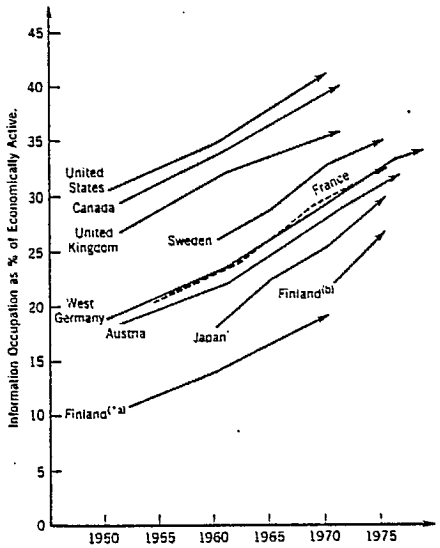
In order to counteract this kind of problem, a considerable amount of work has been done over the past two decades in the United States and in other OECD countries to recast the basic tools of economic analysis in order to make them more sensitive to the role that communications and information play in economic growth.

The origins of this work can be traced to Fritz Machlup's pioneering work, The Production and Distribution of Knowledge in the United States, which was published in 1962 and was the first attempt to define and measure the growth of the communications and information industries. Daniel Bell's The Coming of Post-Industrial Society, which was published in 1973, was another landmark which introduced the notion that industrial societies were in transition to a

post-industrial stage, in which the application of knowledge and intellectual technology would be critical to growth.

The Information Economy, which was written by Marc Porat and Michael Rubin and published by the United States Department of Commerce in 1977, provided detailed empirical support for Bell's theories. In this study, the authors re-analyzed the U.S. national accounts for 1967 using a set of concepts, derived from Machlup, which sorted the data into six new economic sectors, three of which produced information goods and services, three of which produced other goods and services. This report demonstrated that, by 1967, roughly half the United States' GNP and labour income were accounted for by knowledge, communications and information work. It also showed that the percentage of information workers in the U.S. economy had risen steadily since 1860, when it stood at approximately 5%, and that this trend line nicely tracked the decline in agricultural and industrial workers.

Following the publication of this report, the Organization for Economic Cooperation and Development undertook a comparative analysis of other major industrial economies. Although significant differences emerged, the OECD report confirmed the trend which is captured in Figure 4. The Department of Communications took part in this project and the results of its investigations were published in 1980 by Michel Andrieu and Shirley Serafini under the title The Information Revolution: Implications for Canada.



*Data for Finland was derived from two separate sources (a) I. Pietannen; (b) The Central Statistical Office of Finland, both sources using a rather more restricted definition.

Changes in the share of information occupations in all economically active over the post-war period. *Source:* Organization for Economic Co-operation and Development, *Information Activities, Electronics and Telecommunications Technologies, Impact* on Employment, Growth and Trade, Paris: OECD, 1981, p. 25. Used with permission.

Figure 4

3. New Directions

The achievements of the "information economists" have been impressive and appear to have had some impact on public policy in a number of countries, most notably Japan, France, the United Kingdom and the United States, which have adopted policies and programs predicated at least partly on the assumption that industrial economies are being transformed into information economies. In Canada, they have remained largely without influence - in spite of the fact that Innis and McLuhan can be counted among their progenitors - largely because their arguments have failed to convince mainstream economists or policy makers.

Indeed, while there may be some weariness, not just in Canada but in other countries, with apocalyptic approaches that attempt to overthrow the entire superstructure of conventional economic analysis, enquiring minds have continued to chip away at the foundations of economic theory and the search for new

approaches which more satisfactorily explain the role of communications, information and other core factors in the performance of individual firms and whole economies. The Committee for Scientific and Technological Policy of the OECD has produced an excellent survey of this literature, which is found in Section C of volume two. A principal theme of this literature is the attempt to explain productivity, competitiveness and growth, at both the macro and micro levels, by such factors as technology, institutional structure, and culture, in addition to such traditional measures as price, experience and scale.

Although many conventional economists may remain unconvinced by much of this latest round of speculation, its principal arguments appear to correlate with recent trends in organizational and management theory.

Beginning with work done in the universities in the 1960s and 1970s, initially popularized through a spate of books on Japanese management practices, and firmly implanted in the public mind by Peters and Waterman's In Search of Excellence, the view is now widespread that corporate growth depends to a very great extent on such factors as an understanding of what business a company is in, a sensitivity to changing customer needs, and the multidimensional changes taking place in the business environment, shared values, a strong corporate culture and good two-way communications.

Communications and information are integral to all these factors. This has led to the emergence of the concept that communications and information are "strategic resources" whose effective management is essential to corporate survival and growth in the increasingly competitive economic environment. For example, in the recently-published book Infotrends: Profitting For Your Information Resources, Donald Marchand and Forest Horton identify five ways in which information resources have historically yielded competitive advantage:

- by providing intellectual protection through copyright, patents and trademarks;

- by accumulating experience and shortening the trip up the "learning curve";

- through business intelligence;

- by providing instant communications to all parts of the world;

- by improving paperwork control.

They then go into examining seven strategies for future growth made possible by developments in communications and information technology:

- using information resources strategically inside companies;

- using information resources in creative ways;

- using information resources to offer new products or services;

- using information resources to distribute new products and services;

- using information resources in manufacturing;

- getting into the information-management business as a by-product of company operations;

- engaging in collaborative information-management ventures.

The convergence between the various streams of thought identified in this section - new approaches to economic analysis, organizational theory and management philosophy - appears to offer a novel and potentially fruitful approach to explaining and analysing the relationship between communications, information and growth. The net effect of these trends is to suggest that the traditional emphasis in economic analysis on quantitative measures should be balanced by a new concern for qualitative factors, which would see information on user needs and supplier capabilities take its place beside demand and supply curves in policy analysis and formulation.

OVERVIEW OF PART B

PRINCIPLES

This section contains three papers:

- "Communications, Information and Growth: Understanding the Links", surveys alternative methodologies for analysing the communications and information industries and relating them to other sectors of economic activity.

- "Designing the Future: An Overview of the Telidon Impact Assessment", presents the lessons learned through the Telidon program about introducing informatics in Canada.

- "Guiding Principles", summarizes the achievements of previous DOC programs, analyses the problems they encountered and suggests criteria for future action.

DESIGNING THE FUTURE: AN OVERVIEW OF THE TELIDON IMPACT ASSESSMENT

1. Introduction

The development of informatics products and services is a formidable technological challenge. It is also a challenge to 'people' technology - the web of social, cultural and economic arrangements which shape the lives of individuals, groups and nations. Some of these challenges are well understood. The impact of informatics on education and training, employment, economic growth, individual privacy and public life has been the subject of much speculation and analysis. The aim of the Telidon impact assessment is to examine the challenge of informatics technologies at a more concrete level - at the point of interaction between government agencies seeking to promote the development of informatics, industries interested in supplying new equipment and services, and their potential customers - in order to recommend a set of principles to govern program design.

The Telidon program, which ran from 1978 until 1985, was the largest effort ever made by the Department of Communications to support the development and application of informatics technology. In total, some $65M was spent by the DOC and other government departments during this period on a wide range of activities which included: technological and behavioural research; standards, content and product development; industry and marketing support; and raising awareness both of the potential socio-economic impact of informatics, as well as the promise of Telidon technology.

At the outset of the Telidon program, a time when talk of the 'Information Revolution', 'Post-Industrial Society', the 'Third Wave' and the 'Fifth Generation' was sweeping the world, both the general public and Canadian political leaders could have been excused for believing that Telidon was at once Canada's best and perhaps only hope for finding a place of pride in the world of tomorrow. By the end of the program, all concerned had acquired a much more sober appreciation of the opportunities and obstacles facing those involved with informatics technology.

The range and scale of the Telidon program - the sheer variety of objectives which were attempted and the ways in which they were pursued - make it an ideal case study for future informatics programs. If properly discerned and applied, the lessons drawn from the Telidon program may help us one day reach the future which shone so brightly and clearly before those who conceived, designed and executed Canada's first bold step toward the information society.

2. Major Themes

Two main themes stand out in the assessment of the Telidon experience. One is conventional, the other less so:

- The Telidon experience confirms what is often said about informatics - that understanding people's needs is critically important to the successful development of technology, and that content is more important than hardware. There is little need to dwell on these points, since they have bedevilled the developers of almost every new telecommunications technology in the last one hundred years. All past experience seems to indicate that applications of new technologies do not spring fully formed from their inventors' heads, but that they emerge over time through a process of social adaptation and discovery.

- The more pertinent question in an increasingly competitive world is over how much time and through what process this adaptation takes place. The main lesson which emerges from our analysis of the Telidon experience is that the approaches which were used to program design were unable to cope with the rapid rate at which informatics technology provided opportunities for product and service innovation. Since these arrangements, by and large, were modeled on techniques that had worked very well with previous generations of technology - communications satellites, for example - and since informatics technology continues to evolve at an undiminished rate, the apparent inadequacy of traditional approaches strongly suggests the need to invent new mechanisms to support the development, application and diffusion of computer communications technology. Indeed, this is perhaps the principal

challenge posed to people technology by computer communications; its significance may well overshadow more commonly discussed issues such as education and retraining.

The validity of this proposition is obviously tied to traits particular to the Canadian situation, while its applicability to other countries depends upon the extent to which these patterns are replicated elsewhere. Some salient considerations are the following:

- The scale of much of Canadian industry, the nature of our financial institutions and a number of other factors have contributed to a business culture that makes it difficult for Canadian companies to act in anything but their relatively short term self interest. This is recognized as a problem in the economic context of the late twentieth century, and in recent years a good deal of attention has been paid to this issue. For example, there has been a wave of literature examining Japanese management practices, in the search for principles and business practices that could orient western firms towards longer term social goals, not just the bottom line.

- Canada's political and public service institutions have produced a culture in which it has been easier to launch large and relatively expensive programs than small and inexpensive ones. Somewhat paradoxically, this may continue to be the case, even during a period of fiscal restraint. In part, this reflects the inevitable desire of politicians to take on and solve, in highly visible ways, the major problems facing their constituents. In part, it reflects the fact that the bureaucratic machinery put in place to deliver programs and to ensure that public monies are well and correctly spent, tends to be large rather than lean, relatively slow to get started and slow to change. This latter tendency is reinforced by the fact that while, as in all areas of human life, there is a natural reluctance for governments to admit error, the discipline of the political arena is rarely as severe or sudden a master as the discipline of the marketplace.

There should be nothing particularly remarkable or surprising about the observation that, in Canada as in other western societies, there is a gulf and to some degree a clash between the culture of government and the culture of business. Indeed, if we look closely enough beneath the ideological trappings of other systems, it is probably universally the case. The need to do business and the need to govern the conduct of others appear to be irreducible elements of the human spirit. The problem is not to merge one into the other, but to build bridges between them.

In order to address the question of what bridges are most appropriate to supporting the development of new computer communication services, it is useful to draw a distinction between technologies and socio-economic activities which have the characteristics of infrastructure and those which are more ephemeral in nature:

- By infrastructure is meant those technologies, industries and activities which persist in time and which underlie other social and economic activities. Transportation, communications, banking and education are obvious examples. In many countries, most if not all elements of infrastructure are provided by the state. In countries such as Canada where transportation, communication and banking services are, to a very significant degree, provided by the private sector, they are done so under close government scrutiny, supervision and regulation, even where a considerable degree of competition exists. In addition, the industries which supply the equipment required to provide these services, particularly in the telecommunications field, are often given privileged status by governments, through the form of non-tariff barriers, 'chosen instrument' policies, special consideration in government purchasing and other measures designed to insulate them, to some degree, from the realities of the marketplace. In return for these favours, companies which supply infrastructural equipment or services are explicitly or implicitly expected to behave not only in terms of their narrow, short term commercial interest, but also with a view to the welfare of the society whose activities they support.

- By ephemera is meant those technologies, industries and activities that come and go or otherwise move with the tides, trends and fashions that mark the surface of any society. Much of this activity happens largely independently of government action, as long as it does not threaten the general legal order or the values upon which that society rests. To the extent that government attempts to encourage ephemera, it generally does so by handing out money to suppliers, through the tax system, or in direct grants and subsidies. In order to achieve their objectives, these instruments only seem to function effectively in cases where there is well established market for the product or service being supported. In Canada, at any rate, they have proven themselves very ineffective supporters of innovation.

Over time, of course, the picture is not static. Technologies, industries and activities can change status. Some elements of infrastructure fall into the realm of the ephemeral - sailing ships, certain established religions, passenger rail service and the post office all seem to have followed this route. On the other hand, fashions sometimes take root and grow to become elements of social infrastructure. The automobile, sexual equality and informatics arguably fall in this latter category. This second process appears to be the result of a two stage process:

- Over time, it is the result of fitting form to content, of adjusting new technologies and existing social relationships to newly expressed human needs.

- More concretely, it results from the invention of the appropriate machinery for fitting form to content, with the largest social and economic prizes generally going to the countries that first make this discovery. The success of Theodore Vail in turning the telephone from a toy for the rich or an adjunct to postal and telegraph service into a universally available and affordable tool of mass communication, which was accomplished by inventing a social mechanism - regulated monopoly, subsidized rates for residential subscribers and system wide pricing - is a perfect example of this process.

On the basis of these distinctions and with the benefit of hindsight, the central difficulty faced by the Canadian government in the Telidon program was the mismatch between the available tools to support the development of the technology and the nature of the technology. The sponsors of the program certainly saw informatics systems and services of the kind Telidon represented as a new element of social infrastructure. Indeed, the program was ultimately inspired by the loftiest of ideals: in a historical era when information is increasingly recognized as an important source of economic and social power, their objective was nothing less than to ensure universal access to information, and to eliminate the gap between the information rich and the information poor. One day, this vision may materialize. But it is now clear that Telidon and its competitors, during the period of the program and possibly well into the future, are highly ephemeral technologies, subject to constant change and competitive pressures.

The essential story of the Telidon program was its effort to come to grips with this unprecedented situation. It sought to do this in a variety of ways, initially by applying the instruments made available by previous experience. However, it found itself caught in a vicious circle. The ephemeral nature of the technology tended to neutralize mechanisms which had previously proved quite effective in supporting the development of infrastructure. At the same time, available means of supporting ephemera were relatively ineffective in supporting the development of a technology whose possible uses were only just beginning to be explored, and for which no clearly identified market yet existed. Faced with this situation, attempts were made within the program to evolve new mechanisms of cooperation between government, business and potential users of the technology. Although these provided very valuable lessons for future attempts to develop informatics systems and services, they remained something of a subplot in the program, which was locked in by various bureaucratic rigidities that limited its adaptive capacity.

The Telidon program involved three major industry support activities:

- Quite naturally, the program looked first to the established providers of telecommunications services to be the vehicle for developing Telidon

services and equipment. Although all the major telephone companies in Canada sponsored Telidon field trials during the first phase of the program in order to familiarize themselves with the technology and get some sense of the market for videotex services, only one went on to provide an operational service. Looked at in retrospect, their decision not to champion the development of Telidon services was perhaps predictable. The initial applications of new technologies usually occur when they are substituted for existing technologies providing closely related services, or where they tap a market that is not being served by established institutions. With the benefit of hindsight, it seems obvious that videotex did not substitute in any very evident way for existing telecommunications services. It was suited to communication in images, not words and numbers. Interestingly, the Telidon experience also showed that the broadcasting and cable television industries, which are accustomed to communicating in images, were almost equally unable to effectively utilize the new technology, fundamentally perhaps because they were not structured to function as interactive distributors of information products. Instead of being developed by any of the established telecommunications media, the market for Telidon developed most rapidly in areas where it provided an effective substitute for activities falling outside the bounds of traditional telecommunications, or where it filled a communications need that had gone unsatisfied under existing arrangements. Contrary to initial expectations, the market for videotex services and products, in North America at any rate, has developed most quickly in closed user groups and special purpose applications, rather than on publicly accessible networks, or, in the case of the Manitoba Telephone System's Grassroots service to farmers, where an effective communications infrastructure was largely lacking.

- Following the pattern set over the previous decade in the highly successful Canadian satellite communications program, a second program activity concentrated on developing an industrial capability in Canada to manufacture Telidon products under the leadership of a 'chosen instrument'. However, whereas the carefully planned and orderly

process under which the space industry unfolded made it possible for Canadian governments, over the period of a decade or more, to nurture Spar Aerospace to the point where it could function as the prime contractor for Canadian communication satellites, the ephemeral, chaotic development of informatics in the early to mid 1980s made it impossible to replicate the feat with Telidon. A mass market for standalone decoders, the original target of the Telidon industrial strategy, appears unlikely ever to materialize. It now appears that the market for standalone videotex equipment will be restricted to a variety of closed user or special purpose public access applications, while the mass market will continue to be occupied by personal computer software decoders and teletext decoder chips built into television sets. As the prospects for a chosen hardware instrument faded, attention shifted to the possibility of developing a chosen instrument system supplier - a videotex equivalent of a telecommunications or satellite services provider. This possibility also faded before the reality of a competitive, quickly evolving and somewhat chaotic field.

- When the basis of a Telidon industry began to emerge in the early 1980s, including hardware, software, content and systems suppliers, the program called into play a third set of activities modeled on existing industry support programs - essentially, grants of money given to applicants who qualified according to established program criteria. The great majority of companies that received grants to purchase hardware or develop content are still in business, and doing at least moderately well in their chosen fields, even though their performance has fallen somewhat short of original expectations. However, a detailed examination of case histories reveals that these results were more often achieved in spite of the program mechanisms put in place than because of them. It is to the credit of the program staff that they were able to make creative use of the ephemeral mechanisms they had at their disposal.

3. Lessons for the Future

Three main lessons can be drawn from the Telidon experience about the kinds of mechanisms which are most appropriate for bridging the gap between government and the private sector in developing informatics systems and services:

- The first is not to make any assumptions about the final destination of ephemeral technologies. As is suggested above, there is ample historical evidence which can be drawn from many countries, not just from Canada's Telidon experience, indicating that the absorption of new technologies requires a considerable degree of social adaptation and learning. Mechanisms designed to stimulate this process must above all else stimulate it. Learning is best accomplished in individual lives, in societies and in programs in a series of stages, with the results of one experiment feeding forward into the next until the desired level of knowledge or understanding is reached. Mechanisms aimed at accelerating the process should therefore be iterative and experimental in design, incorporating explicit hypotheses which should be assessed in terms of program results. It flies against our experience, as individuals or as social beings, to believe in one-shot approaches to technological innovation.

- As a corollary to this, the sponsorship of specific products, be they hardware, software or systems, appears to be an inappropriate focus of support programs for informatics systems and services. Because of the ephemeral nature of innovative technologies, products are likely to be highly unstable and any attempt to stabilize them through program intervention appears unlikely to succeed. Instead, program emphasis should be placed on conceptual transfer - transferring an understanding of the capabilities of innovative technologies to the private sector - on supporting the efforts of suppliers and users to find uses for new technologies, and on evaluating and disseminating the results. The more intensive the learning process created by these mechanisms, the more quickly the process of social adaptation will occur.

- Finally, while established players should obviously not be ruled out as partners in social and technological innovation, they should not be viewed as the only or necessarily the best collaborators. The Telidon experience demonstrated that established telecommunications institutions pursuing their traditional lines of business may not be very effective in promoting the development of new technologies, even when they are harnassed to considerable government will through outright ownership, or through more subtle forms of government supervision. On the evidence, it appears that they can only be effective when pursuing a distinctly different line of business which incorporates a healthy measure of concern for long term social benefits. If these conditions are not met, the Telidon experience seems to indicate that program designers may be better off looking beyond their traditional clientele to new businesses, to established organizations moving into computer communications from related technological bases, or to elements of society whose communication needs are underserved.

GUIDING PRINCIPLES

1. Introduction

The Speech from the Throne, the Economic Statement and the government's two Budgets have all indicated the priority which the government attaches to the creation of jobs and new sources of wealth through industrial innovation, as well as to reducing the federal deficit. These priorities are intimately related:

- new jobs can be created and existing industries made more productive and internationally competitive through the development and application of new technologies;

- this will lessen demands on the public purse for income support and increase tax revenues, thereby contributing to deficit reduction;

- at the same time, the cost of government can be reduced and its effectiveness enhanced by the application of new technologies;

- because government is the largest market in the country for some of these technologies, government procurement can substantially assist the development of high technology industries.

The Department of Communications can play an important role in meeting these objectives. Each of its major functions can impact - positively or negatively - on the development and application of new technologies in the private and public sectors:

- if properly harnessed to industrial capabilities and market forces, DOC's research program could support private sector innovation in areas where there are clearly identified public or government needs;

- DOC's responsibility for planning and providing government telecommunications services could be a powerful instrument for improving government efficiency and supporting Canadian industry through coordinated procurement;

- communications and cultural policy can contribute to creating an environment that encourages entrepreneurship and innovation in the development and application of new technologies;

- DOC's responsibility for managing the radio frequency spectrum provides a hands-on means of encouraging the introduction of many new technologies;

- the department's international responsibilities offer an effective means of supporting the international marketing of high risk technologies.

Government priorities have given the Department of Communications a clear challenge: to use its instruments to support industrial innovation on the one hand and increase government efficiency on the other. Two fundamental strategic thrusts are required to respond to this challenge:

- DOC must utilize its instruments to reduce the technological, financial and market risks which confront Canadian firms - particularly small- and medium-sized firms - in the innovation process;

- DOC must become the centre of expertise within the federal government for the application of efficiency-enhancing technologies to government operations.

2. Lessons Learned

In devising ways of implementing these priorities, much can be learned from the past. This paper will focus on four major programs undertaken by the Department to promote the development and application of high risk technologies:

- the space program;

- the Telidon program;

- the Elie-St. Eustache fibre optics field trial;

- the Office Communications Systems program.

2.1 The Space Program

When DOC was created in 1969, it took over the work on space which had begun in the late 1950s at the Defence Research Telecommunications Establishment of the Department of National Defence. This work had produced a series of outstanding achievements in the 1960s. Canada was the third nation in space with the launch of Alouette 1 in 1962. This was followed by three other satellites in the Alouette-Isis series, all designed for scientific purposes.

By the middle of 1960s, it was becoming clear that there were many potential practical applications of space technology. In 1967, the government decided to focus its efforts on the application of satellites to telecommunications and resource management. In 1969, it created Telesat to operate a domestic communications satellite system. In 1972, with the launch of Anik I, Canada became the first country in the world to provide commercial communications services with a geostationary satellite.

Under DOC leadership, the government's communications satellite program has evolved through three distinct phases:

- from the late 1960s to the mid 1970s, emphasis was placed on technology development, principally through the Hermes program which ran from 1970 to 1980. The cost of this program was about $70M;

- in the late 1970s, program emphasis shifted to industrial and applications development. The principal means of achieving the

government's industrial development objective was the prime contractor policy which was adopted in 1975 and is still in force today. The main vehicle for promoting new applications of satellite technology was the Anik B program which ran from 1978 to 1983 at a cost of $44M;

- in the 1980s, the program has focussed on the commercial development of satellite communications through MSAT. The cost to date of this program is $26M.

In addition to the amounts spent on Hermes, Anik B and MSAT, the government has invested about $80M in the development of the Canadian satellite communications industry. It has also earmarked an additional $90M for cooperation with the European Space Agency on the Olympus Program through to 1990, of which about $60M has been spent to date. In total, the government has therefore spent about $280M on satellite communications over the past 15 years. On top of the technological achievements noted above, this has generated the following results:

- the achievement, with Telesat's Anik D series, of the objective of supporting the development of a Canadian prime contractor for communication satellites;

- private sector investment of $60M in satellite production and a comparable amount in earth terminal production;

- about 1,000 permanent jobs in the production of communication satellites and 400 jobs in the production of earth terminal equipment;

- 1983 space industry sales of $276M of which 70% was exported, the highest percentage among nations having a space industry. It is also worth noting that Canada is the only country in the world where the value of satellite equipment exports exceeds government expenditures on space.

With respect to satellite utilization, Telesat employs over 400 people and had revenues of $110M in 1984. Its satellites have a total capacity of 108 channels of which 60 are currently being used - 48 by Canadian customers, mostly broadcasters, and 12 by Americans. This ratio of available to occupied channels corresponds almost exactly to the situation in the United States.

In sum, the success of the space program is due to a number of factors among which the following are particularly significant:

- it responded to a clearly identified national need;
- the policy decision to set up Telesat created a market around this need;
- the program took advantage of the R&D capabilities of government laboratories through an ongoing program of technology transfer to industry;
- initiatives to support technology and applications development were generally done in conjunction with users and suppliers of equipment and services;
- federal and provincial government procurement played a significant role in this process;
- the program placed considerable emphasis on international marketing and joint ventures;
- the program evolved as the industry matured, from an early emphasis on technology development to the present concern for commercialization.

The principal problems surrounding the space program have centred on the fact that the policy, regulatory and institutional framework surrounding satellite communications have not always kept pace with technological change.

Controversies surrounding such questions as Telesat's appropriate place in the Canadian telecommunications system, the terms and conditions under which satellite capacity could be leased, satellite broadcasting and the ownership of earth stations have added to the risk faced by private investors in satellite goods and services.

2.2 The Telidon Program

Like the space program, the Telidon program was a major departmental undertaking spanning many years aimed at promoting technology, industry and applications development. It involved the expenditure of significant public funds and generated a great deal of public attention as Canada's first major venture into informatics.

The program, which ran from 1978 to 1985, can be divided into three distinct phases:

- during the first phase, from 1978 to 1981, the main emphasis was on technology development. This was largely done by sponsoring a series of field trials, at least one of which took place in every province. Government investment in this phase was $9M;

- in the second phase, from 1981 to 1983, the emphasis shifted from technology to industry development. Major activities included the Industry Investment Stimulation Program and the effort that was put into securing recognition for Telidon as an international standard. Government investment was $26M;

- during the final phase, from 1983 to 1985, the program emphasized the development of content and applications in the private and public sectors, through the Content Development Program and a number of other initiatives. Government funding was $23M.

In addition, the government invested $7M between 1981 and 1985 in the attempt to develop a broadcast Telidon, or teletext, service on CBC.

In total, the government therefore invested $65M in Telidon. This investment achieved the following results:

- the development of a world class videotex technology which is recognized as the North American standard and one of the three world standards;

- private sector investment estimated at $200M;

- a Canadian videotex industry which currently comprises about 80 firms, provides 750 full time and another 100 part time jobs, did about $30M of business in 1984 and exports over half its production.

The Telidon program's technical achievements were an outstanding success. As the figures cited above indicate, its industrial development activities must also be counted at least a modest success, particularly in the export market where Canadian firms have held their own with their British and French rivals, in spite of the much heavier support provided by the governments of those countries. However, with a few notable exceptions, the program did not succeed in promoting the development of marketable applications in the domestic market.

The principal message which can be drawn from the Telidon program is that in informatics, the Department has so far been more effective in supporting the development of world-class technology than in encouraging its application and diffusion in the domestic market. The conventional wisdom is that in the Telidon program, the Department was pushing a technology that either did not have a market, or not nearly as large a market as the Department believed. Although there is some truth in this view, it is overly simplistic. The Telidon experience also reflects the reality that, too often, new technologies - some of which Canada has developed - have only been adopted in this country after they have been successfully applied elsewhere. This delay between development and application often means the loss of significant industrial benefits - particularly because, over time, the business opportunities involved in applying technology through software, service and content development, training and maintenance far exceed the opportunities provided by hardware development.

A second item of contentional wisdom is that, in future, Canada should refrain from attempting to develop technologies and concentrate on applying and diffusing technologies that are developed elsewhere. Again, while containing a kernel of truth, this proposition is overly simplistic. The opportunities for developing new products based on the fundamental communications and information technologies appear literally unbounded. They are certainly not the preserve of any one nation or set of nations. Indeed, it is apparent that today, there is no such thing as technological sovereignty. All countries involved in technology development import components from the countries where they can be manufactured most cheaply, and international joint ventures to develop technologies are becoming the rule rather than the exception. Canada has no choice but to move with these trends.

Finally, it is equally clear that we are unlikely to compete with the Japanese and the Americans in the production of high-volume, standardized products. However, there are significant opportunities for Canada in integrating these components, through hardware and software development, into new products and systems which respond to our needs - and also have significant off-shore markets.

2.3 The Elie-St. Eustache and Office Communication Systems Programs

The Elie-St. Eustache local distribution fibre optics field trial and the Office Communications System program were relatively small scale compared to space and Telidon - $10 M and $14 M respectively. Both were very successful in meeting their objectives, which centred on developing technology in Canadian industry. In large part, this was because they involved active partnership and risk sharing with users and suppliers of the technologies:

- in the Elie-St. Eustache trial, the Manitoba Telephone System, other carriers and Northern Telecom all contributed matching funds;

- in the OCS program, Canadian companies were given the opportunity to develop integrated office automation systems using selected government departments as seed beds.

One of the challenges before the department in the next few years is to support the application and diffusion of the technologies that emerged from these programs.

3. Conclusions

If we compare our achievements with those of other countries, it seems clear that Canada could have complemented its technological achievements and developed larger markets for products and services based on new technologies more rapidly if it had adopted more effective strategies for promoting their application and diffusion. Specifically, there appear to have been two main obstacles which have not yet been successfully addressed:

- the policy, regulatory and institutional framework of the Canadian communications system has not kept pace with technological change. To some degree, this has inhibited private sector investment in new products and services;

- the efforts made by the Department to encourage the development of new technology were not matched by corresponding efforts to develop marketable applications and content.

In addition to the positive elements identified above, the main lessons that can be drawn from past are the following:

- the Department must adopt a stronger market orientation in policy and program development. Greater emphasis needs to be placed on activities such as technology assessment, analysis of user needs and industrial capabilities, market analysis, consultations with industry and the provinces, marketing support, and standards development. As part of this market orientation, the department should continue to emphasize risk sharing with users and suppliers of new technologies;

- the Department needs to do a more effective job of coordinating its industrial development instruments. DOC has two programs which can directly affect the development and application of high risk technology - its research program and its responsibility for planning and managing government telecommunications. Together they provide the base of technical knowledge which enables DOC to assist other government departments in developing and applying new technologies, thereby creating markets which the private sector can exploit. In an era of fiscal restraint, they are likely to be the main program tools for achieving DOC's industrial development objectives. In addition, if appropriately utilized, the Department's policy and regulatory responsibilities can help create a climate which encourages private sector entrepreneurship, investment and innovation;

- in newly-funded program initiatives, a better balance must be struck between activities aimed at encouraging the development of technology and those aimed at encouraging the development of content and applications.

On the basis of past experience, we have therefore identified five criteria for future DOC action:

- they must respond to clearly-identified public or government needs;

- there must be significant, demonstrable and attainable domestic and off-shore markets for products and services developed as a result of departmental initiatives;

- there must be demonstrable private sector capability or interest in capturing these markets;

- the technological, industrial or market risks associated with these initiatives must be so high that they preclude private sector action;

- DOC, acting alone or in conjunction with other departments, must have the tools to reduce risk to an acceptable level and to encourage an appropriate level of private sector investment.

OVERVIEW OF PART C

PROPOSALS

Part C contains two papers:

- "An Outline of Policy and Program Proposals", suggests policy principles to guide DOC initiatives intended to promote the use of communications and information for Canada's growth, and proposes items for immediate action as well as for study and development.

- "A Program Strategy for DOC", suggests in some detail a program philosophy for DOC.

AN OUTLINE OF POLICY AND PROGRAM PROPOSALS

1. Policy Principles

If Canada is to capitalize on its historical advantages and use communications to support its future growth, it is clear that new principles are required to guide government action in this complex new international environment.

As a first principle, following the evidence presented in previous sections of this volume, government policies and programs should increasingly emphasize the user perspective. In research and development, this means abandoning the technology-driven perspective which has predominated in government research laboratories in favour of a client orientation. If policy and programs, it means less emphasis on activities designed to build new communications infrastructure, and more emphasis on activities designed to promote the more efficient and effective use of existing infrastructure. In fact, there is no shortage of technology in the world today. The main challenge facing Canadians is to use technology more effectively - to improve the quality of our human resources through better education and training; to raise the productivity of our resource, manufacturing and service industries so that they will be able to compete more effectively in the global marketplace; to improve our ability to innovate, to develop new products and services in all sectors of the economy; to assist private and public organizations alike in adapting to the increasingly complex economic and social demands being placed on them through the better management of information resources.

As a second principle, following the general policy orientations of the government, the private sector and the universities should lead the process of using communications and information for Canada's growth, with the active support of the public sector. There are three main ways in which this support can be provided:

- Governments should use their policy and regulatory powers to create a climate which is conducive to the application and use of communications

technology in order to meet these goals. Through its tax and fiscal policy, our government has already taken steps to create a climate that encourages risk-taking, entrepreneurship and investment in Canada. Through the Ministerial Task Force on Program Review, it has sought to streamline federal government programs designed to support innovation, and improve their accessibility to Canadians. The challenge for the Department of Communications is to develop, in conjunction with the provinces, a communications policy for Canada which encourages Canadians to take advantage of the full range of communications technologies now available to us, while protecting their right to basic service at reasonable rates;

- The government should do everything in its power to assist the private sector and other non-governmental institutions in acquiring the knowledge required to put communications technology to work - but it should let users and entrepreneurs, who are in direct touch with market and client needs, make the decisions about what products or services should be developed. The information produced by government research programs, collected through its many contacts in Canada and around the world, and generated by its own experience with communications and information technology is a priceless asset which is not being exploited nearly as fully as it should. One of the principle objectives of the communications program should be to transfer this information, these concepts, these ideas to the private sector, to our schools and to our universities, so that bright young minds can apply them;

- More specifically, governments should do a much more effective job of analysing their own needs for communications technology and services in order to better serve the Canadian public, and examine how their needs can be used to promote the general use of communications in Canada and the development of the Canadian communications industry. One of the main objectives of our government is to improve the quality of the services we provide to the Canadian people, but it has hardly begun to explore the many ways communications technology can help achieve this objective. There are a series of possibilities for doing this, running

from improved office communication techniques, to computer assisted translation, to electronic publishing of government information, to new ways of communicating with the north and other remote reaches of our country. To the extent these possibilities prove practicable, Canadian industry should participate in and benefit from their development. As well as improving government efficiency and effectiveness, such measures would benefit society as a whole, since techniques developed to provide solutions to government problems would in most case be widely applicable.

As a third principle, Canada must learn to look outward, beyond its borders, and increasingly associate itself with the efforts of other industrialized countries to devise future generations of communications technology - and with the efforts of developing countries to use available communications technology to strengthen their economies and improve the quality of their lives. In terms of the vision of global development outlined in the first part of this paper, Canada's vocation may well be to act as the intermediary between north and south, between the first world and the third. As a country, we have a foot in both camps - we are both developed and developing. Canada is already recognized world-wide as one of the leading users of telephone and broadcasting technology. If we make it our objective to become the leading users of new communications technologies, we will have the world at our doorstep. Developed countries will want to draw on our expertise in adapting technology to social needs. Developing countries will view us as an honest broker, a purveyor of products and services designed to respond to client needs, not superpower industrial strategies.

2. Proposals for Immediate Action

As a result of work done over the past two years, there are a number of areas where the Department is in a position to take action immediately to implement these principles.

In the field of telecommunications policy, we are positioned to make progress on a number of important telecommunications policy issues currently

facing the country by continuing and intensifying the process of dialogue begun last year with industry and the provinces. As a result of this process, provincial and territorial ministers responsible for communications met in late February. As a result of this meeting, the Ministers agreed to establish a Committee of Ministers to develop policies acceptable to all parties on such issues as interconnection and the roles and responsibilities of the federal, provincial and territorial governments, taking into account a number of fundamental principles including universal access to telephone service at affordable rates and technological progress to benefit all Canadians. It is vitally important to make progress in this area, since the absence of a Canadian telecommunications policy hinders the use of communications facilities, adversely affects our productivity, competitiveness and growth and unfairly disadvantages Canadians in some regions of the country.

In the field of research and development, action is already underway to reorganize the federal government's communications research program so that it becomes more responsive to the needs of its clients in the public and private sectors, and a more effective partner to industry and the university research community. The communications research program has had a glorious past with many notable achievements to its credit, particularly in the field of satellite communications. However, in recent years, questions have been raised in many quarters about the relevance of the program to government objectives and industry needs. These questions are not unique to the Department of Communications - they are being asked about all government research activities. We have therefore developed proposals to reorganize the research program around a new set of principles, based on a recognition that the client is supreme. Beginning in 1986-87, we intend to phase in these new principles in a series of carefully planned stages aiming at achieving a higher quality, more relevant communications research program. This may eventually lead to the privatization of the communications research laboratories.

As a result of work done over the past two years, we are also poised to launch a number of new program initiatives designed to encourage the development and application of new communications and information technology in support of our government's major economic, social and cultural policy objectives.

- When federal, provincial and territorial Ministers responsible for communications meet in June, in addition to discussing telecommunications policy issues, we intend to propose the creation of a Canadian Program for Advanced Communications Technology, or CANPACT. This program would involve all the governments in the country in the coordinated development and application of communications and information technology, in response to the particular needs and capabilities of each region. It would therefore support a number of economic and social development objectives at the federal and provincial levels, as well as providing the research community with access to a national program potentially equivalent in scope, scientific interest and societal impact to the major programs announced in recent years by our Japanese, European and American trading partners.

- More than half the Canadian workforce are information workers. Most work in offices, at jobs which consist of creating, processing, analysing, storing, and communicating information. The productivity of the private sector and the efficiency of government both depend, to a very considerable degree, on the ability of information workers to work more effectively. A number of years ago, there was a widespread belief that there was a quick technological fix to this problem - that the introduction of computers and sophisticated communications equipment into offices would, in themselves, bring about the kinds of productivity gains in white collar work that the original industrial revolution produced in factory work. Experience both inside and outside government has shown that this is not the case. In recognition of this fact, the department has created a research and development program to examine these questions from the point of view of users, both individual and institutional, and seeks to determine how organizational structures, management practices, products, systems and services can be designed to improve the quality, productivity and efficiency of information workers.

- Like all other industrial sectors, the cultural industries today must cope with the consequences of rapidly changing technology and increasing

international competition. As in other industrial sectors, these developments bring both threats and opportunities: threats - that the already fragile Canadian cultural infrastructure will be overwhelmed and ultimately torn apart by fresh invasions of foreign cultural products; opportunities - to harnass technology, to create new production sources and new distribution channels, to express Canada's cultural realities to Canadians and to the world. In 1986-87, the department is launching a research and development program to examine the opportunities which technology creates in the fields of electronic publishing and video production.

3. Proposals for Study and Development

In addition to the areas where the Department intends to take action in the next year on the basis of preparatory work done over the past couple of years, adopting a user oriented strategy for communications and information will require the planning and development of new initiatives in several fields.

- Canada's future economic and cultural growth will be very significantly affected by the results of the free trade discussions that will shortly begin with the United States, as well as the upcoming GATT round which will focus, among other things, on trade in services. The Royal Commission on the Economic Union and Development Prospects carefully analysed the issue and concluded that Canada would benefit from free trade. It made the negotiation of a free trade pact with the United States its principal economic policy recommendation, and suggested that Canada's long term welfare was tied to a freer trading environment. The Department has undertaken a preliminary sectoral analysis of the impact of free trade on the communications and information industries in Canada. In addition to bringing this work to successful completion, it should examine the free trade issue in light of the blurring of industry boundaries and from the user point of view.

- The international symposium of Ministers responsible for communications being held in Vancouver in June in conjunction with Expo 86 will provide

an ideal opportunity for focussing on the issue of what role Canada should play in promoting the use of communications for global development. The purpose of the symposium is to review issues relating to communications in both developed and developing countries, and to examine ways of bridging the gulf that currently exists between them. If it is correct, as this paper has suggested, that Canada's natural vocation in the world of communications is to serve as a go-between - because of the nature of our country, our past experience and our future prospects - the symposium will provide an ideal forum for Canada to suggest new mechanisms and initiatives that could carry the user perspective beyond our borders and into the world at large.

- From the user perspective, the content of communications is all that matters, not the delivery mechanism. Although Canada has developed a very sophisticated and highly successful process for making policy about communication system, it is a comparative neophyte in the area of information policy. With the important exception of the cultural industries - television, film, publishing and sound recording - there is focal point within the federal government for information policy and no clear strategy in this area. Responsibility for such well defined information policy issues as copyright and the protection of intellectual property, privacy and security is scattered across the federal government, and there is no mechanism for identifying and acting on emerging issues such as the liability of expert systems. The Department is currently serving as the Canadian government sponsor for an important project being undertaken by research groups in Canada, the United States and the United Kingdom, with the objective of advising the governments of those countries on the policy implications of the increasingly important role that information is playing in economic and social development. Over the next couple of years, it is hoped that this research, in conjunction with other initiatives currently being launched by the Department, will put it in a position to recommend an information policy for Canada to the federal government.

- As well as being ill-equipped to deal with information policy issues, Canada has yet to develop effective mechanisms to manage the human resource development issues raised by the growing importance of communications and information in economic and social development. As pointed out in the first part of this paper, the "informatization" of work and leisure activities has important ramifications for the whole process by which individuals are acculturated - primary, secondary and post-secondary education, training and re-training, organizational structure and behaviour. Again, responsibility for these activities is scattered across the federal and provincial governments. It is quite unrealistic to think that any significant degree of integration could occur between these activities. Such is not the nature of our society. Yet there is clearly room for some greater effort aimed at raising awareness, sharing information and coordinating activities than presently exists. From time to time, the Department of Communications has launched promising initiatives in human resource related fields such as instructional technology and distance education, in conjunction with other federal departments and the provinces. It has also, as we pointed out in the previous section, launched a major research program focussed on how organizations adapt to technological change. In the next two years, the Department should examine how it could build upon and generalize these promising initiatives in order to contribute to a national and ultimately to a world scale effort to come to grips with the human resource implications of communications and information.

- In order to successfully develop policies in these areas, as well as others that may be identified through the process of public consultation, the Department must increase its policy research effort on some of the basic questions that underlie the issues identified in this paper. In order to devise practical policies and programs which ensure that communications and information contributed as effectively as possible to Canada's future growth, we will have to know more about each questions as the rate and direction of technological change, its general impact on individuals and groups as well as the structures particular to our society, factors which influence the diffusion and acceptance of new

technologies, the impact of supply-side measures such as tax incentives and grants, and the forms of economic and social analysis which are appropriate to a user perspective.

A PROGRAM STRATEGY FOR DOC

1. The Role of Government

In Canada, the development and application of communications and information technology is largely the role of the private sector, although a number of federal and provincial crown corporations are also involved. However, there are two areas where the federal government, through the Department of Communications, has historically been directly involved:

- the extension of communication services to remote and underserved areas of the country. The space program has been the principal means of achieving this objective;

- the development of advanced communications technologies, such as Telidon and office communication systems. Essentially, these technologies are a new kind of communications infrastructure. They combine telecommunications, computer and information management technologies into systems designed to suit a wide range of economic and social needs - at home, in the workplace and in public institutions. To some degree, these systems are being developed outside the traditional telecommunications infrastructure. However, to be truly effective, they must ultimately be connected to it. They therefore represent an important extension of the Minister of Communications' mandate to "promote the establishment, development and efficiency of communications systems and facilities for Canada" (DOC Act).

In the current policy environment - which is dominated by a concern for fiscal restraint, reduced government intervention in the economy, and private sector leadership in research, development and innovation - it might be questioned whether a case can be made for further direct government action aimed at supporting the development and application of communications technologies. On the basis of government policy enunciated in the Speech from the Throne, the Economic Statement of the Minister of Finance, the Budget, the stated priorities

of the Minister of Communications, and policy documents prepared by his colleagues, the following grounds appear to justify such action:

- properly introduced, these technologies offer the potential of improving the quality of service to the public - a key objective in the Speech from the Throne and the Budget - as well as internal government efficiency. They therefore provide a basis for either reducing the size of the public service, or for responding to steadily increasing public demands without matching increases in the civil service complement;

- these technologies will impact directly on the responsibilities of the Minister of Communications, particularly on the cultural agencies responsible for producing, distributing and storing information - the CBC, the National Museums and the National Library and Archives. All of these institutions need to make important investments in the next generation of communications and information technology, if they are to continue to serve the public effectively in a rapidly evolving technological environment. If properly planned and channelled, these investments could be of significant benefit to Canadian companies involved in the research, development and application of new communications technologies;

- in addition, new communication technologies will affect the telecommunications, broadcasting and cultural industries for which he has legislative and regulatory responsibility. They will raise policy issues which the government will be asked to decide, and government decisions will in turn create an environment which will either favour or discourage the development of Canadian industry in these areas;

- because the federal government is the largest single market in the country for communications and information processing systems, whatever action it takes to develop, apply and purchase these technologies will be of critical importance to the growth of Canadian companies which make products or provide services employing these technologies;

- the high risk associated with the development and application of these technologies - which must be balanced against the opportunities they represent - appears to justify some measure of direct government investment, in partnership with the private sector.

The following sections explore these themes in some detail. They suggest that government policy continues to warrant some measure of direct encouragement for the development and application of advanced communications technologies, even in the current environment of fiscal restraint, if the following criteria can be satisfied:

- proposed initiatives should be designed to assist private sector concerns in capturing clearly-identified opportunities by helping them overcome significant risks which have technological, industrial, organizational, economic, social and cultural dimensions;

- they should respond to clearly-identified public and government needs;

- they should involve the coordinated use of various departmental instruments, including R&D assistance, industry and marketing support, applications programs, government procurement, and the creation of a favourable policy, legislative and regulatory climate.

2. Elements of Risk

Communications and information technologies may be classified as "high risk" if there is a relatively low probability of return on resources invested in their development and application, but a relatively high payoff if these efforts succeed. High risk may be due to a number of different factors including the inherent difficulty of developing an as yet unavailable technology (e.g. artificial intelligence), and the relatively low probability of successfully commercializing a largely available technology where there is a high degree of competition or where market and human implications are not properly understood (e.g. office automation).

High risk technologies typically exhibit some or all of the following characteristics:

- they involve substantial research and development on technical and human factors;

- there is little likelihood of a short-term return on R&D investment; products based on these technologies are often five or more years away from commercial markets;

- these products tend to have a very short life span in relation to the time required to develop them - in many cases, eighteen months to two years;

- the impetus for developing these technologies generally comes from small- to medium-sized start-up companies rather than from corporate giants;

- these companies are potentially subject to strong international competition, in large part because of massive R&D investments being made by other governments.

3. Government and Public Needs

In addition to their general impact on all elements of our society, the technological developments referred to in the previous section have specific implications for user groups falling within the mandate of the Minister of Communications. Work done to date to assess technology trends, market forces and industrial capabilities have indicated a number of areas where there appear to be clearly defined government or public needs which could provide significant opportunities for the private sector to develop and apply advanced communication technologies but where some measure of government program support or policy encouragement is required. Some examples of areas are:

Distribution Systems

a) Satellite Communications: Proposals to support the commercial development of a Mobile Satellite (MSAT) System in cooperation with the United States have been studies by Cabinet and are being further developed as part of the strategic plan for Canadian involvement in space. Plans are already underway to develop Extremely-High Frequency (EHF) satellite systems, initially in cooperation with the European Space Agency's L-SAT Program;

b) Fibre Optic Networks: Fibre optic technologies are currently being deployed by telecommunications carriers on international, intercity and trunking routes. As well, they are being applied in some cable systems and private local area networks (see 4(b) below). Fibre optics transmission and the associated opto-electronic and optical switching technologies are expected to be the dominant communications technology over the next ten-twenty years. Canadian industry has considerable strength in this area and there will be many opportunities for the government to promote the development, application and diffusion of this critical technology - using both policy and program instruments - in the government environment and in the private sector.

Television Technologies

a) Video Technologies: The CBC has estimated that $100M will be needed to acquire new studio equipment for the Toronto consolidation. Canadian industry will require some support to be in a position to compete against Japanese, American and European companies for this very lucrative procurement contract. The market for higher resolution video production, recording and display technologies is particularly important because entertainment applications have historically often led the way in introducing new technologies which ultimately found much wider application;

b) Demand Access Video: Pay television has suffered in competition with videocassette recorders because it cannot offer programs in response to individual demands at specific times. Using new communications systems which combine optical storage with fibre optics distribution, it will be possible to develop "video jukeboxes" containing hundreds of program offerings, and to distribute them on an interactive basis in near real time. This technology could be very important to the future growth and development of the cable and broadcasting industries, and their ability to achieve the cultural policy goals set for them. It also has important implications for program production and copyright policy;

Electronic Information Systems

a) Electronic Publishing: This term refers to the interactive distribution or exchange of text and graphic material through electronic means, often although not necessarily in real time. It differs from conventional broadcasting in that content can be manipulated or tailored to meet individual tastes, demands and needs. In a rapidly changing technological environment, the ability of broadcasters, publishers, videotex operators, to achieve the cultural policy goals which the government has set for them will depend in no small measure on their ability to adopt this technology. One of the goals of policy development and program expenditures in these areas should therefore be to assist Canadian companies in developing the products and services required by these institutions;

b) Machine Assisted Translation: Work is currently underway with the Secretary of State Department to develop a joint program on machine assisted translation. The proposed program would unite the research, development, program management, industry and marketing support and needs analysis capabilities of DOC with the subject matter expertise of SOS. Its fundamental aim would be to improve

the productivity and efficiency of the Translation Bureau in meeting the increasingly heavy demands placed on it, without a corresponding rise in resources;

c) Public Information Access Systems: New communications technologies provide a means for more effectively distributing government information to the public. The Department is currently attempting to develop a health care information system in conjunction with the Department of Health and Welfare to more effectively serve the public's need for preventive health care information. To the extent that it succeeds, the program will also lessen the demand for health care services, thereby reducing the call on the public treasury.

Office Communication Systems

a) The Application of Available Office Automation Technologies: Office automation technologies are critical to achieving the objectives of restraining the growth of government expenditures and improving the quality of service to the public. These objectives require coordinated action by a number of players. As the general manager of the public service, the Treasury Board is responsible for setting overall administrative policy for the application of office automation technologies. The Treasury Board Task Force on Informatics has made a series of recommendations on this subject. They are currently being considered at the senior levels of the Board. As the federal government's purchasing agent, the Department of Supply and Services is responsible for pooling departmental requirements and ensuring that they are directed to the benefit of Canadian industry. The Department of Public Works, for its part, is responsible for all aspects of building design, construction and management. The Department of Communications has a critical role to play in support of the efforts being made by these central agencies to promote office automation. This role has two main elements. First, DOC's responsibility for planning and

providing government telecommunications means that the Department is responsible for developing the communications infrastructure required to support office automation in the federal government. Second, the expertise which DOC has acquired in the technical, organizational and human aspects of office automation through the OCS program, as well as the research capabilities of the CRC and the CWARC, put the Department in a unique position to advise and assist other departments and agencies in specifying, designing, developing and acquiring office automation systems which meet their needs. Policy and program proposals to carry out these responsibilities are currently being prepared.

b) Local Area Networks: Office automation technology springs from three sources: telecommunications, EDP, and the development of standalone products designed to automate discrete office functions. Currently available technologies seek to integrate these into systems designed to serve specific organizational units. This was the goal of the OCS program. The next stage in this evolutionary process is to extend the range of office functions which are automated (particularly to include better telecommunications, information gathering, storage and retrieval systems), to enhance the intelligence of the resulting systems and to develop the networks required to connect and extend them to larger organizational units. Local Area Networks (LANs) - which serve work groups, offices, buildings, campuses, factories and farms - are emerging as the central communications infrastructure for achieving these objectives. The construction of the new national museums and the new CBC headquarters could provide Canadian companies with the market required to enter this area, if these projects are accompanied by an appropriate technology development program.

c) Automated Information Storage and Retrieval Systems: As mentioned previously, one of the great challenges in communications will be to develop means of effectively using the large amounts of

information made available by the new technologies. The storage capacity of optical discs, which approach that of the human brain, presents a particularly interesting problem. By marrying the document processing capabilities of optical scanners and laser printers, the ability of expert systems to emulate human mental processes, and the storage capacity of optical discs, it will be possible to develop much more efficient storage and retrieval systems than currently exist within the public service. Systems of this kind are particularly needed in the national museums, archives and libraries, as well as in general office applications.

4. Government Instruments

In fields where the government decides to attempt to capture the benefits of advanced communications technology for Canada by using its own requirements or public needs as a catalyst, it faces the difficult task of selecting and coordinating the most appropriate instruments for achieving its objectives.

Ultimate success in developing and applying advanced communications technologies in the areas identified above requires the use of many instruments and the involvement of a large number of departments and agencies, both as users of technology and as suppliers of policy and program inputs. Major players include the Department of Finance, which is responsible for setting the government's fiscal framework and establishing a climate conducive to private sector investment; the Department of Regional Industrial Expansion, which is the principal source of industry support funds; the Department of External Affairs, which has overall responsibility for trade and foreign relations; and the central agencies which collectively manage the internal affairs of the Public Service - the Treasury Board, the Department of Supply and Services, the Department of Public Works, and the Public Service Commission.

Within this galaxy, the role played by the Department of Communications is based on DOC's unique expertise in both the technical and the human aspects of advanced communications systems - an expertise which no other department or agency can provide. In playing this role, the Department also makes use of a

unique set of instruments, comprising responsibilities for R&D, applications program management, industry and marketing support, common services planning and procurement, and policy. In sum, this role is seven-fold:

- to establish a clear set of development priorities - reflecting user needs and industrial opportunities - through a program of technology and policy assessment as well as industry and market analysis studies;

- to mobilize the R&D resources of the Communications Research Centre (CRC) and the Canadian Workplace Automation Research Centre (CWARC), in support of these priorities;

- to assist user departments and agencies in developing and applying advanced communications technologies;

- to assist Canadian industry in marketing the resulting products and services;

- to provide the communications infrastructure essential to the application of advanced communications technologies in the federal government through the Government Telecommunications Agency;

- to provide the policy and regulatory climate required to encourage the application and diffusion of advanced communication technology throughout our economy and society;

- to support the development and use of common standards.

By making coordinated use of these instruments, concentrating initially on the many opportunities which arise in the Minister's portfolio, the Department will be able to provide invaluable support to users and suppliers of these technologies.

5. Government as a Customer

The four broad areas identified above for policy and program initiatives differ with respect to the principal instruments which the department can use to address them. In two areas - distribution systems and new broadcasting technologies - the major instruments are policy and regulation. In the other two - electronic information systems and office communication systems - the main instruments are government procurement and related industry support measures. The purpose of this section is to set out for discussion some of the central features of strategies revolving around government as a customer.

Possible Approaches

There are three basic options for promoting the development and application of advanced communications technologies, using government as the 'first customer':

a) Status Quo

A number of positive steps have been taken in the government in past few years to encourage the development and application of advanced communications technology within the government environment, and to extend the resulting benefits to the private sector. A Treasury Board task force has made recommendations on the application of informatics in government departments. The Department of Supply and Services has made advanced communications and information technologies a central focus of its annual strategic procurement plan. Both the Departments of Regional Expansion and External Affairs have placed high technology goods and services at the centre of their program delivery activities. Many departments and agencies are awakening to possible applications within their fields of responsibility. The main danger in simply continuing the status quo is three-fold:

- key players may not awaken in time. The Department of Public Works, the Post office and the Public Service Commission are examples of central government agencies that are probably not yet playing the roles of which they are capable in the development of advanced communications technology;

- if user departments are left entirely to their own devices in developing and applying advanced communications technology, a great deal of inefficient learning and needless redundancy is bound to occur, resulting in lost opportunities for productivity gains and industrial benefits;

- even if central agencies and user departments are fully alert to the benefits of developing and applying these technologies, their efforts may be uncoordinated or at cross purposes if they are not founded on a common information base covering the technical and human aspects of advanced communications technology.

b) A Centralized Program

A natural reaction to the prospect of technological ad hocery or anarchy is to mount a centralized program to address the problem. However, this does not appear to be a practical response to the challenge posed by advanced communications technologies. It is impractical because of the realities of the fiscal environment. More importantly, it is impractical because centralized programs - which often involve long time horizons and large-scale, standardized activities - simply do not work very effectively in highly volatile technological and organizational environments. Experience in Canada and other countries tends to confirm this. The speed with which technical and human parameters are evolving reduces the chances of a successful 'megaproject' approach in a political/public context to virtually zero. There are only two exceptions to this rule. First, effective technology development is impossible without a sound,

technically advanced telecommunications infrastructure. It is therefore vitally important that the role of the Government Telecommunications Agency in planning, providing and coordinating the procurement of government telecommunications be strengthened. Second, it would be most undesirable for other departments and agencies to attempt to duplicate the expertise of the CRC and the CWARC in the technological and human aspects of advanced communications technology.

c) A Decentralized Program

In light of the foregoing considerations, the option which appears to make the most sense is to equip the Department of Communications with the policy mandate and program resources required to support the central agencies and user departments by:

- identifying needs for advanced communications technologies;

- providing R&D assistance in developing products and services which meet their needs;

- managing the application of these technologies in a minimally disruptive fashion;

- evaluating the impact which technology innovations have on human and organizational elements, both within user departments and client groups, and suggesting product or service modifications which may be indicated;

- assisting Canadian industry in marketing products developed for government clients;

- publicizing the lessons learned.

In order to carry out this role effectively, and in particular to help ensure that government applications of advanced technologies are ultimately of benefit to the private sector, it will be necessary for the Department to maintain an up to date database on technology trends as well as industry and market developments.

Suggested Guidelines

On the basis of the foregoing analysis, the following framework should guide the formulation of policy and program proposals to promote the development and application of advanced communications technologies by using government as a customer:

a. Policy and program proposals must be consistent with overall government policy. This means that:

- in line with the policy enunciated in the Speech from the Throne and the Economic Statement, their principal objective should be to contribute to fiscal restraint by improving government efficiency and to contribute to national reconciliation by improving the quality of government service to the public;

- following the policy on technology, innovation and industrial development prepared by the Minister of State for Science and Technology and the Minister of Regional Industrial Expansion, they should ensure that leadership in the innovation process is returned to the private sector, that the activities of the Communications Research Centre and the Canadian Workplace Automation Centre respond to the needs of the private sector, and that government procurement - at all levels - is used to support the growth and development of Canadian companies which manufacture or provide advanced communications technologies and services;

- in the spirit of Cabinet's decision on the MSAT program, they must provide an appropriate sharing of risk between the government and the private sector, taking into account the complete range of instruments available to the government, including fiscal and non-fiscal measures.

b. Policy and program proposals must also be consistent with the fundamental strategic principles set out in the Minister's March 20, 1985 letter to the Chairman of the Cabinet Committee on Economic and Regional Development describing his priorities. In line with the principles that cultural activities are increasingly important to all forms of economic activity and that communication systems should be developed to ensure the effective distribution of cultural products, the proposed DOC initiatives should have three principal objectives:

   - to encourage the development of intelligent communication systems - i.e. systems embodying hardware and software elements which more closely emulate human intellectual, perceptual, organizational and cultural faculties, improve the quality of content, and enhance the capability of users to deal meaningfully with the ever increasing amounts of information available in electronic form;

   - seek to eliminate barriers to communication between different hardware devices, software programs and communications systems by promoting common standards and the development of interfaces.

   - to make effective use of new transmission technologies to deliver services in a cost effective way;

c. In order to provide the impetus necessary to successful policy and program implementation, the government should recognize as a matter of national policy the important contribution which new

communications technologies can make to improving the quality of service to the public and the internal efficiency of government. It should accord priority to the development and application of new communications technologies in response to clearly defined government and public needs, in areas where there is a reasonable expectation that industrial and economic benefits will flow to the private sector from government investments. To the extent possible, the private sector should share the risk of developing these technologies with the government in some fair proportion to its capacity to pay and anticipated benefits.

d. The way in which these policy recommendations are implemented should be consistent with the government's desire to transfer the lead in technology development and innovation to the private sector. One way of achieving this objective is to allow government departments to serve as laboratories or test beds within which Canadian companies can develop innovative products or services. Although this would involve some expenditure of new money, the funds required to support small-scale, developmental projects are not large in comparison to the cost of operational systems. Since departments will eventually be making massive expenditures on new systems - for example, the federal government office automation market alone is expected to reach $500M by 1990 - it would seem to be 'penny wise and pound foolish' not to invest some additional resources in development projects designed to give Canadian companies the chance to compete for the large markets that will materialize in Canada and elsewhere;

e. This policy should recognize that it is beyond the financial and human resource capacities of many Canadian firms - particularly the smaller firms which are often the source of product and service innovation - to undertake more than a small part of the R&D required to develop high risk technologies. A significant portion of this work will therefore have to be done in the departmental laboratories at the CRC and the CWARC, or funded in industry through the DOC

research program. However, this is consistent with the government's desire to align the work of federal laboratories more closely with industrial needs;

f. The policy should also recognize that Canadians cannot do everything themselves. Alliances should be encouraged between Canadian firms and foreign companies. Massive investments in these new technologies are being made by giant multinationals as well as by governments in the United States, Japan, France, the United Kingdom and the Federal Republic of Germany. Canadian strategy must concentrate on developing technology only in those niches where we have some clear advantage. More importantly, efforts should be focussed on integrating Canadian and foreign technologies into complete systems and providing them on a turnkey basis;

g. As the OCS program demonstrates, it does little good for government to help industry develop technologies if it is not prepared to purchase the resulting products and services, once they become fully operational and commercially available. Any high risk technology development program with the characteristics described in the preceding paragraphs must therefore be complemented by a program to encourage and assist government departments and agencies in applying developed technologies to their ongoing operations. A high risk communications technology program would therefore have two distinct phases. During the first or developmental phase, Canadian companies would be assisted in developing high risk technologies through a program which mixed support for needs analysis, research, technology development, international technical cooperation, small-scale experimental field trials and evaluation, in selected departments. During the second or applications phase, the resulting systems would be widely applied on an operational basis, with industrial and marketing support to assist companies in reaching beyond the government market;

h. Understanding people's needs and the functioning of organizations is absolutely critical to the development of new technologies, as well as to the application and diffusion of established products or services. This is particularly so as technology begins to exhibit an increasing number of human attributes. These concerns must accordingly have a central place in the strategy. Needs analysis should be the point of departure for both the developmental and applications phases of the program, and a constant point of reference throughout;

i. The provinces must be actively involved in this program, both because they enlarge the available laboratory and eventual market and because their involvement will help ensure equity in the distribution of development efforts;

j. In light of the foregoing, specific policy and program proposals should be developed bearing in mind the following model of DOC's role:

- the Department's fundamental mission is two-fold: to provide the telecommunications infrastructure required to develop advanced communication technologies in government departments and agencies; and to advise and assist central agencies and user departments in formulating and assessing policies and programs for the application of advanced communications technologies;

- in order to carry out this mission effectively, the Department must marshall the research resources of the CRC and CWARC and direct them in support of a clear set of technology priorities based on an assessment of technology trends, user requirements, industrial capabilities, market opportunities, and organizational and human impacts;

- initiatives proposed under this model to encourage the development and application of advanced communications technologies should be small-scale and designed to provide for rapid learning and iteration, in view of the risks inherent in the technological environment and in the organizational and human impacts of these technologies;

- once advanced communications technologies have been developed to a market ready state, the Department should provide advice and assistance to user departments and agencies in analysing their needs, specifying their requirements, procuring hardware, software, and systems, managing the application of these technologies in operational settings, and evaluating the results, which should then be fed forward into the process of developing the next generation of advanced technology;

- the Department should provide support and advice to Canadian companies on marketing products and services developed for government customers;

- the role of the Government Telecommunications Agency in providing the telecommunications infrastructure required to permit the development and application of advanced communications technologies and in facilitating communications between different hardware, software and systems should be recognized and enhanced.