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Ministère d'État

Science and Technology
Canada

Sciences et Technologie
Canada

Towards 1990: Technology Development for Canada

Canada

Foreword

Canada, along with the other industrialized nations of the world, stands on the frontiers of a new age. The exciting future will be shaped by the technological advances of today.

Canada's rich and varied resources, its scientific and technological talent, and its dynamic and innovative spirit are the key to our success in the new age. We have achieved a high level of technological development, but we must continue to invest in research and development to maintain our position as a world leader.

Towards 1990:

Technology Development for Canada

The world is changing rapidly, and technology is the key to our success in the new age. We must continue to invest in research and development to maintain our position as a world leader. The federal government has placed a high priority on technology development, and we must continue to invest in research and development to maintain our position as a world leader.

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A program of this kind is only possible if we effectively use the opportunities of the 1980's.



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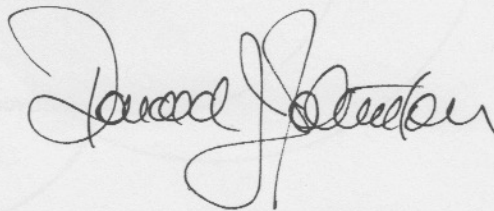
Canadians can be justifiably proud of this country's contributions to science and technology. We were the first country to operate a domestic communications satellite system and we have achieved an international reputation for excellence in remote sensing, space science and telecommunications. The dramatic performance of the Canadarm during the flight of the space shuttle Columbia is another Canadian success story.

The Government of Canada is determined to ensure that our tremendous technological potential is used to the maximum economic and social benefit of the country.

The working group on science and technology established at the June 1982 Summit Meeting in Versailles emphasized in its recent report the pervasive effects that science and technology are having on all our lives and called for greater awareness and planning for these changes by all governments. Canada was a part of this working group, and has been quick to respond to the challenges presented in the report.

The federal government has placed a high priority on bringing technology into the mainstream of economic policy development so that the benefits of existing and proposed technologies can make their maximum contribution to the future well-being of all Canadians.

A prosperous 1990 is only possible if we effectively use the opportunities of the 1980's.



Donald J. Johnston
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A Technology Policy for Canada

What Policies Affect Technology Development?

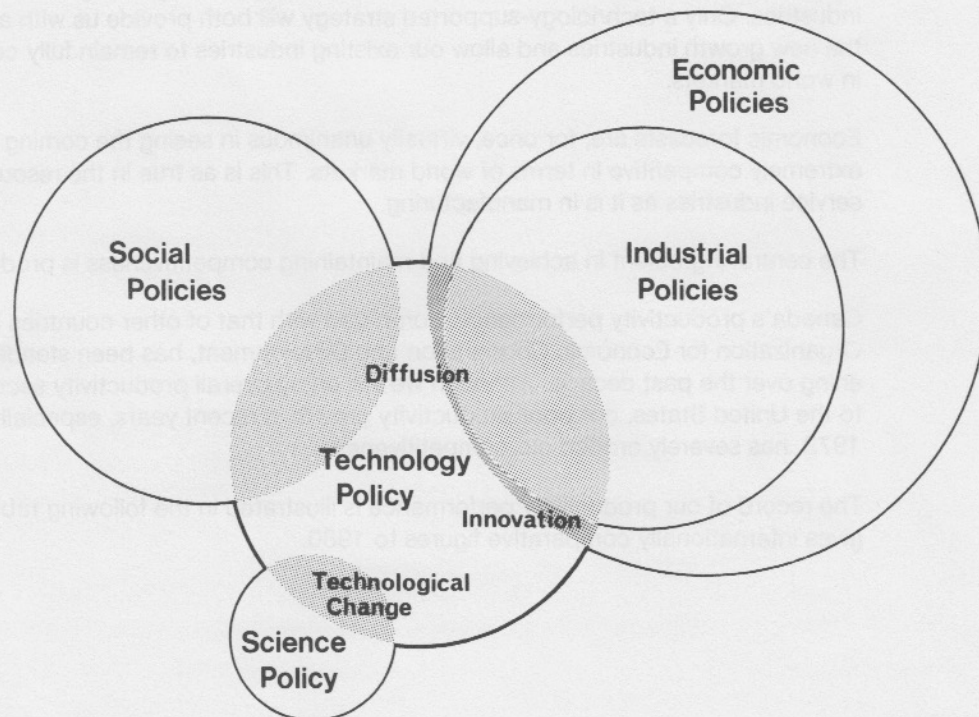
Technology policy concerns the development, application and diffusion of technical and scientific knowledge in the Canadian economy. One of the most important characteristics of such a policy is that *it cannot stand alone*.

Technology policy is related to both economic and industrial policies, and indeed it cannot be fully effective without this interdependence. Nor can it be separated from social policy as it also has an impact on employment, health, environment, lifestyle and other social issues.

Nor can technology policies be considered in isolation from science policies; the basic research fundamental to scientific progress has often provided the inspirational source for remarkable leaps in technological development.

The following diagram schematically simplifies these complex interrelationships.

Technology Policy Its Scope and Character



The diagram also highlights three central aspects of the role of technology in the economy:

technological change - which is the acquisition of new knowledge about methods to produce goods and services;

innovation - which is the introduction of these methods into the regular system of production of goods and services; and,

diffusion - which refers to the widespread adoption, purchase and use of new techniques or products.

These differing aspects of the role of technology in the economy emphasize the broad spectrum of issues which a comprehensive technology policy must address. Included in its scope are the research, development, design and marketing aspects of technology as well as scientific and engineering expertise. Equally important is the effect of technological change in workplace. The degree to which a technology policy is designed to particularly influence any one of these three aspects of technology development profoundly affects the character of the technology policy itself.

Technology and Economic Development

A technology-supported economic development strategy is the most effective route for Canada to follow to meet the challenges of the next decade. We will continue to have our resource strengths, but we have to choose whether to supplement them with technology or to use our scarce resources to support a growing list of non-viable industries. Only a technology-supported strategy will both provide us with a share of the new growth industries and allow our existing industries to remain fully competitive in world markets.

Economic forecasts are, for once, virtually unanimous in seeing the coming years as extremely competitive in terms of world markets. This is as true in the resource and service industries as it is in manufacturing.

The central ingredient in achieving and maintaining competitiveness is productivity.

Canada's productivity performance, compared with that of other countries in the Organization for Economic Cooperation and Development, has been steadily weakening over the past decade. Although we still enjoy overall productivity second only to the United States, our poor productivity growth in recent years, especially since 1973, has severely eroded our competitiveness.

The record of our productivity performance is illustrated in the following table which gives internationally comparative figures to 1980.

Table 1
Average Annual Percentage Change in Real GDP per
Person Employed; For Selected OECD Countries

Countries	1960/ 1980	1960/ 1967	1967/ 1973	1973/ 1980
Canada	1.7	2.5	2.9	0.0
United States	1.5	2.7	1.6	0.2
United Kingdom	2.2	2.4	3.4	1.1
France	4.1	5.0	4.7	2.6
West Germany	3.8	4.0	4.8	2.8
Japan	6.5	8.6	8.3	3.0

Source: OECD Economic Outlook, "Historical Statistics, 1960-1980".

The sources of growth in productivity are complex and poorly understood. Investment, management, industrial relations and skills training all have key roles to play. However, in today's industrialized world, no ingredient of productivity growth is more important than technology.

Objectives for a Technology Policy

Within the fast-paced environment of technological development, national objectives have an important role to play.

Such objectives focus our efforts on the longer term economic goals that can be achieved through increased management of technological change. They also provide guidelines for the policy decisions that must be taken by the federal government to achieve our technological potential. At the same time they ensure that the benefits of technological change are shared equitably by all Canadians. The federal government has established objectives for a technology policy for Canada within the context of its role *vis-à-vis* the other sectors.

The general objectives of the federal technology policy are:

- To strengthen the Canadian economy through the development of new technologies for producing goods and services and the widespread adoption of new and existing technologies;

- To manage the process of technological development so as to ensure that Canadians are aware of both the opportunities and the problems that might arise;

- To ensure that the benefits of technology development are shared equitably among all Canadians in every region; and,

- To create a social climate that places a premium on scientific and technological excellence, curiosity and innovation.

In addition to these broad objectives, the federal government has set for itself more detailed objectives in relation to the other sectors involved in technology development.

The Business Sector

The objectives relating to the business sector reflect the primacy of the private sector in initiating innovation and new investment, and relate primarily to providing support to the private sector. These are:

- To continue to provide an overall business environment that encourages investment, innovation and enterprise;

- To ensure that the current industrial support programs for technology development are working as effectively as possible towards achieving economic and technological objectives;

- To ensure that firms operating in Canada are aware of, have simple access to, and apply the most productive technologies available to ensure their continuing competitiveness;

- To ensure the development of internationally competitive high technology industries in Canada, suited to our knowledge base, resource base, and industrial structure; and,

- To ensure that industry is able to obtain the best possible information with regard to technological forecasting and assessment.

The University Sector

Within the context of the university sector's traditional functions, which are to acquire, store and transmit knowledge, the objectives relating to the university sector are:

- To create a core of excellence within the university structure that undertakes research relevant to industry;
- To form the research manpower required to meet the objectives of the technology policy;
- To increase the responsiveness of universities to the research and technology of industry; and
- To make industry more aware of the contributions which universities can make to the process of technology development.

The Labour Sector

With respect to the labour sector the objectives are:

- To encourage labour-management mechanisms both at the level of the firm and at industry and national levels that will permit joint planning with respect to technological change; and
- To support labour in studying the issues brought about by technological change and in educating both organized and unorganized labour, and in particular women workers, and the general public on these matters from a labour perspective.

The Government Sector

With respect to the research and technology development performed or funded by the government sector itself, the objectives are:

- To ensure that all federal programs and policies related to technology development contribute as effectively as possible to overall federal objectives for technology and economic development;
- To ensure that research undertaken in federal laboratories in support of technology development is relevant to industrial requirements and compatible with the stated economic objectives; and
- To ensure that Canada develops and maintains a national competence in the research and development necessary for technology development.

The Provinces

The federal government intends to work with the provincial governments:

- To achieve harmonization of technology related policies and programs; and
- To provide an environment which encourages interprovincial cooperation.

Social Issues and Human Resources

To support individuals and institutions in responding to the changes, challenges and opportunities posed by technological development, the federal government has set the following objectives:

To ensure that all Canadians are aware of the implications of technological change on their lives;

To anticipate the impact of technological change, and to minimize its negative impacts, in close consultation with those most likely to be affected, particularly working Canadians whose jobs may be threatened;

To provide access to the training and educational opportunities that will help individuals take advantage of new opportunities; and

To ensure that individuals in all regions of the nation have similar ranges of opportunity, and that all regional economies take advantage of technological opportunities in line with their comparative advantages.

Implementation of the Policy

Sub-Committee on Technology Development

A policy for technology development will only be effective if it is implemented through a broad spectrum of economic, social and science policies. To accomplish this, the Prime Minister has established a special Sub-Committee of Cabinet chaired by the Minister of State for Science and Technology and for Economic Development to deal with all matters concerning technology development. This group of Ministers, and their supporting federal officials, are dedicated to achieving our technology-supported economic development strategy. Because of their departmental mandates, they also have the power, resources and influence to bring about change, not only through establishing new programs, but also through adapting existing ones.

This organizational initiative will integrate the critical technology development decisions in all the policy areas which are important to the effective mobilization of our technology resources.

The Sub-Committee on Technology Development provides a vital policy link which will be demonstrated through increased coordination of the federal incentives which encourage research and technology development in both the university and the business sectors. It also provides the opportunity to better mesh research currently undertaken in the federal government for technology development with our national industrial development.

The Sub-Committee on Technology Development will also assess the social impact of technological growth and initiate programs to ease the negative aspects of technological change on our social environment.

Current Federal Support to Technological Development

The federal government supports technology development through research and development within its departments and agencies and also through incentives provided to the industry and university sectors and through contracts for procurement of high technology goods or research itself.

In 1983/84, the federal government will be spending \$3.0 billion on the natural and human sciences in Canada.

Federal funding of science and technology activities performed in the university and industry sectors is budgeted at over \$1.0 billion for this next fiscal year. This does not include the tax incentives which, in terms of foregone federal revenue, are estimated to benefit industry by over \$200 million.

Federal incentives for technology development range from tax incentives, to grants and contributions, to direct technical assistance, to government procurement, and to labour adjustment programs. Each of these forms of assistance is designed to support a particular aspect of technology development.

For example, research and development tax incentives are fiscal policy measures which help improve the risk ratio for technology investment for companies with sufficient cash flow. Smaller companies in more urgent need of cash flow to support R&D investment are assisted through direct financial incentives which are closely related to other industrial policy measures.

The federal government is concerned with the effective delivery of the programs in support of technology development and through the Sub-Committee on Technology Development intends to review the "mix" of programs regularly to ensure the scope of support for technology development is adequate.

The current programs and incentives are described in the publication "The Government of Canada's Support for Technology Development".

New Initiatives—The Budget

Tax Incentives

Although Canadian tax incentives for research and development are among the richest in the world, the federal government, in response to requests from industry, has proposed improvements to these incentives to enhance the ability of firms, particularly smaller ones, to benefit from them. These changes would make the incentives simpler and more effective, and allow R&D performing firms to use tax incentives to attract outside financing.

The first proposal is to replace the current 50 percent deduction for incremental R&D expenditures—increases above a firm's three-year average—with a 10 percentage point increase in the present tax credit applying to all R&D. This would double the base rate of R&D tax credit from 10% to 20%, while the rate in the Atlantic provinces and the Gaspé would rise from 20% to 30%. Small business corporations would be eligible for a 35% R&D tax credit.

The second proposal recommends a flexible mechanism which would allow R&D companies to attract new investors. Under an agreement with the investor, the R&D performing corporation would renounce the benefits of R&D tax deductions and credits, and in turn, the investor would be eligible for a special 50% tax credit for funds invested.

The April 19 Budget also outlined changes in the existing federal investment tax credits which apply to R&D tax incentives. The Budget increased the carry-forward and carry-back provisions to 7 years and 3 years respectively, and also proposed that a portion of the tax credit earned between the Budget date and June 30, 1986, could be refundable. These portions would be 40 % for small or unincorporated firms and 20 % for others.

The R&D tax proposals would add \$100 million to the current level of support. In addition, the general budget measures will provide \$85 million of further tax support for companies specializing in the R&D field.

Improved Research Facilities

Under the Special Recovery Capital Projects Program, which was announced in the April 19 Budget, research and training facilities critical to mastering new technologies will receive accelerated funding totalling \$290 million over the next four years. Fifteen new facilities will be built in all parts of Canada over the next four years. In addition, approximately \$180 million will be allocated for high technology procurement.

Human Resource Development

To take full advantage of the opportunities offered by technological change, Canada will increasingly need well-educated and well-trained workers. Moreover, workers will have to acquire new skills and knowledge throughout their working lives. The federal government is allocating an additional \$155 million for human resource development programs. This will bring to \$1.2 billion this year the funds allocated for skills development in occupations that are significant for economic growth. Over 250,000 Canadians, half of them young people, will benefit this year from federal support for human resource development. In addition, funding under the Canada Student Loans Act will be expanded by \$60 million to \$141 million this year.

Other New Initiatives

Several other new initiatives to foster technology development in Canada have been undertaken by the federal government on the recommendation of the Sub-Committee on Technology Development. These are the first of a number of proposals the Sub-Committee will be considering.

Each initiative supports the objectives of the Technology Policy, and encourages the various sectors within the economy to work and plan in close cooperation.

The total costs of these new initiatives will be \$100 million over the next two years.

Productivity and Technological Adjustment

A broad national effort in the years ahead will ensure that Canada remains one of the most productive, prosperous and competitive economies in the industrialized world. To encourage concerted action in areas of mutual concern, the federal government will consult with labour unions and business organizations to launch a national drive towards higher productivity and employment growth. The first task of these consulta-

tions is to establish a founding committee for a *national centre for productivity and employment growth*. The founding committee will be asked to recommend an appropriate name, mandate, structure and mode of operation for the centre.

Regional Support

The federal government is providing additional funding for regional technology development through expansion of the National Research Council's *Industrial Research Assistance Program*. In particular, the *Field Advisory Service* and the *Technical Information Service* will expand their current services to small and medium sized businesses. These programs provide technical information and advice to help solve manufacturing problems, to improve productivity and to promote the use of research results in industry.

The federal government is also strengthening its support of *joint university/industry technology research* efforts.

The objectives of this support are:

- to generate and maintain a core program in a field of specialization and to develop new technologies;
- to train the research manpower required by industry in the development and application of advanced technologies and to teach postgraduate courses; and,
- to perform specific R&D for participating industries, carry out joint research programs with industry, and perform contract research.

Potential fields of operation include microelectronics, artificial intelligence, biotechnology, materials research, manufacturing technologies, and space technologies.

University Support

Universities provide a valuable base for technology development through their fundamental research and their training of skilled researchers and manpower for technological expansion. The federal government will support university research through increased funding to the Natural Sciences and Engineering Research Council. The Council is the largest single funder of university-based research in Canada. Continued support for the Council's Five-Year Plan will encourage continued expansion of research training and research support programs and allow the Council to launch the new programs required to train the specialists needed to meet Canada's objectives for research and technological development.

Microelectronics

The federal government will be establishing a *National Microelectronics Design Network* comprising a nation-wide, university-based, computer-linked network of design and testing stations for Very Large Scale Integrated Circuits (VLSI).

The design network is an extension of a project currently supported by the Natural Sciences and Engineering Research Council in conjunction with Queen's University and Northern Telecom Canada Ltd. Through a coordination centre at Queen's University, ten Canadian universities are now submitting chip designs to Northern Telecom for fabrication free of charge. The fabricated chips are subsequently returned to the universities for testing and use in experimental systems.

About thirty universities are expected to participate in the expanded design network. These facilities will help provide the trained and experienced manpower which is critical to the expansion of the Canadian microelectronics industry. Enhanced collaboration between industry and Canadian universities as well as opportunities for the exploitation of software research will also result from this initiative.

Biotechnology

Biotechnology is one of the most important emerging technologies. Advances in biotechnology will radically transform both products and processes in the energy, food, drugs, chemicals, plastics, mining and agriculture industries.

To help ensure that Canada fully benefits from this technology, the federal government has endorsed a *National Biotechnology Strategy* which, as its first priority, will be establishing research networks in government, university and industry and concentrating efforts in areas of critical importance to Canada's economic future. The federal government will encourage strong cooperation between university and industry by matching all industrial contributions with federal funds. These networks will be focussed on improving the use of Canada's resource base and on industrial development.

A Biotechnology Advisory Committee will also be established to advise the Minister of State for Science and Technology and for Economic Development on all matters related to biotechnology, including the means to improve the effectiveness of the strategy as new frontiers in technological development are forged.

Communications

Canada is a world leader in communications technology. To further develop our strength in this area, the federal government is proposing the creation of a Canadian Communications, Informatics and Space Research and Development Institute. As a non-profit corporation, it would conduct research and development in the allied fields of telecommunications, space technology, informatics and computer sciences. A Task Force, headed by the Minister of Communications, will assess the viability of the proposed institute.

Public Awareness

We are entering a technological era when most career and day-to-day activities directly involve working with, understanding and living comfortably with science, mathematics and technology. A growing number of personal, public and professional decisions require awareness and familiarity with the activities, principles and methods of science and technology. A better understanding and familiarity with science and technology can help us:

- Encourage our youth to enter fields of scientific study so we can develop the highly skilled scientists, engineers and technicians we require to develop our technological potential;

- Encourage people in the labour force to watch for and welcome retraining opportunities in areas of technological change;

Develop managers and decision makers who understand the nature and implications of technological development and more readily make the required adjustments; and

Encourage citizens to follow and weigh the progress and implications of science and technology.

The federal government is establishing a fund to promote the public awareness and understanding of science and technology and of the impact developments in this area will have on the Canadian economic and social environment.