Ministry of State
Science and Technology Canada

Ministère d'État
Sciences et Technologie Canada

Strategic Overview 1982/83 — 1984/85

Canada

STRATEGIC OVERVIEW

MINISTRY OF STATE FOR SCIENCE AND TECHNOLOGY

April 2, 1981

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(April 2, 1981)

STRATEGIC OVERVIEW

MINISTRY OF STATE FOR SCIENCE AND TECHNOLOGY

INTRODUCTION

The Ministry of State for Science and Technology was established ten years ago. At that time, there was serious concern among the industrialized countries of the OECD about the adverse effects which science and technology were having on the social and physical environment. Technological change had been an important factor in the high and sustained rates of economic growth achieved since the end of the war and the consequent rise in standards of living. There were, however, some very high costs associated with these successes which towards the end of the 1960's were becoming more and more apparent and which could no longer be ignored. Increasingly, governments came to realize the powerful influence which science and technology exerted on society as a whole and to understand the need for a comprehensive and purposeful science policy to replace the more passive growth oriented one which had prevailed until then.

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The prescriptions for science policy prepared in the late 1960's and early 1970's assumed that rates of growth of the western economies would continue to be high. They aimed at making science and technology more responsive to social and environmental concerns through technological forecasting and assessment.

The actual context in which science policy has developed in recent years turned out to be quite different from the expected one. The main issues were not so much social as economic in character and science and technology were, and are, still seen as one of the main policy instruments at the disposal of governments in their attempts to achieve higher rates of growth and employment and lower rates of inflation. This reflects in part the apparent failure of the economy to respond to traditional macro-economic policy measures and in part to increased competition from developing countries in the more mature and well-established industrial sectors of developed countries. At a recent meeting of OECD Ministers, the main topic of discussion was the integration of science and technology (or innovation) policy with general economic policy.

Nonetheless, the concern about the wider impact of technological change on society remains an important factor in the formulation of science policy in most countries.

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This is the broad background against which this strategic overview is presented.

It would in itself justify a re-examination of MOSST's role. There are two other important but more narrowly based reasons for doing so. The first is the creation of new Ministries of State, one for economic development and one for social policy. These two ministries have to some extent taken over part of the functions of MOSST (as well as of some other Departments). The second development is the decision by the Prime Minister to place responsibility for space with the Minister of State for Science and Technology. This has led to questions about the future role of MOSST.

THE EVOLUTION OF MOSST

Much of the early work of the Ministry was focussed on the problem of defining the concept of a comprehensive science policy and on studying means through which science policy could be used to influence and set broader national goals. MOSST sought to play a leading if not dominant role both in the formulation of science policy and programmes and in the definition of the ends that science was to serve. MOSST also sought to gain in the process a high public profile. Ministries of State were new creatures at that time with no clearly defined or agreed role. The one which MOSST offered to play was

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not accepted; MOSST had not found it possible to resolve satisfactorily the basic dilemna of science policy which, if it places too much emphasis on the ends to be served by science, is seen as acting in areas beyond its sphere of competence and which, if it places too much emphasis on science, is said to ignore the ends which science is to serve. It was this state of affairs which led to, and guided, the review and re-organization which took place in 1974 and 1975.

During the course of the review, it was determined that the concept of a single science policy was not particularly useful. What in fact existed were numerous policies for the use of science and technology, developed in relation to the objectives of federal departments and the private sector, as well as broader national goals and priorities. Emphasized in this re-definition of science policy and the subsequent revision of the role of the Ministry, was the view of science as a means to an end and not as an end in itself. The Ministry's formal objective, which was formulated at that time and exists to the present day, was stated to be "to encourage the development and use of science and technology in support of national goals". Its sub-objectives were, and are, to:

- formulate and develop policies for, and to advise on, the support of science and technology;
- formulate and develop policies for, and advance the application of, science and technology to national issues;

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- foster the use of scientific and technical knowledge in the formulation and development of public policy.

Thus, as a Ministry of State, MOSST has a role similar to that of a central agency within the federal government. Its policy mandate overlaps the operational responsibilities of many of the federal departments as it is concerned with all the science and technology activities of the federal government. These extend to the relationships between the scientific activities of different federal departments and agencies; between the scientific activities of the government and those of provincial governments, universities and industry; and between scientific activities in Canada and those of other countries.

There are some important differences, however, in MOSST's required mode of operation. Whereas central agencies such as Finance, Treasury Board and the Ministry of State for Economic Development are able to operate through a powerful mandate, arising from legislative authority or delegated responsibility over the financial expenditures of the federal government, the Ministry of State for Science and Technology must operate primarily through the provision of informed advice either to its Minister or to its service clientele. In the first instance, the strength of the Ministry rests on the influence the Minister exerts in Cabinet or the Cabinet Committees on which he has a voice; in the second instance, the influence of

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the Ministry depends upon the perceived value of the advice and the receptivity of the department or client to such advice. This latter point was not clearly understood in the early days of the Ministry. The original intent, it has been suggested, was to give MOSST little power so that it could exert much influence; MOSST chose to seek much power and so lost all influence.

Thus, MOSST was very much aware under its redefined mandate of the need to ensure that it had a clientele interested in its policy analysis and its advice. It could not unilaterally intrude into departmental mandates. It set out, quite deliberately, to develop a service orientation which could respond to the needs of the government as a whole, of the central agencies and of individual departments. The new approach was low key, service oriented and internal to the government.

The Ministry was re-organized to reflect this. The basic organization consisted of three branches centered respectively on government, industry and universities as being the main performers and funders of S&T. There is one or at the most two divisions in each Branch which is given a continuing responsibility or activity. But, the central feature of the re-organization and re-orientation was the establishment

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within each Branch of a Projects Division which would carry out discrete, well-defined projects with a definite timetable. The projects could originate within the Ministry, but it was hoped that the larger number of them would be undertaken as a result of requests from Cabinet, from one of the central agencies or from departments.

MOSST was able to bring to this approach a certain number of valuable assets. The fact that it did not have any operating responsibilities meant that it could, on most issues, take a detached and objective stand. Departments were prepared to entrust to MOSST for study, analysis and advice problems, often involving overlapping mandates, which they had not been able to resolve satisfactorily and where a disinterested agency could play a helpful part.

The absence of an operating role also meant that MOSST was not under the same strong compulsion as operating departments to focus on immediate, short-term or urgent problems. It was able to take a longer term view and bring to bear on the examination of problems a perspective which otherwise might have been absent.

Finally, as a central agency -- albeit in a limited and special sense -- MOSST was concerned with all the science and technology activities of the federal government.

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THE PRINCIPAL FUNCTIONS OF MOSST

The Ministry's activities have centered around five functional areas. These are the service, policy formulation, policy analysis, permanent programme and information functions.

The service function is undertaken largely as a result of requests arising from within the science-based federal departments, but may also involve other sources as well. Because the Ministry does not have an operational role, it is perceived as not having a vested interest in any particular science activity or organization, and has been asked on several occasions to head task forces or working groups to review particular scientific activities which involve several departments and to make suggestions on how their management could be improved. Examples of work within this function include the participation in an A-base review of a single department such as the Department of Environment; or the study of ice-covered waters carried out by MOSST at the request of PCO which affected several departments. Similarly, the Ministry was asked to assess the effectiveness of existing mechanisms for the co-ordination of the space programme. It has also reviewed, at the request of the Department of the Environment, the forestry research programme, and more recently

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was asked to undertake a study of how the various interests of departments involved in radar can be brought together.

Although the service function acts as the most immediate forum for the Ministry's policy advice, it is through the policy formulation function that the Ministry has the potential for the greatest long-term impact on the country and the economy. The policy formulation function differs from the service function in that the policy issues it deals with are primarily initiated by the Ministry itself rather than by its clientele. The end product, policy advice, is provided in a variety of ways, but perhaps the most important, and certainly the most visible way, is through the submission of memoranda to Cabinet. The Ministry has, since 1975, submitted some 25 to 30 memoranda which have ranged from very general policy matters such as the establishment of a planning framework for R&D as a whole or for a particular sector, to fairly specific programme proposals covering such varied subjects as automotive R&D, centers of excellence, regional R&D programmes, source procurement and R&D priorities. The Ministry has also had significant input into the policy work of other departments. For example, during 1977-78, the Department of Finance, after consultation with the Ministry, introduced tax incentives for R&D in three successive budgets.

The policy analysis function underpins and supports the policy advice and service which the Ministry offers

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in fulfillment of its mandate. A great deal of the Ministry's analytical work has been published in the form of background papers, which at this point number thirteen. The range of subjects is extensive, covering the relationship between R&D and economic performance, the respective R&D performance of Canadian and foreign owned subsidiaries, and the analysis of the major issues affecting university research and federal funding of such research. Other examples of analytical work, not covered by the above series, include: a recent study of the transfer of technology from federal laboratories done jointly by MOSST and DOC; an analysis of the automotive industry, which identified the problems and opportunities presented to Canada as a result of the changes in the industry; and a study of the nuclear industry which concluded that for the medium-term at least the fission option (CANDU) had to be kept open, but that it was in danger of being closed because of the difficulty in maintaining industrial capacity due to a lack of demand.

The fourth function, permanent programmes, refers to a variety of activities for which the Ministry has been given continuing responsibilities. An area of concentration within this function concerns the Ministry's increasing activities in the federal-provincial and international spheres. Both these areas have begun to emerge as areas requiring a greater concentration of effort by the Ministry, as the provinces

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have begun to express a greater interest in developing and co-ordinating their R&D policies and the international scientific and economic environment has begun to have a greater impact on Canada's own national well-being. In November of 1978, the Ministry hosted the first Federal/Provincial Ministerial Conference on Industrial R&D and has since been heavily involved with activities arising from the decisions of the Conference. Over the course of 1979-80 it held intensive discussions with the Atlantic Provinces and developed an "Action Plan" for industrial R&D in that region.

Work in the international area contributes, in a sense, to the service function in that the Ministry works with the other federal departments to obtain a concensus on science and technology issues of international interest, or arranges representation at international meetings on scientific matters, and analyses international developments on behalf of the interdepartmental community. It also contributes to the policy work. For example, analysis and recommendations for a change in the co-operative arrangements between Canada and the Third World countries has led to a new role and additional funding for the International Development Research Centre. Information and analysis from the international fora (OECD, UNCTAD, ECE Science Committee, NATO, IIASA), also

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provide valuable inputs into the Ministry's other policy analysis and formulation work.

Another permanent programme activity is Program Review and Assessment, wherein the Ministry advises departments and agencies and the Treasury Board on Organizational matters, broad program content and resource levels for science activities.

The fifth function, information, represents the means whereby MOSST increases the awareness of the general public on a number of science and technology issues. One of its major undertakings is the publication each year of a review of Federal Science Activities. It presents in some detail and from a number of perspectives the federal government's science budget. The publication also attempts to show more clearly the linkages which exist among the various scientific activities of the federal government. The information is broken down by area of application, by function, by major sector and by region.

Science and technology is one of the few functional areas where it is possible to assemble and analyze data on a cross-departmental basis. Another major publication has been the Directory of Scientific and Technological Capabilities

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in Canada. MOSST has also developed and disseminated information on a set of performance indicators for industrial R&D and a forecast of demand for highly qualified manpower.

THE CHANGING ENVIRONMENT

The current definition of MOSST's role continues to reflect the considerations that led to its establishment in the early 1970's and guided its re-organization in the mid-1970's. These considerations rejected the implicit assumption on which science policy had until now been based and which held that the interests of science and technology were largely co-incident with the interests of society as a whole. The new assumption was that if science were to serve society it had to be actively managed to achieve specific objectives.

These objectives, it should be noted, were originally defined in social and environmental rather than economic terms. It was believed that the economics of industrialized countries would continue to grow at high rates. Science and technology would as in the past both respond to these high rates of growth and contribute to them. There would be little need for economic policy to take science policy explicitly into account to any great extent. Research and development

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and ensuing innovation activities would flow for the most part from the favourable economic setting and the appropriate macro-economic policies.

The persistence of low growth rates and high rates of inflation and unemployment and their apparent insensitivity to macro-economic measures have led to a significant change in the perception of the role of science and technology in the economy. The members of the OECD expect that science and technology will contribute significantly to the solution of the major economic problem which they now face. This is not to say that the social and environmental factors are once again being disregarded. On the contrary, impact analyses of varying sorts have now become necessary components of the process of science policy formulation in most industrialized countries; however, they believe that technological innovation will help to rejuvenate their economics and improve their performance on the international market.

Thus, one of the responses to continuing slow economic growth, to more intense international competition and heavier balance of payments burdens has been for governments to put a renewe

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and vigorous emphasis on developing new technologies as a basis for stimulating industrial growth and increasing exports. In respect of the new and emerging technologies in particular, in which great expectations are now placed (e.g. biotechnologies), R&D is viewed more as a source of strategic opportunity than of problem solving. To an increasing extent, governments are supporting high technology activities which are expected to have future commercial potential, through selective subsidies, fiscal incentives and procurement policies. If the governments pursuing this approach assist extensively the specific industries in question, the competition may no longer be between firms, but between governments. This is one of the issues which dominated the recent OECD meeting of Science Ministers.

One direct result of government involvement in the process of technological change is that the time frame of government planning has lengthened. For example, France adopted a ten year global strategy in July 1980. Among other things, it expects to increase R&D spending from 1.8% of GNP (1977) to 2.3% by 1985. Japan, in 1977, published a report on science and technology policies in a long-term perspective. R&D spending there is expected to increase to 2.5% of GNP by 1985, from 1.7% (1977). Sweden recently undertook a comprehensive study of its technological opportunities in the 1980's.

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A similar change in perspective which emphasizes the longer-term point of view is taking place in Canada. The federal government has re-affirmed its commitment (February 1981), first enunciated in June 1978, to achieve a level of national investment in R&D equal to 1.5% of GNP by 1985. For the first time, a planning framework has been established. It sets out the growth in R&D expenditures which is expected of each of the main sectors, i.e. industry, governments and universities. The implication is that Canadian policy now ought to become more concerned with the nature of the R&D which will contribute to achieving the target of 1.5% of GNP -- not only in order to compete internationally with other countries in those areas of technology in which we do or can excel, but to identify as well new technological developments which could pose a threat to Canadian industry, to formulate an adequate response to them and in general to determine more precisely where our own technology interests lie in the medium and longer-term.

Another factor which has led governments to take an increasing interest in technological change is that science and technology are now recognized as being both driving factors and essential elements in the process of structural adjustment through which all of the OECD countries are going and in which indeed, they are actively engaged in response to the new social and economic conditions and their changing relationship with non-OECD countries.

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Generally speaking, world economic conditions have been transformed by the fact that Europe and Japan have "caught up" with the United States and by the industrialization of countries which, until recently, were considered under-developed. There are also long-term consequences of the increasing price of oil, the redistribution of wealth internationally and the need for systematic efforts to both conserve energy and increase its supply.

Perhaps the most visible contribution of science and technology to structural adjustment is taking place in the energy field in order to adjust to supply constraints and new factor costs.

Another factor forcing structural change in Canada and other countries is the growing technological capacity of newly industrializing countries. For the most part, this results from the continuing flows of technology from the developed to the developing countries which has certain feedback effects. An OECD Working Group recently completed a study of these technology flows which concludes that the net return effects on OECD countries have been, overall, positive in terms of trade and employment. However, the gross effects have fallen rather unequally on different industrial activities and on different countries. While engineering enterprises and machinery

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and equipment industries may have been boosted by demand for their products from developing countries during a period of low activity in OECD countries, other industries have had their problems compounded by competition from a limited number of developing country exporters.

To date, there has been little work within the federal government to analyze where Canada may be affected in the future, and the role technology could play in adjustment policies related to declining industries. This is of concern, as technology transfers are expected to continue at a significant rate while feedback effects are expected in the more advanced technology industries such as those producing electrical and non-electrical machinery.

Another feature of the changing environment, peculiar to Canada, is the increasing interest and activity by virtually all of the provinces in science and technology policy development. All of the provinces, except P.E.I. and Newfoundland, have research councils or foundations to assist firms with technical problems and aid the development of provincial natural resources. Some of these organizations have been in existence for some time and operated at "arm's length"

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from the governments concerned. They are now being re-invigorated and brought even closer to the policy formulation process and their activities more fully integrated with related government programmes. Most of the provincial governments have progressed well beyond the stage of enunciating general science policy and priorities.

They have moved to the identification of specific areas of interest to them and the development of specific technologies e.g. hydrogen, biotechnology. The new activities of the provinces have increased the scope for federal/provincial cooperation to ensure that the respective policies and programs are consistent with one another. As well, the opportunities for the federal government to lever the provinces to increase R&D expenditures have been enhanced. However, the danger of inefficient overlap between provinces in terms of their plans and projects has also increased considerably.

Another consideration is the change in the university system. In the late seventies and into the eighties, the universities have seen and will continue to experience dramatic changes. Declining enrolments and an aging professoriate are major problems at a time when governments, both federal

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and provincial, are looking to the universities to produce the research-trained manpower and a basic and mission-oriented research capability as prerequisites for industrial development. At their recent meeting, OECD Ministers were concerned that the erosion of fundamental research would undermine innovative capacity even though it is difficult to have, in a systematic way, links between the two.

All of the factors mentioned (and there are others) have led governments to take a much more direct interest in developing new technologies. As a consequence, the rapid pace of technological change has been further accelerated and may have reached a point in some areas which is beyond the capacity of the private sector alone (except perhaps for very large corporations) to finance and sustain, particularly as R&D is but one of several factors in successfully bringing new technologies to market -- there are other pre-production activities as well as the capital costs of buildings and equipment. Government involvement now extends well beyond R&D into virtually all other parts of the innovation process.

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One particular aspect of this involvement deserves special comment. The rapid pace of technological development can mean that new products are ready to be used before there is a commercial demand for them. Under more normal circumstances, the innovation cycle could not be completed until these conditions had been corrected by the market. Governments are, to an increasing extent, creating the markets artificially or prematurely through a number of instruments which they have at their disposal e.g. export credits, procurement, regulating powers. This is also a factor which forces the pace of technological development beyond the point which the private sector left to itself can easily accommodate and absorb.

Thus, the traditional reasons for government involvement in R&D and the innovation process (see next section) are being extended and as already noted, this was a point of concern at the recent OECD ministerial meeting.

ASSESSMENT OF CURRENT ROLE

MOSST's activities have been described in terms of five functions. Two of these functions, the service and policy formulation functions, are at the core of MOSST's

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activities and in any assessment of MOSST, they must be the center of attention.

In its policy formulation work during the 1970's, MOSST concentrated on the low level of R&D in Canada compared to that of other industrialized countries and thus directed its attention to the broad policy which would affect a reversal of this trend and on the development of the appropriate infrastructure to support R&D. For example, the Ministry's work on tax incentives to encourage industrial R&D led to several such incentives being put in place before 1979. It advocated greater emphasis on government procurement because of its effect on the development of technology through the modification of market conditions. It refined its contracting-out policy which aims at strengthening the industrial R&D base by having more of mission-oriented R&D requirements carried extra-murally. The Ministry also evolved general policies for the federal support of university research designed to develop and maintain additional capacity for fundamental research and to train manpower to carry out an increased level of research in Canada.

It was also against this background of more general concern about the low level of R&D in Canada that the Ministry

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announced in 1978 that a target for national expenditures on R&D of 1.5% of GNP would be beneficial to Canada. The 1978 announcement did not provide a framework for planning and measuring progress toward the target. Such a framework was approved by Cabinet and announced in early 1981. It established spending targets for R&D including one for the federal government. The increase in federal funding called for by the target has been tentatively allocated as follows: one-half to the support of industrial R&D, one-third for the support of mission-oriented R&D and one-fifth to university research.

The adoption of the planning target has been a major step in the development of a comprehensive R&D policy for the country and has also marked a turning point in the policy work of the Ministry. Within the framework, Canada must now identify the type and areas of research and development which will best contribute to achieving the objectives underlying the target.

Although policy makers of western economies are traditionally loath to manipulate the supply side of the economic equation, there are particular characteristics of science and technology in the changing environment which make a strong argument for so doing. First, there continues to be a social concern about the development of

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appropriate technologies and an awareness that not all technological development is of public benefit. Second, most technologies require a long incubation or development period before they are ready to be integrated into the innovation process and thus planning for their development must start before there is a measurable forecast of economic return. Thirdly, many of the technologies are applicable across such a wide range of industries that no one industry or corporation would feel it of benefit to develop the resources.

These factors, along with the changes in the environment described in the preceding section, have resulted in increased pressures on governments for direct intervention in the support of the high technology areas of their economy. In fact, the active interest that governments are taking in both the development and the marketing of technologies would suggest that each country should have at the very least a mechanism for appraising the importance of new, promising or rapidly evolving technologies to its economic, industrial and social development and for following up with whatever action, if any, that appraisal may suggest.

In Canada, we lack such a mechanism. At present, proposals by departments and agencies, over a period of time, amount to a de facto policy; a policy which, with its lack of cohesive forward planning, is beginning to show certain costs to the Canadian economy. For example,

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in 1979, it was decided that Canada should embark upon a program of longer term automotive research. However, by that time, it was already too late to capitalize on many opportunities which were already being exploited elsewhere to meet the 1985 regulatory deadline for better fuel economy and reduced emissions.

The potential role of the Ministry in filling this gap was implied in the letter of August 1971 from the Prime Minister which outlined the responsibilities of the first Minister of State for Science and Technology and wherein he noted that "In the process of determining national objectives, you will be seeking answers to such questions as 'is it in the national interest for Canada to make a major effort in astronomy, biology, or particle physics?'".

To some extent, over the past three years, the Ministry has begun to undertake this role. For example, between December 1978 and February 1979, the Ministry developed a policy for R&D in the automotive industry which became an integral part of the overall policy for the sector announced by the federal government in March 1979. In April 1980, the Ministry presented the Economic Development Deputy Ministers with a Cabinet Memorandum on Automotive R&D Policy. Although Deputies were in general agreement

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with the proposals, the Memorandum did not go forward due to lack of funds. To the extent possible, the recommendations are being implemented by this Ministry in conjunction with the Department of Industry, Trade and Commerce.

The Ministry is also currently developing a policy to advise on the role Canada should play in the field of biotechnology. It is also examining the policy requirements of developing a space program which would be responsive to national needs.

These examples aside, however, it is becoming clear that greater attention needs to be paid to the role of specific technologies in the Canadian economy. With some exceptions, the federal government lacks an overview of what specific technologies are likely to be of particular importance to future industrial and economic growth in Canada, and what policy alternatives these represent in terms of government intervention of one kind or another. As well, there is evidence to suggest that we seem to lag other countries in taking action.

Thus, the emphasis on broad policy formulation, advisory and co-ordinating functions reflects the intent of

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the 1975 review and re-organization. It does not reflect the developments since that time noted earlier in this overview. It is also based on the assumption made at the time of the 1975 review, that the line departments would bring all the necessary scientific and technological knowledge to bear on the development of policies and programmes. The assumption has not proven to be correct. There are definite gaps in the assessment and utilization of scientific and technological knowledge and opportunities. The research programmes of line departments are mission-oriented and their choice of science and technology programmes is heavily influenced by this factor and by the immediate operational pressure to which they are subject. They are not always able to give sufficient weight to all the relevant factors and considerations, especially the longer term ones. An example is the relative weight given to the R&D required to control the use of chemicals in agriculture compared to the weight given to the effect of such chemicals on the long-term prospects for the industry as a whole. Line departments are also notoriously weak in addressing issues which fall within the mandate not of one but of several departments. This has happened, for instance, to toxicology which, despite its importance, has been neglected. Finally, the science activities of line departments do not of course encompass all the areas of science and technology which may be of interest to Canada. Mission-oriented departments are not essentially interested in technology except as potential users.

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DIRECTIONS FOR THE 1980's

In essence, the foregoing analysis suggests that the policy development role within the Ministry should put a far greater emphasis on defining policies for the development of new technologies expected to be strategic to the economy in the medium and longer term, and on integrating these and the applications plans with the overall economic plans of Cabinet. In order to succeed, this requires the creation of a capacity to identify technologies which will have a future strategic role in the context of national economic and industrial objectives, and to identify early on technologies internationally which are likely to pose a longer-term threat or opportunity to industrial and economic development in Canada.

This requires in the first place that MOSST, as adviser to the government on science policy, move away from being a purely generalist Ministry and acquire a more specialized scientific and technological capability. For this to be effective, MOSST should also be given a planning responsibility to which should be joined at the very least a "control" function and possibly some operational responsibilities. The planning and any operational responsibilities would extend not to all areas of science and technology but to a limited number of carefully selected ones.

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a) SPECIALIZATION

MOSST could acquire a specialized knowledge of science and technology in either one of two ways. The first would be to hire its own specialist staff; the second would be to tap on an advisory basis the best available expertise in the country.

The second approach is to be preferred. It would be more flexible in terms of the kinds and sources of expertise that could be tapped. It would allow the Ministry to adjust more easily to changes in priorities or interest. It would keep down the number of person-years required. Finally, it would allow the Ministry to work on a regular basis with some of the most knowledgeable and able people in the country and extend, so to speak, the Ministry into all parts of the scientific community.

The techniques for enlisting the services of these people in this way would vary. In some cases, where the issues were of a general nature, an advisory council might be the best device. In cases where it was desirable to explore the potential of a particular technology and of designing policies and programmes to realize that potential, a task force or working group might be in order. In most cases, the requirement would be for a mechanism to ensure that the

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Ministry is kept informed about current scientific and technological development in all areas of interest. This could best be done by securing on a retainer basis the services for a given number of days each year of one or more specialists in each area of interest. It is expected that the technique most frequently used would be of the "retainer" type. In taking this course of action, MOSST would wish to avoid any suggestion that it wished to intervene in the basic management, operation or direction of departmental R&D programmes.

b) PLANNING AND CONTROL FUNCTIONS

The acquisition of more specialized knowledge should go hand-in-hand with the assignment of specific planning responsibilities and functions for certain areas of science and technology. The specific planning responsibilities and functions for certain planning functions would consist of three basic activities: the examination and appraisal of the importance of particular areas of science and technology to Canada; for areas found to be of importance, the presentation to Cabinet for approval of a multi-year

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development and applications plan; and overall responsibility for and control over the execution of the plan. The control could be exercised by ensuring that any new initiatives, whether at the policy or the programme level, would have to be approved as part of the plan and that any new expenditures form part of the approved budget for the area in question. This control function is considered important because it is considered to be the minimum step required to reduce MOSST's excessive dependence and allows it to discharge its role more effectively.

c) OPERATIONAL RESPONSIBILITIES

The planning approach outlined above is not unlike the one currently in use for space. It does not involve MOSST in an operational role. A variation to this approach would be to associate to the planning function a small operational role either to support the function itself e.g. the conduct of studies or to support any plans approved by the government. A second approach would be to associate the planning function with a major operational role and turn MOSST into what might be called a Ministry or Department of Advanced Technology.

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Under both approaches, the areas and activities covered by the planning function would be the same. The main difference between the two is whether a major operational responsibility should be joined to the planning function. The importance of the operational responsibility would vary considerably from one area of science and technology to another depending in part on the complexity of putting into effect a particular plan for a particular area.

In the case of space, for instance, the various tasks which need to be performed include (i) the identification of the needs of line departments to make use of space in discharging their basic mission; (ii) the examination of the technical and economic feasibility of using space in the way proposed; (iii) the establishment of priorities; (iv) the organization and execution of the research and development to allow the widest and best possible use of space by Canada; (v) the assignment to each of the main performers of R&D in government, industry and universities of the R&D tasks most suited to them; (vi) the development and administration of the programmes requires to support the R&D and to have it performed; (vii) the translation of the results of the R&D into fully operational programmes directly or, if required, by the construction of prototypes or through demonstration projects; (viii) the creation out of these activities of a competitive Canadian space industry;

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(ix) the coordination of the various instruments which the government can use to achieve its objectives in the space sector; and (x) the establishment of close working and operational relationships with other countries which have space programmes.

In the case of space, which has been examined in detail, the conclusion is that the best solution would be to place virtually all of the operational activities under one authority. It is the only solution that permits the degree of flexibility and coordination required to achieve Canadian space objectives. There may be other cases of similar complexity calling for similar solutions. But there would be others where the planning function alone may be sufficient and a third group where some but not all the related operational functions should be joined to the planning function. The specific operational responsibilities would have to be decided upon in each case. The important decision at this time is whether to accept in principle that MOSST can and should become operational (or at least not reject that possibility).

d) AREAS OF CONCENTRATION

While MOSST would attempt to keep abreast of major developments over a wide spectrum of science and

technology, this surveillance function might focus on those technologies where there is, or may be, a legitimate role for government, bearing in mind that to the maximum extent possible, the private sector should be allowed and encouraged to respond to normal market forces without government intervention.

The technologies to be examined would include:

a) new technologies which would lay the base for Canada's future domestic and international competitiveness possibly by capitalizing on an early lead in research and development e.g. biotechnology;

b) technologies which could significantly enhance the productivity and competitiveness of established industries, including technologies to enhance the value of the natural resource base e.g. robotics;

c) technologies which will be essential at some future date in order to realize national economic objectives or implement national policies, the implication being that the R&D may need to be commenced now so that the unavailability of a certain technology does not impose a constraint at some later date e.g. energy;

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d) so-called "core" technologies which can have a significant impact on innovation and output across a number of industry sectors e.g. composite materials;

e) technologies which are an essential element to broaden the industrial structure of selected regions, based upon regional strengths, problems and opportunities e.g. ocean technology.

The Ministry has begun work on a matrix which could be used to assist in selecting the technologies for strategic study. A copy of the matrix is attached as Appendix I. At this stage, this matrix should not be taken as a definitive statement of priorities for science and technology. Considerably more work needs to be done on it. It is nevertheless interesting to note that the French in their ten year plan classified technologies into four groups which show some correspondence to the one on which MOSST is working. Their four areas are a) opportunities for capitalization on mature technologies; b) incipient areas of promise; c) interdisciplinary and intersectorial fields and d) complex interactive systems.

As well, such a process, by its very nature, would induce communications about goals, strategic issues and resource allocations. A very concrete example of this is the Ministry's recent bilateral consultations with the provinces

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on the action plan for industrial R&D. These consultations stimulated the provinces to think about priorities with the result that some of the provinces have now defined their priorities beyond the extent of the federal government's work.

Despite the lack of completeness of the matrix planning and analyses and the obvious necessity for further work on it, there are some areas of technology that have been identified as requiring some form of early consideration by the government. The first four areas are biotechnology, space technology, energy conservation technology and environmental protection technology. These are current projects within the Ministry. Other areas proposed in the Ministry's current work plan include the use of automated technologies in resource extraction, manufacturing technologies, and micro-electronics (very large scale integration - VLSI).

In the choice of further technologies to be examined, the following additional criteria might be used:

a) There are certain areas of technology which are of interest to a number of departments in terms of fulfilling their mandates but for which there is no national lead department. Space technologies belong to this category. Toxicology is another area of recognized importance to Canada and of interest to several departments that needs to be addressed in a concerted way.

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b) There are areas of technology which will reach commercialization within a 5 to 15 year timeframe and which can create opportunities or pose threats for Canadian industry. These are areas which industry itself may not be willing to research and to develop because of the long-term framework, because of the need to apply its financial resources to more immediate projects, because the research facilities do not exist in industry, because industry without government assistance cannot hope to compete with what is done in other countries or because the development of the technology requires a concerted effort for which only the government can take the lead. In the absence of a sponsor in government, the probability of developing the technology may be seriously diminished. Telidon is an example of such a technology which found a sponsor.

c) A third category is comprised of a group of technologies which can have an important bearing upon the productivity and competitiveness of industry but which, for the most part, are not central to implementing the mandates of the science-based departments. There is a broad group of manufacturing and process technologies which, if not developed and adopted by Canadian industry, will have an adverse effect on our

competitiveness. These include robotics, computer-aided systems, and plastic processing. The need for increased productivity is being forced by inflation and by the need to maintain leadership in the face of growing LDC competition. Canada seems to be lagging other countries. Among other things, it would make sense for MOSST to examine in detail resource extraction and manufacturing technologies to define a programme of action on a national basis.

d) A fourth category would consist of technologies which are of interest not only to departments in terms of their mandate, but also in terms of their potential industrial application. Biotechnology, ocean technology, energy conservation technologies, and environmental protection technologies are within this category.

It should be noted that, due in part to the unique nature of each of the areas, and also due to the fact that it is a relatively new way of proceeding for the Ministry, the Ministry is still at various stages in selecting and studying these strategic technologies and anticipates doing considerable work to refine the selection techniques coincidentally with the initial work on the selected technologies.

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It is anticipated that the Ministry could, with minimal increases in resources (and that primarily for advisory staff) handle the detailed study of approximately eight technology fields during any one year. Further resource requirements would depend upon the degree of intervention ultimately recommended in each area.

The Ministry's current total financial requirements are relatively small. The operational budget reflected in the 1981/82 Main Estimates totals $9.7 million with 161 person-years. In order to meet the demands for the increased outside expert advice required by the Ministry's new directions, it is likely that an increase in our operational funds would be required. Based on our experience in 1980/81 with the Biotechnology Task Force, each area may require the involvement of a dozen or more representatives over a period of six months to a year. We estimate that additional operational funds would be required of about $100,000 for each of the eight areas identified. This would, therefore, add a continuing annual requirement of about $0.8 million to our Ministry budget, starting in 1982/83.

If the option of a sixth function regarding overall control and greater operational involvement in the planning and development of various technologies is approved, then

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additional person-year and salary resources will be required.

e) ESTABLISHED ROLES AND FUNCTIONS

This overview has concentrated on extending the mandate of MOSST by giving it a more specialized role and joining that role to certain planning, control and operational functions. The extension of the role is advanced on the grounds that there has been a change in the environment since MOSST's mandate was last examined and that there is a need for a mechanism to examine and propose responses to new technological developments.

The stress on the re-orientation of MOSST is consistent with the purpose of the overview, but this is not to say that the other roles and functions of MOSST should be downgraded. Accordingly, they are reviewed in Appendix II.

SUMMARY AND CONCLUSION

The Ministry of State for Science and Technology has been in existence for some ten years now and some re-assessment of its role seems to be in order.

The conditions which led to the establishment of

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the Ministry have changed. At the end of the 1960's and early 1970's, the governments of the industrialized countries had come to realize the pervasive influence of science and technology on all aspects of our lives and recognized the need for an active science policy directed towards meeting national goals. In Canada, these developments led among other things to the establishment of MOSST.

More recently, governments look upon science and technology as one of the principal means of overcoming the problems of growth and unemployment which exist in most OECD countries. Concomitant with this new emphasis has been a shift in interest away from R&D as a more or less isolated activity to an interest in the development and application of an entire new technology. In most countries, there is a mechanism for appraising the importance of technologies and for taking a national attitude towards them. No such mechanism exists in Canada and as a result we often lag in the development and use of technologies which are of importance to Canada.

MOSST could and should fill this need but as presently constituted is severely handicapped. It needs a better understanding and knowledge of the various technologies. It could acquire that knowledge and understanding without large increases in staff by tapping the scientific

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community in a regular and systematic way. In addition, MOSST would have to be given an explicit planning responsibility in respect of certain technologies and overall control over the budgets required to put approved plans into effect. Finally, given the complexity of modern technologies, the many interests involved in their development, the continuous interaction between the private and public sectors and the variety of policy instruments that need to be used, the planning function should go hand-in-hand with some operational responsibilities.

Thus, the expanded role of the Ministry would consist of:

a) maintaining an overview and early warning of technologies which are likely to have a longer-term strategic importance (both threats and opportunities) to industrial, economic and social development in Canada;

b) identifying those technologies which may necessitate the definition of integrated policies and concerted government intervention to ensure their development and/or diffusion;

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c) keeping the Cabinet informed of those developments where government action appears indicated; and

d) having the responsibility for the overall planning, coordination and management, on behalf of the federal government, of policy and programme for certain specific technologies.

In addition to these new major thrusts, the Ministry should continue to discharge its other responsibilities and functions but with some movement towards a more specialized approach.

AREAS OF TECHNOLOGY OF FUTURE IMPORTANCE TO CANADA

Type of Effort Needed	Degree of Importance for Canada to Allocate Resources to the Area		
	High	Moderate	Limited
TECHNICAL/SCIENTIFIC KNOWLEDGE WHICH IS IMPORTANT FOR INDUSTRIAL NEEDS	Forest management Ocean engineering for cold regions Genetic engineering High temperature chemistry (coal) Materials science Sea ice monitoring & properties Ocean climate Aquaculture Ship design Cold regions engineering R&D Food science	Electrochemistry (corrosion resistant materials) Thorium cycle research Powder metallurgy Energy storage devices Composite materials Lasers	Fusion energy Geothermal (B.C.)
BROAD DEVELOPMENT OF ADVANCED TECHNOLOGY	Remote sensing Radar Communication networks Biotechnology Welding Computer-aided manufacturing Computer-aided design Forest engineering Forest products manufacturing	Digital microelectronics Office communications Computer-aided learning Construction technologies Information storage/retrieval Plastics processing Robotics Marine natural products	Ceramic materials
CONCENTRATION ON ADVANCED TECHNOLOGY FOR COMPONENTS, EQUIPMENT AND SYSTEMS	Custom microprocessors Fibre optics communications Public mobile satellite systems Direct broadcasting satellite Telidon Nuclear icebreaker Arctic vessel design and construction Remote sensing/meteorological/ surveillance satellite	Electronic systems integration Electro-optics Deep ocean towing systems Superconductors Underwater vehicles Remote manipulator systems Automotive components/systems Urban transportation (e.g. hybrid vehicles Railway technology Ocean instrumentation Pipeline materials & systems	
DEVELOPMENT OF TECHNOLOGIES FOR INCREASED ENERGY SUPPLY, SUBSTITUTION AND CONSERVATION	Energy reduction in agriculture Oil sands and heavy oils recovery Conventional reservoir enhanced recovery Energy conservation (commercial/ residental) Fuel economy (transportation sector) Improved ore processing technologies Coal/oil mixture for power generation	Production/use of alcohol fuels Production/use of natural gas Solar, biomass, wind energy Low-head hydro High voltage DC transmission Energy efficient fishing vessels Thorium fuel cycle	Tidal power Breeder reactors High temperature gas cooled reactors Hydrogen energy Waves and currents
IMPROVEMENT IN EFFICIENCY AND VALUE-ADDED IN EXTRACTION AND PROCESSING OF RESOURCES	Further utilization of forest resources Productivity improvement in metals/ minerals processing	Mineral exploration technology Offshore geoscience technology Geochemical technology Coal mining technology (improved recovery) Sulphur removal from coal (beneficiation technologies) Substitution for imported minerals Food processing & transportation Fish harvesting Agricultural engineering Processes for low grade & complex ores	Materials recycling Manganese nodule mining systems
DEVELOPMENT OF TECHNOLOGIES AND KNOW-HOW FOR SOCIAL OBJECTIVES	Environmentally appropriate process technologies Radioactive waste disposal Medical diagnostic and care technologies Mining safety Toxicology Marine environmental control	Personal security Interactive TV systems (e.g. telemedicine) Solid waste disposal (urban) Utilization of mineral & metal wastes Tailor-made vehicles (e.g. for disabled) Transportation of hazardous substances	

APPENDIX II

ASSESSMENT AND DIRECTIONS OF OTHER FUNCTIONAL AREAS WITHIN MOSST

A) Description and Assessment

While the Ministry's service function includes elements of policy analysis and formulation, its main role is to respond to the requests or specialized needs of other departments. As noted earlier, this is the key function that came into being in the 1974-75 reorganization and has remained essentially the same since. It is expected to respond more slowly to the changing environment as its work is, in a sense, filtered through the perceptions of the other departments.

In the recent past, the Ministry has successfully undertaken studies in the areas of oceans, energy, the environment and the North. It is anticipated that as the number of technological issues which cross interdepartmental mandates, or fall between mandates increases, there will be an increased demand on the service function of MOSST.

The Ministry also provides advice and guidance to the Foreign Investment Review Agency. For example, in 1978, FIRA commenced to place an increased and separate emphasis on assessing the technological benefits associated with proposals for the acquisition of existing companies and new investment in Canada. Guidelines were prepared by MOSST for use by FIRA, in order to improve R&D benefits to Canada and to suggest commitments of various types which might be made by applicants. From time to time, FIRA also consults with MOSST on specific proposals for foreign investment which have technological implications, but which are still at the negotiating stage.

The Ministry also chairs the Inter-Council Co-ordinating Committee (ICCC) which was established by Cabinet when the federal Granting Councils were restructured under the Government Organization (Scientific Activities) Act, 1976. The membership of the Committee is composed of the Presidents and Vice-Presidents of the three Granting Councils, i.e. the Natural Sciences and Engineering Research Council, the Social Sciences and Humanities Research Council and the Medical Research Council, and the National Research Council. It also chairs the Canadian Committee on Financing University Research, an advisory committee which draws its representatives from the federal, provincial and university sectors.

The policy analysis function has received a great deal of emphasis in the Ministry in the last few years, primarily because of the lack of an adequate data base in the science and technology area and the absence of historical analysis in the area. Thus, a number of economic studies were undertaken during this period in order to develop a factual foundation for subsequent policy development work. Early on, a model was developed to compare the performance of R&D in Canadian manufacturing with that of four Scandanavian countries. This led to the indication that Canadian industry was investing too little in R&D rather, as others had commented, the view that government in-house research expenditures were too large.

Further studies were designed to examine the underlying factors in more detail. For example, the level of R&D in Canada is, by itself, insufficient to support industrial activity. Work was, therefore, undertaken to estimate the value of technology entering Canada through intra-corporate channels in order to determine the total technology base of the country. Indirectly, this provided another indication of the short-fall in industrial R&D expenditures.

There was also an assessment of the performance of R&D intensive industries relative to those manufacturing

industries which do little or no R&D in Canada. The results confirmed that industries which do research and development significantly outperform the rest of manufacturing in terms of growth in employment, productivity and price stability.

A methodology was developed to establish which manufactures are technology intensive and to compute Canada's trade position in these technology intensive manufactures over a span of several years. Previously, only the trade balance for all end products was available. This was far from adequate, as it did not permit the identification of the contribution to Canada's exports and imports of higher technology products. These and other analyses illuminated the shortfall in industrial spending on R&D and led to extensive interdepartmental policy discussions leading to the tax incentives.

Subsequent studies compared the R&D activities and policies of Canadian foreign-controlled firms, to assess the impact of foreign subsidiaries on the innovative capacity of the domestic industry. It was concluded that the R&D performed in these subsidiaries is, generally, not only quantitatively less, but also qualitatively different, being directed principally toward adapting imported technology to domestic conditions. These studies led to an examination, which is still continuing, of ways

and means to encourage "product mandates" in foreign-controlled subsidiaries.

A recent orientation in the Ministry's policy analysis work resulted in part from the need to restrain government expenditures. MOSST was asked by Cabinet in 1980 to study how federal policies and programs can be used to lever up private sector investment towards the objective of increasing the overall national level of R&D investment to 1.5 percent of GNP. This study incorporates a review of those general instruments put in place over the past few years.

The Ministry has also developed a computerized data base and simulation model to analyse trends in highly qualified manpower (HQM) and to project the demand for such manpower. The data base includes updated information on HQM occupations, attrition, the supply of new graduates, post secondary education enrollments and university staff.

Although the Ministry has been working closely with Statistics Canada and in particular cases, Revenue Canada, to obtain the necessary data for effective analysis, the data is very slow in being reported and thus, is only appropriate for historical analysis. Consideration is

currently being given to obtaining an alternative data feed-back whereby the reaction of the industrial community to policy and program measures can be more quickly determined and their intentions for the future can be interpreted and fed into the Ministry's policy work.

The activities in the federal/provincial areas have increased in importance over the last few years. A major step in the direction of developing a national consensus on actions to increase industrial R&D took place late in 1978, when the first Federal/Provincial Ministerial Conference on Industrial R&D was convened. At the Conference, MOSST took the opportunity to encourage the provinces to give greater consideration to the identification of priority areas for support of R&D, in addition to "horizontal" measures which are designed to increase the level of industrial R&D generally. This led to subsequent federal/provincial bilateral consultations to identify actions which should be taken in order to strengthen the scientific and technological capacity of the provinces in priority areas where R&D will be important for the attainment of regional economic and industrial development objectives. The whole process has also given the provincial governments a much greater interest in defining their own science and technology priorities and policies.

In the international arena, a senior official of the Ministry plays a major role in the OECD where it chairs the OECD Science and Technology Committee. As well as contributing to international policy formulation, feedback from the international meetings has significantly contributed to Canada's own policy work. Participation in foras such as the OECD, UNCTAD and the ECE Science Committee, becomes more important to Canada's interest as the world economic climate begins to change at an ever increasing rate and begins to impact more noticeably on the national economy. The Ministry is also considering means through which Canada's bilateral science and technology ties may be strengthened.

The requirements for the information function have been increasing with the heightened awareness of the public of the importance of science and technology to their economic and social well-being. The increase is expected to continue as the Ministry tackles more complex issues and the government/industry interface increases in sophistication.

B) Other Directions for the 1980's

The shift in policy emphasis from general infrastructure support to specialized intervention will place new demands on the policy analysis role.

In addition to placing a greater emphasis on policies and plans for technology creation, there would be merit in examining how industry might be encouraged to adopt existing technologies at a faster rate. There are many technologies which, if diffused, could result in significant productivity gains. Some preliminary work by the Ministry indicates that there are numerous barriers to diffusion. There are regional differences in the level of technology being used to accomplish the same task. There are specific industry sectors which appear to lag when compared to their international counterparts (e.g., plastics processing). At the level of the individual firm, factors involved in the adoption decision include the degree of associated risk from the absolute cost of the innovation, its cost relative to the firm's resources, and the ability and willingness of management to manage the new technology. Where the adoption of an innovation is judged desirable, this adoption might be encouraged by incentives designed to increase the relative advantage to be gained from adoption or to reduce the risks associated with adoption.

Some shift can also be anticipated in the nature of the future issues which will be addressed by the economic analysis function within the Ministry. For example, there is evidence that factors such as continuing inflation, high interest rates and slow economic growth are tending to make industrial R&D managers more conservative in their outlook and affect their propensity to take risks. It would be desirable to have a better understanding and assessment of the impact of the evolving economic climate on the research and technology investment decision-making process of corporations. As well, we need to be conscious of the potential dangers posed to industrial innovation by short-term economic factors and their associated policy responses, if they become a continuing feature of the economic system. In general, there is a need to better understand how science policy and economic policy might be coupled more closely.

In discussions the Ministry has had with provinces concerning possible areas for Federal/Provincial cooperation in industrial R&D, it has become clear that the emerging science policies and plans, if uncoordinated, will result in overlapping efforts which are not necessary or not mutually supportive and would result in a misallocation of scarce resources. In view of the fact that a need for research and development and the application of

science and technology underpins many of the economic development priorities of the Provinces, just as much attention should be given to establishing a national framework for science policy as is being given to establishing a national perspective for industrial policy.

With regard to the university sector, the role of the Ministry in recent years has been to determine the role of university research in maintaining a national scientific capability and in training highly qualified manpower, and at the same time seek to determine what the federal role ought to be in support of university research. Both the role of university research in the national science effort and the federal role in supporting it will come under extremely close scrutiny as both federal and provincial governments negotiate new arrangements for the financing of post-secondary education. A major challenge over the next few years will be to develop policy options for the federal government to consider as it attempts to raise the overall level of R&D in the country and at the same time seeks to reduce the level of fiscal transfer payments to the provinces for the aid of post-secondary education.

The role of the social sciences in the formulation of policy for the application of science and technology to national issues has, in recent years, been largely overlooked. As science and technology become greater driving forces in Canadian industrial development, questions as to the appropriate management of S&T and appreciation of the societal impact of their application will need to be addressed. The Ministry has begun the development of a framework for the eventual elucidation of objectives for the federal government in its support of social science research. Although initially directed towards university social science R&D, the scope of such a framework could then be broadened to include social science research in other sectors.

University research potentially represents an important capacity upon which to base industrial growth. Problems remain, however, in the attempts to establish stronger linkages between academe and industry. The Ministry will, therefore, examine and develop, if need be, mechanisms for the successful transfer of university science and technology to industry.

For the Ministry to become more effective in its policy formulation and advisory roles, mechanisms must be sought to give MOSST greater access to scientific and

technical expertise outside of government. The universities represent a large source of that expertise and ways and means will be developed which will allow the Ministry to take fullest advantage of this resource. At the same time, the specific research capabilities in the universities must be identified and continuously monitored to have more effective input into the Ministry's growing appreciation of developments in science and its potential need to access expertise related to those developments.

The Ministry's role vis à vis government research is expected to evolve over the next five years in two principal ways. The first is to create closer ties between the federal mission oriented research and the Ministry's initiatives to adopt more specialist roles in the development of selected technologies in Canadian industry. While this new direction in the Ministry's work will, by its nature, be focussed on industry as the implementing sector for the technologies, there is likely to be a considerable amount of participation by federal departments and agencies which are major funders or performers of S&T. Some technologies may, like Telidon, originate in federal laboratories. In other cases, federal departments may have a vital role to play in research and development to support technologies, or in related scientific activities such as feasibility studies or assessments of the impact of technologies on socio-economic conditions.

The Ministry will also, in order to meet the new demands of its evolving work in the 1980's, have to consider the feasibility of a new policy structure for the government funding of science and technology. Also, policy elements directed at further encouragement of technology transfer will have implications for the conduct, management and evaluation of all federal science and technology programs. Care will be needed to ensure that new policies are well-integrated with existing measures, or that desirable changes are made before or at the same time as the introduction of new measures. As well, the safeguarding of sufficient mission oriented effort to ensure the effectiveness of S&T in supporting departmental missions must be taken into careful consideration, not only because of the obvious need to ensure that science plays its full part in the work of departments and agencies, but also because departments will not be likely to cooperate so fully and energetically in the new thrusts if they perceive these as posing threats to their mission-oriented capabilities.

Within the information function, the work will be directed towards more specificity and closer alignment with the needs and wishes of recipients. As an example of this, the Ministry has in the past modified its annual publication "Federal Science Activities", to reflect feed back received from parliamentarians, the press and

others. The Ministry will intensify its efforts to discover users' view - for example as may be indicated by the current Government-wide Study of R&D by the Office of the Auditor General, which is examining information flow as one of its satellite studies - and to design future information work so as to reflect these views as far as is feasible.