Ministry of State
Science and Technology Canada

Ministère d'État
Sciences et Technologie Canada

Strategic Overview 1983/84 — 1985/86

Canada

Strategic Overview

1. Introduction

Last year's strategic overview reviewed the role and functions of the Ministry of State for Science and Technology and their evolution since MOSST was established in 1971.

It noted that when MOSST was created, it was generally assumed that the rate of economic growth experienced in the 1960's would carry forward into the 1970's. It also assumed that science and technology would continue to be one of the driving forces behind this growth. However, the experience of the 1960's had shown that new technologies are not always socially and environmentally benign. Their full implications, not only their economic ones, had to be examined before they were adopted. The management of science and technology had to take into account the interests of all society and not only parts of it.

The assumptions about economic growth during the 1970's turned out to be far too optimistic. Views on the role of science and technology were adjusted to this new reality. Social and environmental considerations remained important, but the trade-offs between economic and non-economic factors shifted once again in favour of the former. The interest of governments in science and technology began to focus more on their economic potential than on any other objective.

The change in emphasis took place in all industrialized countries. Science and technology came to be viewed as a means through which their competitive positions could be improved and higher rates of growth could be achieved. Some countries (e.g. Germany, Sweden, Japan and, most recently and notably, France) undertook massive efforts to capture the economic benefits of science and technology. Many OECD countries began to analyze technologies in a systematic way to assess their importance to economic development. Efforts were also made to integrate science policy and economic policy with varying degrees of success. Much remains to be done.

2. The Canadian Situation

The situation in Canada evolved along similar lines.

Science and technology have a unique contribution to make to the achievement of Canada's social and economic goals. The government recognizes research and development, especially industrial R&D and innovation, as one of the key factors affecting the capacity of the Canadian economy to innovate, to improve productivity and hence to compete internationally. It established in January 1981 an R&D planning framework which calls for total national expenditures on R&D to reach 1.5% of G.N.P. by 1985. The private sector is expected to make the largest contribution to the attainment of the target. Its share of R&D expenditures is to reach 0.75% of G.N.P. by 1985.

The importance which the government attaches to research and development was reconfirmed in the document entitled Economic Development for Canada in the 1980's which was published at the time of the budget in November 1981. The economic development priorities set out in the document are manpower, resource development,

transportation, regional economic development, exports and industrial development and innovation. Science policy has a bearing on each of these priorities, but most immediately and directly on industrial development, resource development and manpower.

According to the document, one set of industrial development opportunities will be derived from major investment projects, especially those related to natural resources. They will centre on the technologies required for the construction of those projects and for the extracting, processing and manufacturing of our natural resources.

In addition, the document gives a high overall priority to industrial innovation per se without specifying any particular industrial opportunities. These opportunities can be expected to cover technologies related to our resource base though not necessarily to mega-projects (e.g. fisheries), established high technology areas (e.g. aerospace), core and emerging technologies (e.g. material technology and biotechnology) and systems technologies.

A second economic development priority area of

major importance to science and technology is the development of our natural resources. Research in agriculture, fisheries, oceans, forestry, energy and minerals occupies a very large place in the federal government's overall science activity. This research is essential to the realization of the government's industrial development objectives.

A third economic development priority of immediate interest to MOSST is manpower, especially highly qualified manpower trained in research. Shortages of such manpower have already appeared and are constraining growth in certain areas of high technology.

3. Science and Technology Policy

The government has put in place, during the last several years, a comprehensive and visible science and technology policy.

The first major step in this direction was taken in the early 1970's when it was recognized that science and technology had to be managed, and that it had to be managed in the interest of all society, not only its more

narrow economic interests. A second major step was the establishment of an R&D target in 1978. A third one was the transformation of the target into an R&D planning framework. The fourth and most recent step was the establishment of economic development priorities to which science and technology were closely related.

Science policy has been evolving away from more abstract notions, which tended to treat R&D in isolation, towards much more specific ones which permit greater integration of R&D policy with other policies, especially the economic development policies, of the government. The movement is the result of two factors: better understanding of how a managed science effort can contribute to national goals and better, more precise definitions of these goals.

The main elements of the R&D policy are as follows:

1. An R&D Planning Framework which sets a target for R&D expenditures in the natural sciences, a time period for the attainment of the target and the funding contributions to be made by each of the

main funding sectors.

2. A programme for the support of university research and the training of highly qualified manpower in research, centered primarily on the five-year plan of the Natural Sciences and Engineering Research Council and increasingly related to national priorities and needs.

3. A diversified set of measures in support of industrial R&D with major involvement from DRIE, NRC, EMR and DOC. This part of the policy is being further developed in the MOSST "Leverage" paper which is being submitted to Cabinet and should become increasingly responsive to the economic development priorities of the government.

4. A large intra-mural mission-oriented R&D programme with two major focal points:

    - the protection and development of our natural resources;

. the quality of life, including safety, health and protection of the environment.

The importance which the government attaches to science and technology is reflected in the rapid increase in its science budget, especially its budget for R&D in the natural sciences. During the first two years covered by the planning framework, R&D expenditures in the natural sciences increased by about 39%. In the same period, the government's total operation and capital costs for all departments and agencies increased by 22%. The evolution of the federal science budget since 1979-80 is shown in Table 1.

The R&D Planning Framework provides the basis for measuring the performance of the main R&D sectors. The planned and actual performances are compared in Table II. It shows that, while the overall and sector targets have not all been reached, progress towards them has been good. The increases in private sector investment in R&D and the performance of the federal government are specially worth noting. (Statistics Canada is expected to revise its figures within the next two months. The revisions, we understand, will be upwards. See Table 2.)

4. Major Thrusts

The context in which this overview is being presented is thus a very positive one.

The government has put in place a comprehensive and well-articulated science policy. That policy is being integrated to an increasing extent into other government policies. As a result, we are gradually reaching a better understanding of how science policy interacts with economic policy, resource policy, manpower policy, regional economic development policy, industrial policy and many other policies.

The results so far obtained from the government's science policy are most encouraging. All the affected sectors are responding in a positive way and, as a result, the downward trend in R&D expenditures, expressed as a percentage of G.N.P., appears to have been arrested and reversed while industrial R&D expenditures - the key to ultimate success - have increased rapidly over the last several years.

It is important to reinforce and to build on the base which has thus been established but which remains somewhat fragile.

Three major thrusts are being proposed to accomplish this.

1. The further development of general science policy.

2. The further integration of science policy with other policies.

3. A large programme of public information on all federal science activities.

4.1. Further Policy Development

4.1.1 The Planning Framework

The R&D Planning Framework in the natural sciences was approved by Cabinet in January 1981. The framework was received intially with a great deal of skepticism in part because it was seen as too ambitious

and in part because it was not accompanied by new R&D measures to back it up.

The substantial support given by the federal government to science and technology since January 1981 has contributed significantly to greater public acceptance of the framework. The framework has proved to be valuable in increasing public awareness of the importance of R&D, in stimulating a more constructive dialogue between the various R&D sectors and in serving as a point of reference against which performances can be gauged. Perhaps the most interesting development is that industry is beginning to use it as a point of reference in assessing its own performance.

The R&D planning framework needs to be kept up to date to take into account changes in the forecast rates of economic growth. These revisions in the framework are needed to maintain public confidence in it. The revisions can have important implications on the amount of R&D that the federal government must finance to meet its share of the target.

Beyond this, however, it is clear that a further evolution in the planning framework is desirable in order

that it be properly attuned to the government's stated economic development priorities. In this context, MOSST will be paying particular attention to building into the overall industrial share of the R&D target a recognition of the needs and concerns of specific industrial sectors. The government has already given a measure of guidance in this direction by identifying three broad industrial sectors -- resource extraction, resource-related manufacturing, and high technology industries -- as the key opportunity areas for the 1980's, and MOSST will therefore be emphasizing these areas in its sector-oriented considerations on the framework.

Sensitivity to regional concerns also needs to be incorporated into the planning framework. The government's economic development priorities recognize that the resource development and industrial growth opportunities of the 1980's will have economic and social impacts specific to each region of the country. Clearly, recognition of the attendant regional R&D implications, and of the related R&D interests of provincial governments, must be more fully reflected in the federal government's overall science policy and planning perspective.

While further elaboration of the R&D planning framework will be a major MOSST priority in the immediate future, continuing efforts must be devoted to assessing the adequacy of the country's R&D performance in relation to that framework. In fact, Cabinet has explicitly directed MOSST to periodically report to Ministers on precisely this issue. The incorporation of regional and industrial targets into the planning framework will certainly be of considerable assistance in this regard. It could also help to establish R&D priorities, a difficult task which MOSST has often been urged to perform.

To this end, MOSST intends to consult with industry and with the provinces in the further development of the framework. It will also have to maintain and, indeed, improve upon its collection and analysis of data on S&T expenditures in all sectors. A particular concern in this context is the need to develop a greater knowledge of present and anticipated industrial R&D investment. In addition, as described more fully below, initiatives will be taken to develop a meaningful data base on social science expenditures.

4.1.2. Policy for the Social Sciences

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 the appreciation of the societal impact of their application will need to be addressed.

The Ministry has begun this task by examining the role of the social sciences in government. In concert with this, a framework is being developed to guide the Ministry in formulating advice on the allocation of resources to the social sciences. Although initially directed towards university social science efforts, the scope of such a framework will be broadened to include social science research in other sectors.

In addition, an approach will be developed for integrating human science expenditures into the GERD target. This will involve: a review of basic definitions, data systems and practices, both national and international; development of a data framework that

includes all science expenditures; and development of a strategy for changing from the current GERD system to one which covers all sciences. Particular attention will be devoted in this work to the policy implications of introducing such a change, and to public repercussions.

The need and desirability of developing a policy for the social sciences has been discussed with the Committee of Deputy Ministers on Social Development which recognized the importance of the task and urged MOSST to undertake it.

4.1.3. International Considerations

The November 1981 paper on economic development clearly identified strong export performance as a pervasive economic development theme. To the extent that the strategic thrusts identified elsewhere in this document facilitate technological opportunities in the natural resource, manufacturing, and high technology industries, this export performance will be enhanced.

MOSST, however, has also been much more explicitly involved in matters that affect, directly or

indirectly, our relationships with current or potential trading partners. These activities deal with bilateral S&T relationships and with multilateral S&T concerns (e.g. technology transfer) having an impact on the long-term international trade environment.

In the past, much of MOSST's activity in this field has been directed to and has been most successful in the multilateral area. MOSST, for instance, has provided the Chairman for the OECD Committee on Science and Technology, and the Canadian position on North-South science and technology issues has largely been developed in MOSST.

More attention needs to be devoted to bilateral issues. It is intended to devote more resources to them.

4.2 Integration of Science Policy with Other Policies

4.2.1. Integration of Science and Economic Policies

Challenges such as the slow-down in economic

growth, high levels of unemployment, low rates of productivity increase, persistent inflation, structural imbalances in the economy, increased energy prices and environmental problems, continue to face Canada. Science, technology and innovation clearly have a vital role to play in the resolution of these difficulties.

However, in responding to the needs and aspirations of society, it is becomming increasingly necessary to integrate policies for science and technology with other economic policies. In order to achieve this overall objective, a concerted effort is needed to analyse the role and impact of technological change on the economy, and how technological change can be brought about.

It is becoming increasingly clear in discussion of the MOSST "Leverage" paper and of innovation generally that the interface between science policy and economic policy and between technological change and innovation is imperfectly understood, if it is understood at all. Furthermore, the methodology for assessing technological proposals is not well developed.

Very little work is being done either inside or

outside the government to correct these weaknesses. As it is essential that we improve our understanding of these matters, the Ministry intends to increase its emphasis on economic research as it relates to technological change and to innovation. Some of this work can be done inside the Ministry but it is proposed to contract out a significant part of it.

4.2.2. The Development of a General Framework for the Analysis and Assessment of Technologies (Integration with Industrial Policy)

In the Strategic Overview of April 1981, the Ministry identified the need for a more coherent government approach to the development of policies and the provision of advice concerning technologies which will likely be of medium and longer term importance to the economy. In describing this need, emphasis was placed upon the resulting desirability for MOSST to have a better understanding of the "technical" aspects of technologies. This would be distinct from the broad policy formulation, advisory and coordinating roles which have tended to characterize the past activities of the Ministry and which

contributed to creating a better "environment" within which to encourage technological innovation generally.

In order for MOSST to meet the government's needs in this area, it would be useful for the Ministry to develop:

a) a mechanism which provides an overview and early warning of those areas in which technology will have a strategic importance to industrial and economic development in Canada;

b) a way of assigning priorities to industrially-relevant technologies which are competing for government resources, and identifying those which should be the subject of government intervention of a concerted nature; and

c) a planning process which integrates the priorities with the budgeting and programme planning of departments and agencies.

4.2.3 Analysis and Assessment of Selected Technologies (Integration with Industrial Policy)

The time scale necessary to develop a given technology and the level of investment required should be assessed. Questions such as these and others are answered by a detailed assessment of each technology, tailored to the specific case under consideration; that is, each assessment is unique. Generally speaking, however, these studies could include the generation of scenarios of plausible future developments, uses and impacts, which are comprised of both quantitative and qualitative evaluations, together with consideration of points such as:

- identification of the factors critical to the direction and magnitude of the development and application of a selected technology;

- a procedure for analyzing these critical factors;

- the synthesis of scenarios for a selected technology, including consideration of

- related or impacting technologies (e.g. competing alternatives);

- the likely impacts in terms of exports, employment and production in Canada, as well as the possible need for new infrastruture to exploit the technology in question;

- the R&D and innovative capability of Canadian institutions in the area of technology under consideration;

- the activities of other countries in the field.

Consistent with this framework, MOSST will continue to analyse and assess selected technologies to ensure that they receive long-term R&D support adequate to their potential economic contributions, and also to minimize any negative impact which implantation of the technologies may cause.

An example of the Ministry's work in this regard has been the assessment of biotechnology as one area of

technology strategic to Canada's future industrial development. This work utilized a broad consultative approach, including a task force, to enable the Ministry to prepare policy advice to the government on this issue. Regardless of the decision taken by government as a result of MOSST's policy advice on biotechnology, it is clear that the attention which the Ministry drew to this area has had a considerable stimulative effect upon all sectors. The Ministry will therefore continue to monitor the evolution of biotechnology and its implications for Canada.

Other task forces will be reporting to the Minister in the near future on technological opportunities related to environmental protection and to energy conservation. Work is also proceeding on hybrid heating, with the financial assistance of EMR, and all long-term nuclear technologies.

It should also be pointed out in this context that new technologies are often derived from the results of breakthroughs in the basic sciences. (Biotechnology is an excellent example in this regard.) Consequently, it would seem that useful insights into the source and nature of possible new technologies, in the longer term, could be

obtained by attempting to project where the basic sciences may be going. With this in mind, MOSST will be consulting with the scientific community to attempt to obtain predictions on the major advances which might reasonably be expected in the fundamental sciences in the next two decades or so.

4.2.4. Federal Science Policies and Programmes in a Regional Context (Integration with Regional Economic Development Policy)

While a regional dimension will become an important element in the further evolution of the overall R&D planning framework, as mentioned above, regional considerations will also be more explicitly addressed in individual MOSST initiatives.

A particular concern in this context will be the degree to which the federal science policies and programmes reflect and contribute to the regional economic and social impacts of the development opportunities of the 1980's. The regional distribution of federal science expenditures is a matter of concern to Ministers, and with reason. There is nothing, however, in the system at the

moment which will help to redress or offset existing regional imbalances.

MOSST will, therefore, be assessing the regional distribution, orientation, and contribution of federal scientific activities, and will make recommendations, as appropriate, to facilitate improvements. This may include measures for increased federal coordination with expanding provincial R&D programmes and activities.

It should also be noted that the financing of university research and the role of this research in regional development have taken on increased importance in the bilateral negotiations over possible new arrangements for the financing of post-secondary education. The Ministry has been deeply involved with interdepartmental committees in developing alternative policy frameworks for the financing of post-secondary education and research, and will continue to provide advice on strategies to be followed as federal visibility increases in this area. In particular, the Ministry will develop strategies emphasizing the contribution which universities can make to regional economic development objectives and the role of the federal government in supporting them.

4.2.5. Mission-oriented R&D and Resources (Integration with Resource Development Policy)

Major resource development projects are seen as among the driving forces for Canadian economic renewal in the 1980's. Science and technology will clearly play an important role in this process, and MOSST will be placing appropriate emphasis on the relevant science policy concerns.

In particular, it should be pointed out that a substantial share of the federal government's mission-oriented S&T is directly devoted to the assessment, development, management (including regulatory considerations), and utilization of the natural resource base. Continued strength in these programmes should thus clearly be a government priority, and due recognition of this should be reflected in the further evolution of the R&D planning framework.

In addition to advising on the financial and person-year support required by resource-related and other mission-oriented R&D, MOSST wishes to ensure that the

"health" of government science is generally maintained. It has been suggested that the general atmosphere within the government has become less conducive to the effective performance of creative science than is desired. The situation should be examined. Hence, in consultation with the major science departments and agencies, and with other central agencies, MOSST will be giving priority to a study of the milieu in which intramural science is performed, with a view to recommending any appropriate corrective measures that may be required to pertinent administrative, management and resourcing issues.

MOSST, also intends to examine whether federal laboratories should play a larger role in furthering the research and technological capacities of industries in the resource-based, manufacturing and high technology sectors. Considerable effort has been made in this regard in the past, through policy initiatives such as those on contracting-out and technology transfer. They have to be extended, however, if concerted and effective utilization is to be made of the country's limited stock of scientists and laboratory facilities in achieving our national economic development goals. In this context, new mechanisms such as national research centres embodying universities and federal laboratories, and perhaps even

industrial facilities, will be examined in the context of bringing greater focus and emphasis to the national research effort.

Finally, it should be pointed out that MOSST's longstanding role of advising on specific policy and programme issues takes on a new importance if the government's mission-oriented and other S&T initiatives are to reflect, and contribute to, our national economic priorities. This means that MOSST will strengthen its capacity to influence and comment on policy and programme proposals as they come forward, and will seek more timely access to the information necessary to fulfill this role effectively.

4.2.6. Highly Qualified Manpower (HQM) (Integration with Manpower Policy)

As Canada increases its emphasis on technology driven economic expansion and diversification, the demand for highly skilled personnel will increase. Indeed, the availability of appropriately trained people is rapidly becoming a major national concern and is attracting considerable attention at all levels.

Through the use of the HQM data base and demand model, the Ministry will continue to provide assessment and advice on the developing HQM situation. Recently the Ministry published a series of background papers dealing with: trends in degrees awarded and university enrolments, future enrolment projections, engineering graduate requirements, and manpower requirements associated with the accelerated R&D expenditures envisaged in the R&D planning framework. In future reports, the results of the PhD survey, an analysis of future demand and supply situations for university graduates by discipline, and the possibility of integrating funding data with manpower data from the HQM model, will be explored.

4.2.7. University Research Outside the Granting Councils

While a substantial portion of university research in Canada is funded by the federal government's granting councils, university research is also supported by a number of other federal departments. Thus, apart from the more general need to maintain a national scientific capability and to train highly qualified

personnel, university research can also play a major role in assisting departments to fulfill their more mission-oriented objectives.

Recently, MOSST has made an effort to identify the extent to which departments use university research towards meeting national objectives. Extensive consultations with departments indicate that departmental involvement with universities is considerably more prevalent than the available statistical information suggests. Further, it would appear that strategic or mission-oriented programmes of the granting councils could benefit substantially from closer linkage with comparable programmes or expertise within the departments. The appreciation gained from this work will be applied to the Ministry's continuing examination of the health of the government science, and also to the Ministry's continuing consultations with the granting councils.

4.2.8. Space (Integration with Sectoral Policy)

In July of 1980, the Prime Minister gave to the Ministry of State for Science and Technology responsibility for the co-ordination of space policy. At

the same time, he asked the Minister for his views on how Canada's space programme could best be managed.

Since that time, the Ministry has submitted, to and Cabinet has approved, two sets of recommendations which have had the effect of increasing the proposed expenditures on space to $500 million over the next three years.

The Minister and Ministry remain responsible for the programme, but have not been given the person-year resources to do so. It has one full-time officer and three officers from the Interdepartmental Space Committee Secretariat on staff. It cannot discharge its responsibility with such limited resources. This situation cannot be allowed to continue. It is both unreasonable and unfair.

4.3. Communications

As a result of the increased concern about the impact of science and technology on the achievement of national economic and regional development goals, MOSST will be placing increasing emphasis on communications.

There will be continued stress on consultation with all sectors of the economy in order to ensure that there is mutual and comprehensive understanding of science policy concerns. Communications activities will be expanded to take the regional dimension into greater account, and the Ministry will be assuming a greater measure of responsibility for providing information to Ministers, Parliament and the general public on all federal science activities and policies.

A comprehensive communications plan has been developed in support of this strategy.

5. Programme Evaluation

Programme evaluation in MOSST will assess the past and current performance of individual programmes, and attempt to determine whether they should be continued, modified, expanded, cut back or terminated. It is expected that this work will be undertaken by independent specialists, in-house or on contract.

The following aspects will be highlighted: programme rationale, programme impacts and effects,

achievement of programme objectives, potential alternative approaches.

Four major thrusts will be evaluated in the fiscal year 1982/83. These are:

- the biotechnology programme;
- highly qualified manpower (HQM) activities;
- the economic analysis and research function;
- the service function.

6. Implications of Strategic Thrusts

The federal government has developed, over the last several years, a comprehensive science policy. That policy in its initial formulation tended towards the general and treated science and technology somewhat in isolation. The policy has gradually been refined and increasingly it has become possible to relate it in a meaningful way to other policies, and for other policies to draw on the science policy framework.

More important, the policy, measured against the performance criteria which are part of it, is working. Much of this success is due to the fact that the government has followed through on the commitment which it made to science and technology.

Another positive result is that, while a few years ago the government was being consistently criticized for its neglect of science and technology, this situation is turning around and relations with the interested community have improved significantly.

It remains that this base, built at considerable effort and cost, remains fragile. It needs to be strengthened; it certainly must not be abandoned.

Last year's strategic overview pointed out that the successful development and evolution of science policy called for a corresponding evolution in the role of MOSST. It is unfortunate that this call for a clarification in MOSST's role was ignored. One of the consequences is that MOSST has found it more difficult to discharge its role and responsibilities and to adapt to the new circumstances.

There are a number of areas that require attention.

In the first place, the movement away from general policy formulation and the integration of science policy with other policies (and vice-versa) means that MOSST must become more specialized.

Mechanisms must be sought to provide the Ministry with the best available scientific and technical expertise, from all sectors of the R&D community, on an advisory basis.

The techniques for developing access to this expertise would vary. In some cases, where the issues are of a general nature, an advisory council might be the best device. In cases where it is desirable to explore the potential of a particular technology and to design policies and programmes to realize that potential, a task force or working group might be in order. Usually, though, the requirement would be for a mechanism to ensure that the Ministry is kept informed about current scientific and technological developments in all areas of interest. This could best be done by securing, on a

retainer basis for a given number of days each year, the services, of one or more specialists in each area of interest.

It should be pointed out that, in seeking access to more specialized scientific and technical advice, MOSST is in no way moving to intervene in the basic management, operation or direction of departmental R&D programmes.

As already noted, a particular aspect of MOSST specialization deriving from the identified strategic thrusts is the need for greater Ministry capability in economics.

Secondly, the priority given to science and technology, the substantially higher amount of funds being allocated to them and the enhanced importance of the interface of science policy with other areas vital to the economic growth means that the co-ordinating function of MOSST needs to be strengthened considerably.

In this regard, recent attempts to coordinate federal activities in biotechnology and to establish a national programme, rather than a series of unreleated departmental and provincial programmes, have failed. This

failure was due in part to resistance by line departments, and in part to a lack of support or acceptance by the central agencies. The contradicting signals which are thus issued do nothing to assist MOSST in carrying out its assigned mandate. Perhaps even more fundamentally, the results still leave unanswered the question of how to ensure a coherent and purposeful national approach to biotechnology.

While biotechnology is a particularly prominent example of an area requiring more forceful coordination, it is not the only one. No reference is being made here, explicitly or implicitly, to the concept of a "science envelope". Nevertheless, it must be recognized that the contribution which science and technology are widely expected to make to achieving stated national economic objectives will not come about unless there is a more concerted attempt to relate science and technology priorities to priorities in other policy areas.

A fundamental improvement in MOSST's co-ordinating role would be for MOSST to be given the responsibility of submitting, through its Minister, an annual overview on science policy, possibly to the Cabinet Committee on Priorities and Planning.

The timing of this report would be such as to allow it to be taken into account by the Committee in its annual decision on overall government priorities and the establishment of the various resource envelopes.

The report would be a report of state on Canada's science and technology. It would, in due course but certainly not in its first year:

- further develop and refine the R&D planning framework;

- provide a multi-envelope, government-wide overview of R&D spending relative to the target track;

- review progress in the balance of R&D spending among government, industry, and universities in relation to the R&D planning framework;

- analyse government S&T expenditures and make recommendations on broad S&T priorities and the desired allocation of resources relative

to these priorities;

- identify new and emerging technologies that can contribute to economic renewal and other national priorities, and propose approaches to the realization of these technologies;

- review the overall "health" of Canada's S&T, with particular emphasis on the identification of emerging infrastructure problems such as human resource shortages;

- advise on organizational issues pertaining to the government's S&T activities, including proposing mechanisms to alleviate problems in the coordination of government activities and programmes that cut across envelope or departmental lines.

Thirdly, in last year's overview, it was argued that MOSST should be given an operational role. No particular model was proposed. The possible solution changed from what was described as a "gateway function" without any operational funds being voted to MOSST to a Department of Advanced Technology. The issue still

deserves consideration.

It was raised basically for two reasons. The first was that recommendations made by MOSST, especially operational ones but also policy ones, proved ineffective even when approved by Cabinet. Many of them were not incorporated into the policies and work programmes of the departments affected.

The second was that there were many areas in science and technology which were not being adequately looked after even though they were of considerable importance to Canada. Either there was no centre of responsibility for them or the responsibility was so divided that it made it impossible to develop a national approach.

MOSST continues to believe that the issue needs to be addressed because (a) the financial marketing and industrial development expertize in the federal government remains completely separate from the complementary scientific and technological expertize; (b) the research capacity of science based departments remains essentially oriented towards the resource base (e.g. the seed, the fish) while the government's industrial policy calls for

the development of the technologies required to extract and process the resources; and (c) there is a danger as resource based departments take on more responsibility in the industrial (processing and manufacturing) area, our industrial policies and programmes will become more and more fragmented.

7. Resources

Between 1973/74 and 1981/82, the Ministry's operational budget decreased by over 53% from $2,884,000 to $1,216,953 and its person-year quota decreased from 181 to 161. Meanwhile, during the last two years, MOSST's workload has increased significantly, leading to a requirement for supplementary estimates in each year. This has been an inefficient way of managing our finances, giving rise to slow-downs in our operations in mid-year and sudden acceleration as additional resources were approved.

The reason for the increase in workload is the high priority being given to R&D by the Government. This is reflected most visibly in the adoption of the R&D Planning Framework and subsequent early success in

implementation of the Framework's provisions.

The result has been a requirement for MOSST to monitor more closely the increased levels of R&D activity in all sectors and a growing need to ensure that it is more fully integrated so as to contribute effectively to the government's economic development goals.

Government R&D spending, for instance, has grown substantially in the last two years, with consequent demands for closer MOSST liaison with departments and more informed MOSST advice on the contribution of these science programmes to federal economic and social objectives. The emphasis in the Framework on enhancing industrial R&D performance and the subsequent industry enthusiasm have greatly expanded demands for the Ministry to consult with the private sector in order to improve the policy instruments supporting private sector R&D and to encourage the R&D efforts of multi-national enterprises. Emerging problems in the supply of highly qualified manpower to meet our scientific and technological needs have created substantial pressures, especially in light of the changing federal-provincial fiscal environment, for MOSST policy initiatives regarding the financing of post-secondary education and research.

In summary, MOSST has had to augment significantly certain aspects of its policy development work and vastly improve the extent and effectiveness of its liaison with all sectors of the R&D community. This increase in workload has necessarily entailed much greater costs to cover expenses of task forces and advisory groups, conferences, travel and professional services. This is illustrated by a growth of 117% in the Ministry's actual operating expenditures over the last two years (from $727,051 in 1979/80 to $1,580,000 in 1981/82) and, more specifically, by a growth of 153% in expenditures for travel, publications and professional services over the same period.

To date, with the aid of supplementary estimates, MOSST has been able to meet these increased responsibilities. However, increased resources are indispensable if the Ministry is to fill certain other requirements, particularly for the extensive studies and provision of advice to Cabinet which follow from the adoption of the R&D framework. These areas are outlined below.

(1) The Cabinet has asked MOSST to develop an

approach that the government can use to exert leverage on industrial R&D and innovation. In order for the government to do this effectively, it is essential that it identify, assess and promote investment in emerging technologies of strategic economic importance, such as biotechnology. MOSST, is, therefore, focussing on the development of a general framework for the analysis and assessment of selected technologies and proceeding with task force studies in specific cases. This work is outlined in MOSST's Memorandum to Cabinet, dated March 8, 1982, entitled Government Leverage in Industrial R&D.

Additional requirements: 8 person-years and $955,000

(2) In support of the strategies to encourage industrial R&D, MOSST proposes to publish an outline of the top 100 R&D performers, with an associated analysis, and to establish an annual award.

Additional requirements: 3 person-years and

$263,000

(3) A third area of priority which follows from the R&D framework is the need to analyse clearly the economics of industrial R&D and innovation. At present these links are not well understood and very little research on this is being done, either inside or outside of government. As more is spent on R&D, it is imperative to undertake such studies.

Additional requirements: 6 person-years
and $278,000

(4) MOSST has also been asked to undertake the lead role in the development of policy for the government's Space Program. This is another area of high technology in which extensive planning and coordination from one central organization is required. Although resources have been transferred to MOSST for the I.C.S. Secretariat, the Ministry has been forced to absorb the heavy policy development workload.

Additional requirements: 2 person-years

and $70,000

(5) MOSST has been required to greatly increase its communications activities, both with the general public and with the scientific and industrial communities. In particular, the Ministry has, in accordance with Cabinet Decision 335-81RD, July 16, 1981, undertaken to provide the public with full, accurate and timely information about the policies, programmes and legislation approved by Cabinet and Parliament on all current science policy issues. It has also increased its public consultations on new science policy initiatives; increased its regional coverage; and increased its information response to the public on all science policy related issues.

Additional requirements: 5 person-years
and $383,000

(6) The Auditor General has recommended that MOSST increase the accuracy and comprehensiveness of its data base of federal scientific activities.

Additional requirements: 2 person-years and $95,000

(7) The Ministry is required to develop its management practices and controls in accordance with the guidelines of the Comptroller General. In particular, MOSST will require an additional 2 person-years and $141,000 for Program Evaluation, $70,000 for an expanded Comprehensive Internal Audit, and 2 person-years and $70,000 for an expanded Corporate Planning function to support preparation of the Strategic Overview and Work Plans and Operational Expenditure Plans.

(8) Related administrative costs for the additional personnel required would amount to $270,000.

In total, these new demands placed on MOSST require an additional 30 person-years and $2,595,000.

Table 1

R&D AND RSA EXPENDITURES IN HUMAN SCIENCES BY PERFORMING SECTOR

	1979/80		1980/81	1981/82	1982/83	
	(millions of dollars and (%))					
TOTAL HUMAN SCIENCES	397.3		443.7	579.2	578.9	
R&D EXPENDITURES (TOTAL)	90.7	(100)	95.1	109.5	130.4	(100)
Intramural	36.4	(40)	39.8	47.2	55.3	(42)
Extramural (Total)	54.3	(60)	55.3	62.3	75.1	(58)
Industry	4.7	(5)	3.3	4.6	5.0	(4)
University	26.9	(30)	30.5	34.6	42.4	(33)
Others	22.8	(25)	21.5	23.1	27.7	(21)
RSA EXPENDITURES (TOTAL)	306.6	(100)	348.6	469.7	448.5	(100)
Intramural	264.7	(86)	303.7	418.3	392.5	(88)
Extramural (Total)	41.8	(14)	44.9	51.4	56.0	(12)
Industry	9.6	(3)	10.2	12.0	13.9	(3)
University	13.6	(4)	15.5	17.7	19.3	(4)
Others	18.6	(7)	19.2	21.7	22.7	(5)

Table 2

A COMPARISON OF PLANNED AND ACTUAL INCREASES IN GERD BY FUNDER

Funder Sector	1979	1980	1981	Annual Average Rate of Growth Planned	Actual
	($ millions)				
Federal Government	936	1105	1254	17%	16%
Provincial Government	173	194	213	19%	11%
Industry	1034	1221	1481	27%	20%
University	344	346	387	9%	6%
Other	144	163	183	9%	13%
TOTAL	**2631**	**3029**	**3518**	**20%**	**16%**