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CANADA

Report of the
National Advisory Board
on Science and Technology

COMMITTEE ON FEDERAL SCIENCE AND TECHNOLOGY PRIORITIES

Presented to the
Prime Minister of Canada



Scientific Advisory Board on
Industry and Technology

Conseil consultatif national
des sciences et de la technologie

The Right Honourable Brian Mulroney
Prime Minister of Canada
House of Commons, Room 3043
Ottawa, Ontario
K1S 1A5

Dear Prime Minister:

This report is available in the
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SPENDING SMARTER

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The objective of my report "Spending Smarter" is to provide you with an independent
assessment of the current state of R&D spending in Canada and to provide
recommendations on how to improve it.

The Government of Canada has a long history of supporting R&D in
Canada. The current level of R&D spending is 1.7% of GDP, which is below
the OECD average of 2.4%. This is a significant gap that needs to be
closed if Canada is to remain competitive in the global market.

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JUNE 1993



National Advisory Board on
Science and Technology

Conseil consultatif national
des sciences et de la technologie

The Right Honourable Brian Mulroney
Prime Minister of Canada
House of Commons, Room 309-S
Ottawa, Ontario
K1A 0A6

Dear Prime Minister:

This letter transmits to you the first Report of the Committee on Federal Science and Technology Priorities. The Report was reviewed and approved by the National Advisory Board on Science and Technology Plenary of April 14, 1993.

The subtitle of the Report, "Spending Smarter", reflects our focus and our objective. Our advice is intended to help the government better manage the \$6 billion it spends every year on science and technology (S&T).

The Committee found unequivocal evidence that your government considers S&T to be a priority in the allocation of funds. Confirmation is apparent in the growth of spending on S&T, which has exceeded the growth of most other categories of federal program spending. As you know, however, true priorities have a hold both on our budgets and on our management processes. With respect to this latter criterion, the Committee could not confirm any explicit rationale for the current allocation of S&T funds among federal departments, nor, generally, within departments themselves. In our view, a more pervasive awareness of the need to manage S&T as a distinct entity is a prerequisite to better management of the S&T portfolio. We take the view that federal S&T is a national strategic investment; as such, it requires high level strategic planning. The Report provides recommendations to establish such planning.

An appreciation of the role of government in S&T is critical to the determination of S&T priorities. The Committee identified four principles to guide its analysis. We concluded that the key role for government is to develop a 'knowledge-thirsty society' and to support 'market-driven technology development'. We would also support S&T activities which promote international competitiveness and sustainable development.

...2

The Report assesses the S&T spending of twelve federal departments or agencies. Our findings represent an assessment at one point in time, based on materials available to the Committee and on conversations with representatives of organizations in the selected agencies. The challenge to federal organizations is not represented by 'where they are' in the Committee's assessment, but 'where they could go'. The Committee recognizes that for some organizations, given their legal responsibilities to provide certain services or to fulfil a certain mission, it may be less appropriate than for others to respond to the Committee's criteria. However, in all cases we see opportunities for improvement in S&T programming. Hence, we recommend that Cabinet direct all federal organizations with S&T responsibilities to examine whether and how S&T programming can be modified to support the four principles we have developed. Future allocations of S&T funds should be based on each organization's achievement of the government's objectives for S&T.

The full Board has asked the S&T Priorities Committee to add a further seven organizations to its sample, bringing its coverage of S&T spending to nearly 90 percent of the total. The Committee is engaged in this work now, and will provide you with a second edition of its Report when our work is complete and reviewed by the Board.

Thank you for your support and encouragement of our work. It was critical to our ability to complete our studies in this sensitive area. We trust that this Report will be a solid foundation on which to set priorities for the government's S&T spending.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Peter Janson', with a long horizontal flourish extending to the right.

Peter Janson
Chairman
Committee on Federal
Science and Technology Priorities

Attachment

The views expressed in this paper are those of the authors and do not necessarily correspond to the views or policies of the Government of Canada.

The Committee on Federal S&T Priorities

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Executive Summary

Findings

Judging by the allocation of financial resources, S&T is clearly a priority for the federal government. However, there is no evidence of an explicit rationale for the distribution of S&T spending among departments. The government is organized to manage horizontal issues in S&T (i.e., those common to most organizations), but has not succeeded in finding a method to select priorities among S&T programs or organizations.

The Committee applied four principles in its review of federal S&T programming: Development of a Knowledge-thirsty Society; Market-driven Technology Development; Competitiveness; and Sustainable Development. In the view of the Committee, two of those principles represent the **main objectives for government** in supporting S&T. Federal S&T programming can contribute to the **development of a knowledge-thirsty society** by acquiring, collecting and propagating knowledge and information through such means as research, technology diffusion, education, training and public awareness activities. Federal S&T organizations can support **market-driven technology development** by: identifying their clients; being aware of and responding to client needs; and having current knowledge of the global competitive situation of the industry.

The Committee reviewed the S&T programming of twelve federal organizations. The Chart on this page (larger version on p.14) presents the findings for the selected organizations.

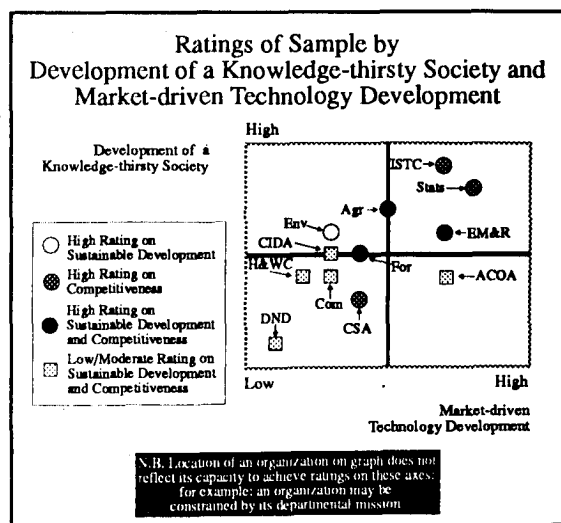
Conclusions

Development of a knowledge-thirsty society and market-driven technology development should be priority areas for federal S&T programming. Programming in support of other objectives should have less priority.

Cabinet makes explicit decisions about the allocation of S&T resources. To do this, Cabinet requires a source of advice on priorities. One or more Ministers should be designated to bring the recommendations on priorities to Cabinet.

Recommendations

The government should support as priorities those activities which support the development of a knowledge-thirsty society or market-driven technology development. The Economic and Trade Policy Committee of Cabinet should review, and approve or modify, the distribution of federal S&T resources across federal departments and agencies at least once every five years, preferably every three years. The review of S&T spending distribution and any recommendations for its change should be presented to the Cabinet Committee in a joint submission signed by the Minister for Science and the President of the Treasury Board. The Ministers who present advice to Cabinet on S&T spending priorities should have as input to their recommendations advice received from a group external to government (such as NABST) as well as advice received from science-based organizations within the federal government.



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Introduction

Priorities emerge from choices about what is important. The outcome of those choices often entails the reallocation of finite resources among competing applications.

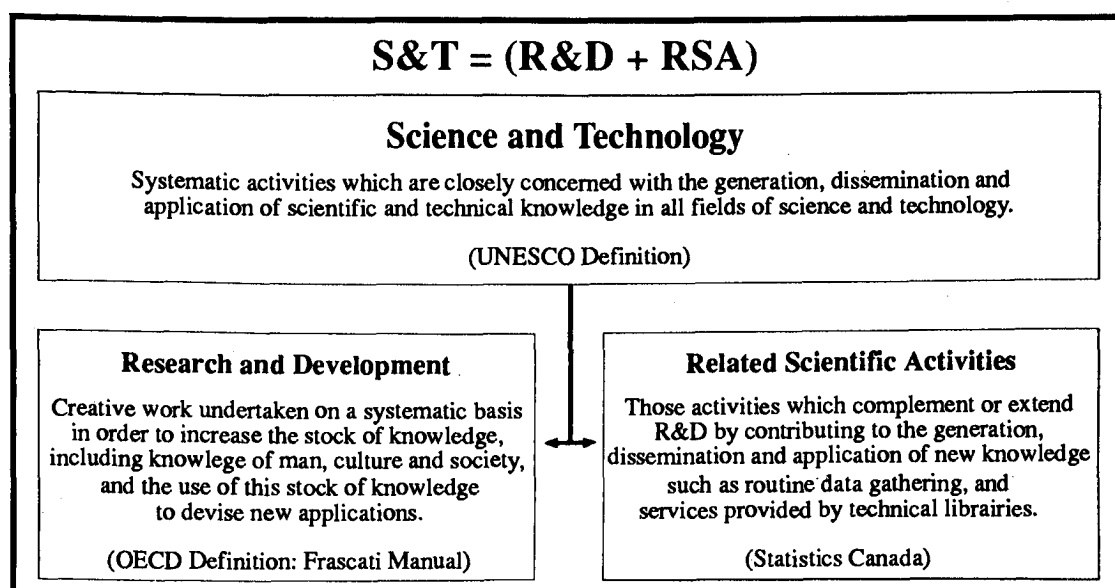
Setting priorities is a management function, as priorities express and fulfil the purpose of an organization. Indeed, an explicit understanding of the purpose, role or objectives of an organization is critical to the rational determination of its priorities.

Accordingly, a method for setting the science and technology (S&T) priorities of the federal government must have as its foundation an understanding of the actual or desired role or objectives of the federal government in supporting S&T.

The federal government invests close to \$5.7 billion per year in S&T. That investment is spread over almost 60 distinct organizations, financing disparate activities and supporting diverse objectives. The amount in itself is substantial, but it is also significant in relation to the whole research and development effort of Canada. Federally-funded R&D accounts for about one-third of the national R&D effort (Gross Expenditures on R&D). That comparison does not include federal expenditures on related scientific activities (RSA), which are also considered part of S&T.

An investment on that scale nonetheless falls short of the demand for funds. Choices must be made. Federal S&T priorities, based on agreement about what is important, can guide that investment to achieve maximum benefits. The objective is not to spend more or to spend less, but to spend smarter.

EXHIBIT ONE Key Definitions



Mandate

NABST approved the following mandate for the Committee on Federal S&T Priorities:

based on a clear policy framework, to develop a simple method for setting the science and technology priorities of the federal government; to apply that method to a substantial portion of federal S&T spending.

Work Program

Assumptions

The Committee assumes that government seeks advice that is practical - advice that can be applied.

Given the size and diversity of the federal investment in S&T, the Federal S&T Priorities Committee concluded that it was not realistic to attempt an examination in detail of the entire federal effort in S&T. Thus the first objective of the Committee was to reduce the scope of its work to a level that was manageable.

The Committee has taken a narrow interpretation of its terms of reference. Members agreed that the sole focus of work should be on setting spending priorities among federal departments and agencies. S&T strategy was another broad and complex issue. Accordingly, the Committee chose not to focus on such issues as what technologies or fields of science are priority areas, or whether there is a priority choice between S&T to advance human knowledge or to develop highly qualified personnel. The Committee also decided not to examine horizontal issues - those which are common to a number of departments and agencies (such as the balance between intramural and extramural research, or the effect of revenue retention policies).

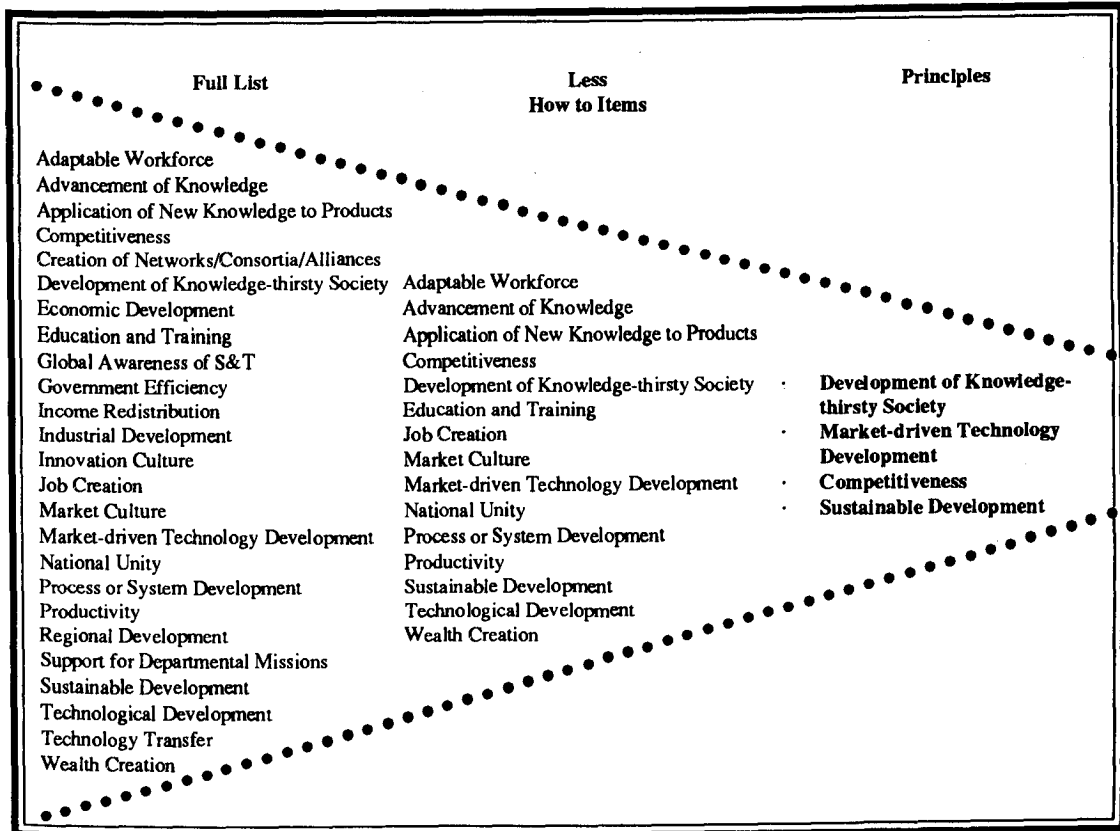
Development of Principles

The terms of reference for the Committee ask that it refer to a clear policy framework as the basis for its work. The framework was not supplied; it was up to the Committee to develop it. Members began with a list of possible principles that might be used to identify S&T priorities. Some potential principles related more to the means by which an objective might be achieved, rather than the objective itself; these were excluded. Members then agreed to apply the following four principles:

- Development of a Knowledge-thirsty Society
- Market-driven Technology Development
- Competitiveness
- Sustainable Development

The winnowing to select the principles is illustrated in Exhibit Two.

EXHIBIT TWO
Selection of the Principles



Development of a Knowledge-thirsty Society

To be competitive, future societies must be knowledge-thirsty. As traded products acquire an ever higher knowledge-content, competitiveness will depend more and more on new ideas and knowledgeable, trained people to bring those ideas to fruition and to sell them in international markets. Hence, development of a knowledge-thirsty society is understood as a necessary (but not sufficient) condition for international competitiveness and future prosperity.

In addition, the Committee is convinced that the thirst for knowledge of all kinds is a characteristic of enlightened, progressive and healthy societies and cultures. A desire to understand, to know more, is an intrinsic and valuable attribute of humankind.

For these reasons, the Committee has decided that development of a knowledge-thirsty society is a key objective for federal S&T programming. Support for that objective is an appropriate and desirable role for government.

A knowledge-thirsty society learns continuously; curiosity is a cultural attribute. Learning refers to the acquisition of knowledge through education or training. It also includes the effort to develop new knowledge in all fields, whether or not the knowledge has an immediate application. The acceptance of lifelong learning as a societal posture is an essential element in building and maintaining the adaptable workforce that Canada will require in the future. A knowledge-thirsty society will support those elements of infrastructure that support learning, such as institutions which collect, preserve and disseminate information. Such a society will be aware of the importance of continuous learning as a societal posture.

The Committee believes that the sharing and use of knowledge is as important as its accumulation. Indeed, knowledge is information that is interpreted, understood and, most importantly, shared. New knowledge, in all fields, should be relevant to the diverse needs of society. The Committee believes that federal S&T programs should support the development or accumulation of knowledge that is of potential interest to a broader clientele than the scientists who create it or their peers.

The objective of developing a knowledge-thirsty society can be met by activities and programs which support:

- the creation and dissemination to Canadians of new knowledge relevant to the diverse need of society, through R&D in government, university and industry facilities;
- prospecting for, collection of, and dissemination of information of use to Canadians;
- involvement of young Canadians in federal R&D through volunteer appointments, summer work, etc.; and
- education, training and the development of a science culture.

The relevance or usefulness of knowledge and information can be assessed by the demand for it from potential users.

Market-driven Technology Development

The application of knowledge to products and processes is another indispensable ingredient of future prosperity. As such, the Committee identifies market-driven technology development as another key principle. Federal S&T programming should support both the acquisition and the development of technology that is required by the marketplace.

Within government (i.e., intramurally), technology development that is not market-driven may serve some other goal, such as the developers' perception of what needs to be accomplished. The eventual output or product may have little relation to what the market actually requires. When resources are limited, and their allocation needs to be prioritized, **market-driven** technological development should have the priority.

The principle of market-driven technology development highlights the need for federal S&T establishments involved in the development of potentially useful technologies to establish links to private markets. Such links could be direct, in the form of joint ventures or alliances, or indirect, as when a federal laboratory responds to advice from the private sector about the direction of R&D.

Market direction should be applied both to intramural and extramural S&T activities: i.e., those conducted inside government or those funded by government but conducted outside. When limited, federal funds are involved, government, university and private laboratories should respond to market needs.

S&T organizations that have chosen to let the market drive their technology development share some common characteristics; each organization:

- has chosen its market; i.e., knows who its clients are. Imprecise identification of clients (e.g., the Minister, or all Canadians) will cause difficulties in identifying and satisfying their needs. Non-market clients (e.g., Ministers, other government departments) are less likely to require technology of use in the marketplace.
- is aware of client needs, through their participation and feedback in research project planning. A client advisory group is one effective method of gaining client participation, but there are others as well (e.g., contact through conferences).
- has some accountability to clients for the conduct of its S&T programs. Although the organization need not always follow the advice of its clients, it owes them an explanation for its response to their recommendations.
- is aware of the global competitive position of the industries and technologies associated with its S&T programs. Such an awareness can assist in the allocation of resources among competing claims.

Competitiveness

Competitiveness is fundamental to national prosperity, indeed, it is an essential element of national survival. This was argued earlier by NABST, in its **Statement on Competitiveness**. That Report also identified competitiveness as a precondition for progress on other, pressing national issues. The federal government gave recognition to this ranking of principles in the 1991 Speech from the Throne in identifying two, linked priorities: competitiveness and national unity.

The Committee understands competitiveness as the state of national economic affairs, defined by the behaviour of firms (or private sector persons), that results in a sustained and sustainable improvement of citizens' standards of living and quality of life. This description recognizes that it is not sufficient, for example, to focus on rapid growth of exports; some exports add more to real incomes than others. Nor is a focus on productivity gains alone appropriate, as these could be achieved solely through reductions in jobs and income.

Similarly, the Committee recognizes that competitiveness means more than maximized economic returns to the individual. 'Living standards' are to be understood more broadly, as elements of the quality of life. The social safety net, societal infrastructure, consumer protection, drug and product safety, and acceptable environmental conditions are, among others, all part of the standard of living in Canada. Sacrifice of these objectives for economic gain would not be accepted by most Canadians and is not proposed by the Committee.

Sustainable Development

Canadians appear committed to a fundamental change in the nature of economic development, a change that requires rethinking the concept of economic development. Sustainable development is a relatively new concept in the developed world and there are many different ways in which it can be understood. The Committee is aware that the concept is often understood to be more broad than the appreciation of the state of the physical environment and its relationship to economic development. Social, cultural and political sustainability are often included as well, as global understanding of the concept grows more sophisticated. In this report, the Committee limited itself to a narrow interpretation of sustainable development (i.e., primarily environmental), as it is the base interpretation with which most can agree. The Committee's assessments of federal organizations would change if a different interpretation had been used.

Environmental and developmental objectives should be mutually supportive throughout the development cycle, but especially at the front-end. Adoption of these supporting objectives can avert the economic and environmental costs that might otherwise occur when one or the other is overlooked.

Sustainable development is an important issue for industry today and will become more important in the future. Environmental concerns and requirements can open new business opportunities for products and services and can lead to major improvements in products and services. However, if industry does not respond to environmental imperatives, governments will intervene, whether at the national or supra-national level. Industries slow to respond may be at risk through government regulation. Competitiveness and sustainable development must therefore be allied.

Federal S&T in support of sustainable development should include work on technologies or processes which reduce consumption of natural resources, which assist firms to develop better designed, longer lasting and reusable/recyclable products and which help industry to minimize the negative impact of their manufacturing or other processes on the environment. Development of environmental standards and work on their application should also be included.

EXHIBIT THREE

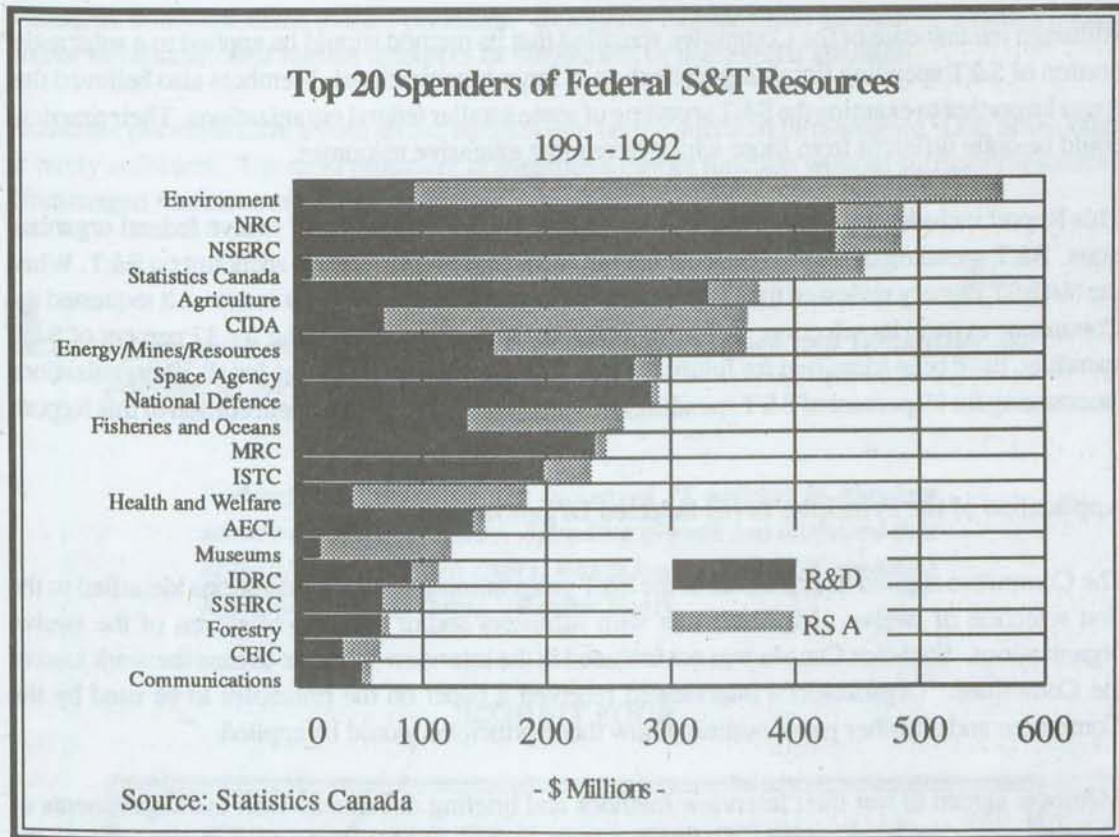
**Selection of Organizations to be Assessed**

Exhibit Three shows the 20 federal organizations which spend the largest amounts on S&T. However, almost 60 distinct federal organizations perform or fund S&T. It was not realistic for the Committee to examine the S&T spending of all of them. It was necessary, however, for the Committee to examine selected organizations that were reasonably representative of federal S&T activities. The selection needed to represent:

- organizations which performed S&T activity intramurally as well as those which fund extramural activity;
- organizations which fund or perform a great deal of research and development (R&D) as well as those engaged in or funding related scientific activities;
- organizations focused on research in the natural sciences versus those focused on the social sciences; and

- organizations which fund or perform S&T to promote economic development, to support a departmental mission, or to advance human knowledge.

Although the mandate of the Committee specified that its method should be applied to a substantial portion of S&T spending (implying a selection of large organizations), Members also believed that it was important to examine the S&T spending of some smaller federal organizations. Their practices could be quite different from those which have more extensive resources.

This Report includes the Committee's assessment of the S&T spending of twelve federal organizations. S&T spending of the twelve accounts for 57 percent of total federal spending on S&T. When the NABST Plenary reviewed the Committee's findings for the twelve organizations, it requested the Committee expand its selection. A further seven organizations, accounting for 32 percent of S&T spending, have been identified for future review. The Committee's findings for all 19 organizations (accounting for 89 percent of S&T spending) will be presented in a subsequent edition of this Report.

Application of the Principles to the Selected Organizations

The Committee applied its principles to the S&T programming of the organizations identified in the first selection of twelve. Members met with Ministers and/or officials of eleven of the twelve organizations. Statistics Canada was not included in the interview schedule to ease the work load of the Committee. Organizations interviewed received a paper on the principles to be used by the Committee and a further paper outlining how those principles would be applied.

Members agreed to test their interview methods and briefing documents with the Departments of Forestry and Communications. Following those meetings, Members agreed to simplify the documentation provided to departments and to focus questioning on how departments set their own priorities. The modified methods were applied in interviews with the nine other organizations in the interview list.

Following the interviews and a review of published materials about the organizations, Members reviewed their general, early findings and presented them, in draft form, for comment to the departments selected. This report incorporates many of the comments received from departments and agencies.

Findings

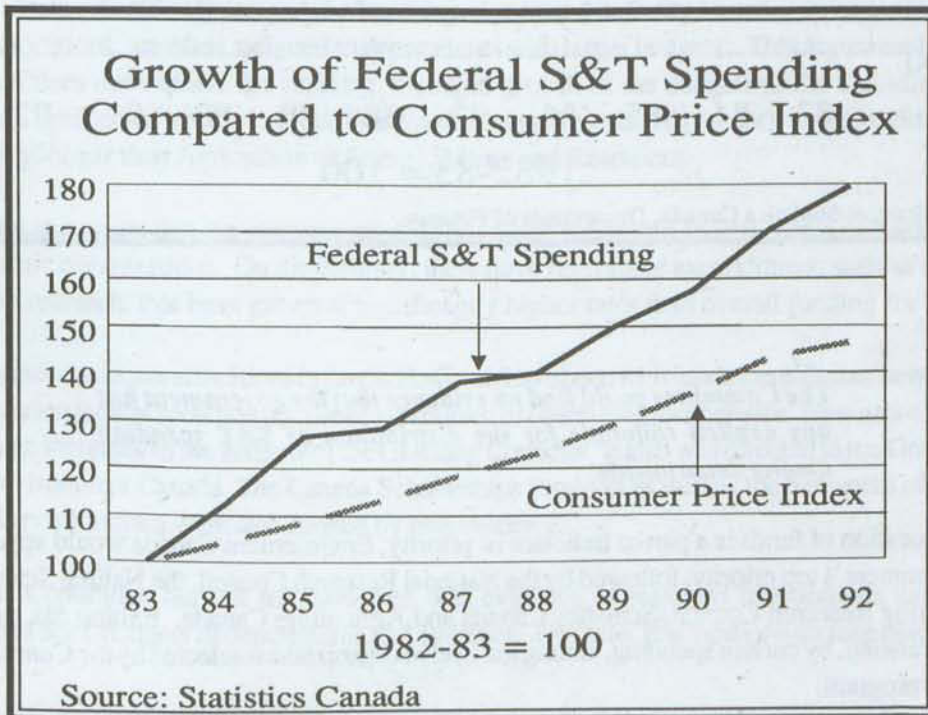
Managers direct resources to their priorities. Resources include fiscal allocations within a budget and/or the allocation of human resources or intellectual or managerial attention.

Authentic priorities have a hold on the budgets and on the attention of managers. One or the other is rarely sufficient. The most proficient management cannot function without sufficient resources. Unmanaged resources are rarely well spent.

1. *By the measure of the allocation of resources, science and technology are priorities of the federal government.*

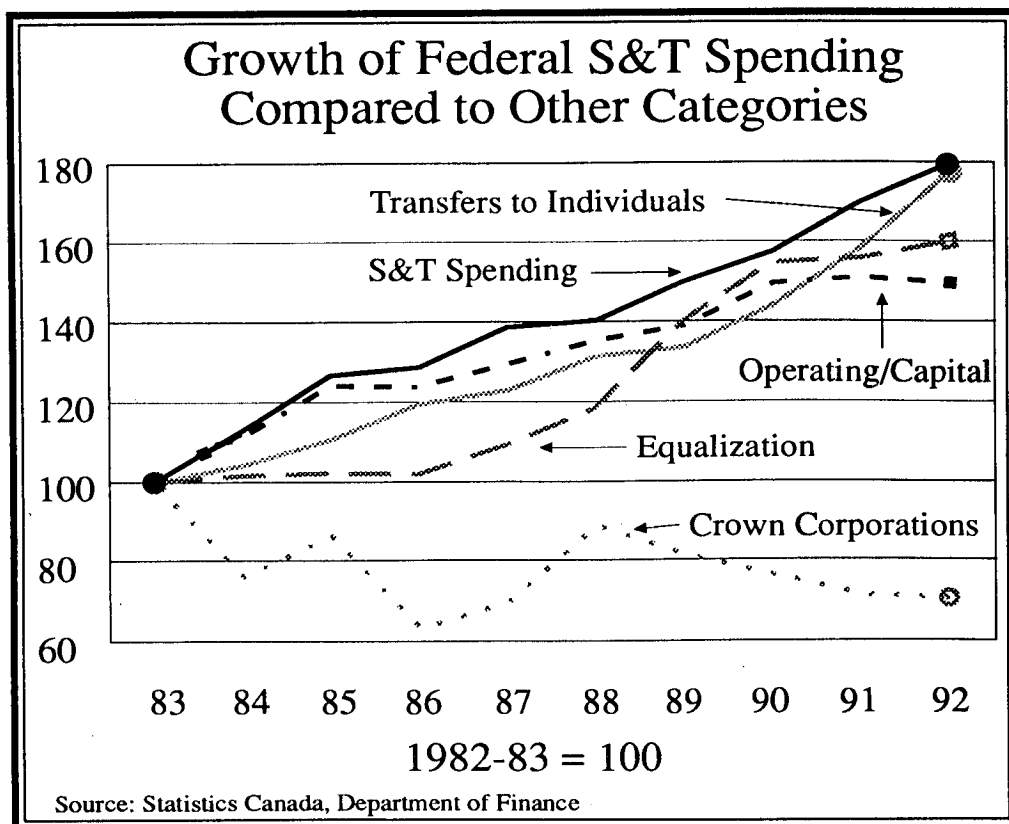
- i) *Federal S&T spending has increased 75 percent in absolute terms over the last decade. Spending growth has outpaced that of the Consumer Price Index, which means that S&T spending has grown in real terms. (Exhibit Four)*

EXHIBIT FOUR



- ii) *The growth of S&T spending has been greater than or equal to the growth in spending of most categories of federal program spending. S&T spending appears to have a priority.*
(Exhibit Five)

EXHIBIT FIVE



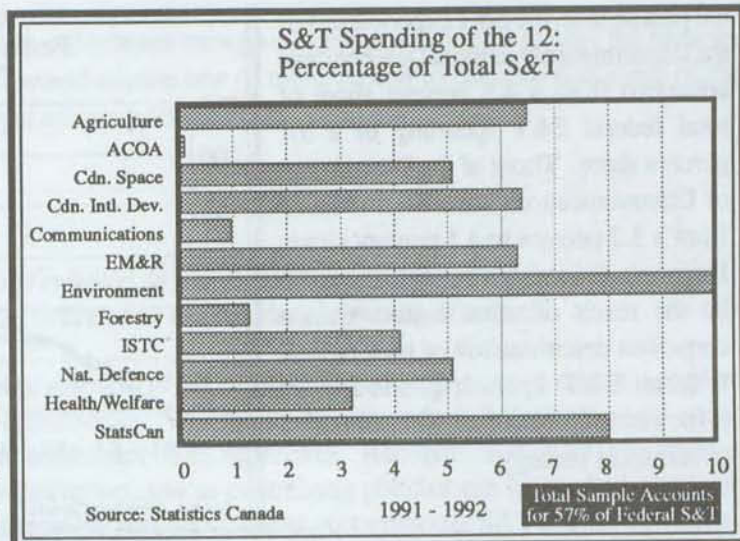
2.

The Committee could find no evidence that the government has any explicit rationale for the distribution of S&T spending among departments.

If the allocation of funds is a partial indicator of priority, Environment Canada would appear to be the government's top priority, followed by the National Research Council, the Natural Sciences and Engineering Research Council, Statistics Canada and Agriculture Canada. Exhibit Six shows the priority ranking, by current spending, among the twelve organizations selected by the Committee for its work program.

EXHIBIT 6

No information obtained by the Committee explained why these individual budgets were at their particular levels, or provided a rationale for why the budget of one organization was larger or smaller than another. For example, the Committee saw no evidence that a clear policy objective was being served by allocating 6.5 percent of federal S&T financial resources to the Department of Agriculture and 1.3 percent to the Department of Forestry. Similarly, there was no apparent strategy behind the allocation of 6.3 percent of resources to Energy, Mines and Resources and 1 percent to the Department of Communications.



One explanation offered by some federal officials is that certain budgets have benefited by historical incrementalism, a hypothesis which suggests that organizations with the greater longevity have the larger budgets. Senior Ministers, who have experience and capacity in maintaining or increasing budget allocations, are often assigned to departments with larger budgets. This argument has some appeal but does not explain, for example, the rapid growth of the budgets of the Canadian Space Agency (5.1 percent of total federal S&T) or Environment Canada (10 percent) - organizations which are much younger than Agriculture or Energy, Mines and Resources.

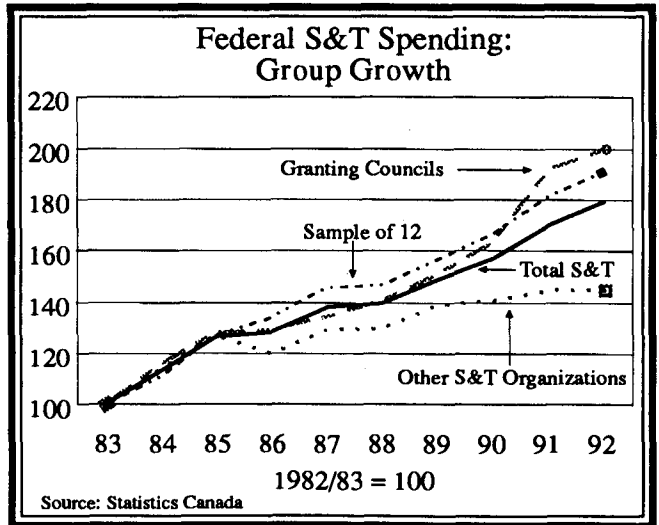
This is not to suggest that the government does not direct funds into specific areas of S&T activity or to specific organizations. On the contrary, there have been some expenditures, such as those for university research, that have grown at significantly higher rates than overall funding for S&T.

These significant recent allocations of funds, however, have been with funds identified as 'new money', which refers to federal spending not already disbursed or committed to other uses. New money funded recent large increases in the budgets of the Granting Councils. It also was directed to the Green Plan, led by Environment Canada. The Canada Scholarships Program as well as the Networks of Centres of Excellence Program were also funded by new resources.

What the Committee did not see, however, was evidence of reasoned reallocations among the established S&T budgets of departments and agencies. De facto, reallocations do take place. Over

EXHIBIT SEVEN

the past decade, the S&T expenditures of the Department of National Defence have advanced from a 4.5 percent share of total federal S&T spending to a 5.1 percent share. Those of the Department of Communications have been reduced from a 3.2 percent to a 1 percent share. However, these reallocations appear to be the result of other factors than a conscious determination of how overall federal S&T spending should be allocated in accordance with a government strategy.



3.

The government has organized itself to manage horizontal issues in S&T, but has not succeeded in finding a method to select priorities among areas of S&T, S&T programs, or S&T organizations.

Prior to the creation of the Industry, Science and Technology Canada (ISTC), the (then) Ministry of State for Science and Technology (MOSST) had central management responsibility (without decision-making power) for the conduct of federal S&T. Much of the former Ministry's work concerned horizontal issues, those which are of common concern to all or many departments and agencies engaged in S&T.

However ISTC, with which MOSST was integrated, does not have a role for the management of S&T; its role is to be an advocate for it. As such, ISTC performs a coordinating and suasion function among science-based departments and agencies. One vehicle for this role is the Interdepartmental Steering Committee on the Management of S&T, with representation at the level of Assistant Deputy Minister (ADM). Policies approved and (to varying extent) implemented as a result of the work of MOSST or the ADM Committee concern such issues as extramural performance, technology centres and intellectual property.

Neither the former MOSST nor the current ADM Committee made progress in identifying the S&T priorities of the government. Prior to its integration into ISTC, MOSST began a process which might have resulted in the identification of priorities. The process was based on a Decision Framework for

Science and Technology and an Annual Overview of departmental performance. It was never completed.

The ADM Committee, which arrives at decisions through consensus, is unlikely to have the capacity to make priority decisions. Such would require one or more ADMs to concede that some of the activities in which they are engaged are not priorities.

4.

Some departments selected do not consider S&T to be a distinct element of their activities, one that needs to be managed as such.

Although they fund or perform large amounts of S&T, some federal organizations do not recognize it as a distinct element of their organizations. That approach may reduce the effectiveness of the organization and possibly prevent attainment of its objectives. Recognition of S&T as a distinct element does not necessitate reorganization, just as contracting policies can be applied within an existing organizational structure. As will be discussed further, recognition of S&T as distinct requires that it be distinguished within the organization and that it be consciously managed in service of departmental objectives.

S&T activity is not an end in itself. It is a means to achieve particular objectives such as the advancement of knowledge, the accomplishment of departmental missions, competitiveness, and so on. There is thus a natural and reasonable tendency to view S&T simply as a tool applied to achieve a purpose.

However, the tools themselves, their condition and the way they are applied, can be critical to the attainment of objectives. For example, although contracts for services may be used as a tool to achieve departmental objectives, the federal government has adopted uniform contracting policies to ensure that the government achieves best value for money and that the process of acquiring goods and services both is, and is perceived to be, fair and open. A government-wide objective is determined by Cabinet and implemented by individual departments. Similarly, although federal personnel are among the instruments by which departmental objectives are achieved, Deputy Ministers in each department are accountable for their adherence to government-wide policies respecting the advancement of women and employment equity.

If S&T are recognized as tools vital to achieving certain government objectives, then it is prudent to care for those tools and to ensure they are applied correctly. As a priority, federal S&T activity should be considered as a domain in its own right, something that is managed directly. Determination of spending priorities is an integral part of management.

Several of the selected organizations have recognized S&T as a distinct element and have developed particular policies or practices to manage S&T. In general, the Committee found that these organizations had more highly developed systems for determining S&T priorities within their own programming.

- 5.** *The comparative assessment of selected organizations, displayed as Exhibit Eight, should be understood, first and foremost, as the Committee's identification of fields in which the organization could improve. Suggestions follow in the written text applying to each organization.*

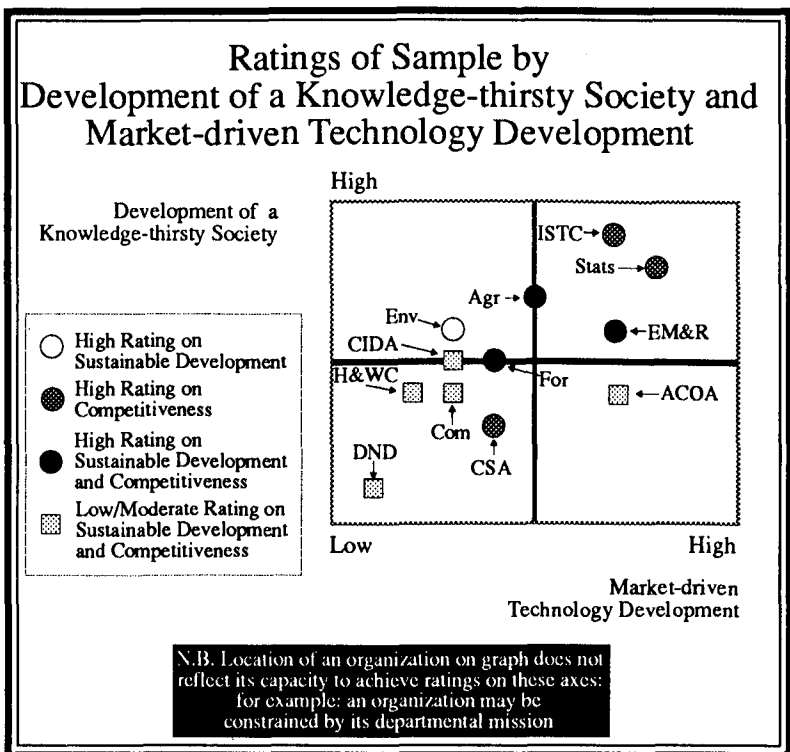
Exhibit Eight is a graphical representation of the Committee's assessment, emphasizing the two main principles by which the Committee assessed the S&T programming of departments. It is intended to highlight the areas where improvements are desirable. Some details are provided in the written assessments that follow in Annex One.

EXHIBIT EIGHT

The assessment is not the result of detailed evaluations or audits. It is a subjective appraisal at one point in time, based on materials available to the Committee and on conversations with representatives of the selected organizations. In consequence, the Committee did not draw conclusions with respect to the future allocation of S&T resources from an organization's exact position in relation to the axes of the graph or indeed its position in relation to other organizations.

Organizations found to have a strong capacity in market-driven technology development are placed to the right of the vertical line on the chart. Those strong in developing a knowledge-thirsty society are placed above the horizontal line. It should not be assumed that the Committee expects all federal organizations to seek an assessment that would place them in the upper right hand corner of the graph. Some departments have more inherent capacity than others to offer S&T programming that responds to the market in technology development or that leads to the development of a knowledge-thirsty society. The mission of the department, or its legislated mandate, may limit what progress is possible.

At the same time, the assessment is offered as a challenge. To the extent that development of a knowledge-thirsty society and market-driven technology development represent key roles for government in S&T programming, the mandate and mission of all departments should reflect them.



Conclusions

The mandate of the Committee calls for analysis in two areas:

- development of a simple method for setting the science and technology priorities of the federal government;
- application of that method to a substantial portion of federal S&T spending, based on a clear policy framework.

The conclusions of the Committee concern both substance and process.

Substance

The **Work Program** Section of this Report (pp. 2 to 8) presents the four principles which the Committee adopted for its review of the S&T programming of the twelve selected organizations. Following discussions with officials in these federal organizations, the Committee came to a basic conclusion about the appropriate role for government in S&T programming.

1.

There should be two main objectives for the S&T programming of the federal government:

- *development of a knowledge-thirsty society; and*
- *market-driven technology development.*

Programming in support of other objectives should have less priority.

As previously noted, future competitive societies must be knowledge-thirsty. Hence, development of a knowledge-thirsty society is understood as a necessary (but not sufficient) condition for future prosperity. Since it is a precondition for future prosperity, the Committee considers the principle of development of a knowledge-thirsty society to be logically prior to the principle of competitiveness itself. For similar reasons, the Committee concludes that development of a knowledge-thirsty society is a necessary condition to pursuit of the principle of sustainable development. The interest of a society in adopting the principles of sustainable development results from the acquisition and appreciation of knowledge about the impacts of human behaviour upon the planet. The capability for an industrial society to adjust to sustainable practices is largely dependent upon knowledge about the consequences of its behaviour.

The role for government in developing a knowledge-thirsty society includes a number of activities. Government has a role in **supporting the creation of new knowledge**. Resource limitations, likely to prevail for the foreseeable future, should lead the government to limit its support to the creation of new knowledge in scientific or social areas that are likely to be of use to society. Another major element of the government's role is in the **dissemination of information** useful for business or

educational activities. More specifically, government has a role in **prospecting**, world-wide, for scientific discoveries and new technologies and processes. It has a role in **evaluating** these, and in then **distributing** the information to scientific researchers, educators and businesses in the private sector. Associated activities include the collection and preservation of information.

To ensure that the information is useful to the diverse needs of society, government should rely on partnerships, alliances, secondments, interchanges and joint funding with private firms, educational institutions, provincial governments and foreign jurisdictions. External advisory groups and peer review activities can also ensure that the work is of relevance and quality.

Building the infrastructure for a knowledge-based economy involves more than the collection of information and the performance of research. Other important activities include education, training, and the development of a science culture.

Another major role for government is in encouraging market-driven technology development. The Committee believes that market-driven technology development is another precondition for competitiveness and prosperity. The focus is limited to market-driven development, given the limited resources available to support S&T; market-driven development is the more likely to produce results which will be of benefit to society as a whole. Development of technology in response to the needs of the market presupposes: client identification; awareness of client needs; participation by clients; and knowledge of the global competitive situation of the industry.

In reviewing the S&T programming of the selected organizations, the S&T Priorities Committee found areas where programming could better respond to the principles proposed by the Committee. These areas for potential improvement have been identified in the assessments. It is the Committee's view that such improvements, once made, would lead to programming more in touch with its clientele and better able to serve Canadian needs.

In reaching this conclusion, the Committee is aware that many federal organizations have specific obligations, sometimes of a legislative nature, to provide certain services. These obligations are usually presented as the 'mission' of the organization. An organization's mission may limit its capacity to engage in market-driven technology development or to support the development of a knowledge-thirsty society. However, even within the requirements of a mission, the Committee believes that all federal organizations can make some progress towards the principal goals of federal S&T programming.

Process

2. *Decisions are required on the allocation of federal S&T spending.*

Government has no grounds for concluding that the current distribution of S&T spending among federal organizations reflects the governments strategic objectives for the country generally or for its S&T investment in particular. Notwithstanding the priority status given to S&T within the federal budget, the government commitment to S&T is incomplete in the absence of efforts to direct and allocate the budget to priority areas. Decisions concerning the allocation of new resources are necessary but not sufficient. The greater portion of S&T spending is long established, much of it growing through incremental additions to budgets. Incrementalism could well be a valid approach to the management of S&T budgets, but there has been no considered decision that that should be the approach.

There is validity to the view that federal S&T is a means by which other objectives are achieved. However, the Committee does not accept the further argument that S&T therefore requires no special management attention. As a government priority, federal S&T should be managed as such. Determination of spending priorities is an integral part of the management of federal S&T spending. As a national strategic investment, S&T requires high level strategic planning. Other government-wide priorities, such as open contracting policies and employment equity, are managed as distinct areas. Deputy Ministers are held accountable for adherence to the policies at the departmental level. This should be required of Deputy Ministers for management of S&T.

The work of this Committee provides the opportunity for government to re-think its objectives in funding S&T programming, to encourage federal organizations to achieve these objectives through modifications to programming and to reallocate its resources to those organizations which can best achieve government objectives for S&T.

As a part of this work, the government would be wise to consider whether the current organizational and activity structure for S&T activity is appropriate to the needs of its clients, whether inside or outside government. The Committee has noted the disadvantages of the current lines of organizational demarcation between the Departments of Agriculture, Energy, Mines and Resources, and Forestry on the one hand and the Department of Industry Science and Technology on the other. The S&T programming of the first three tends to focus on exploitation of raw resources because processing and value-added activities are within the jurisdiction of the latter. If the government hopes that resource industries will find business opportunities in forward integration, then it would be reasonable for the research programs of the resource-oriented departments to support that strategy. It would be appropriate to eliminate rigidities in lines of organizational demarcation so that the resource-oriented departments could support S&T in the application of resources.

3.

Cabinet requires periodic advice on the allocation of S&T resources.

Decisions concerning the allocation of resources are the ultimate responsibility of the federal Cabinet, whether acting as a whole or in Committee (such as the Treasury Board). It is Ministers who bring proposals to Cabinet, developed with the advice of federal organizations, advisory panels, or other sources. Consequently, the government needs to designate: a Minister to present proposals on the allocations for S&T; a source (or sources) of advice that Minister would use in preparing proposals; and the arm of Cabinet which would decide upon the proposals.

Ideally, the Minister who presents the proposals would not be directly affected by their implementation. The individual would be neutral or disinterested. At the same time, that Minister must be knowledgeable about the S&T activities of more than 50 federal departments and agencies. The first criterion would exclude the Ministers who are responsible for the management and direction of elements of federal S&T spending. The second would exclude most Ministers who are not responsible for such management. Strict criteria may therefore be impractical, as the most knowledgeable are also the most involved.

The source of advice on priorities could be inside or outside government. The criteria of neutrality and expertise apply here as well. In addition, the advisor(s) must be capable of providing advice which would alter the current distribution of federal S&T spending, if such is required. This latter criterion may appear obvious, but it is essential that the advisor(s) be equipped and prepared to make potentially controversial recommendations, recommendations which may be vehemently opposed by powerful ministries.

The Committee is not convinced of the necessity for any new executive structure or organization to take the decisions on priorities. Setting priorities is a management function, which can be carried out within the established structure of the government. The Cabinet Committee on Economic and Trade Policy, perhaps augmented by other Ministers who spend significant S&T resources, could be the agent of the decision.

The Committee is well aware that Cabinet may decide to allocate S&T resources for reasons that are inconsistent with the Committee's view of the objectives of S&T, or for reasons which have nothing whatsoever to do with S&T. Ministers must balance many other priorities, such as regional development or social justice. These other priorities may cause the Executive to allocate S&T spending for reasons which have nothing to do with the framework. When this happens, it is appropriate to recognize the actual rationale for such decisions, rather than presenting such decisions as if they were the result of an S&T framework.

However, the Committee rejects the suggestion that a framework is unnecessary or ought not to be provided because it might not (always or often) be used to guide the S&T allocations of Ministers. Such is a counsel of inertia and abdication. Without a framework, Ministers have no terms of reference for S&T decisions. With a framework, Ministers have the freedom to consider its use and to decide whether to apply it or not.

Recommendations

a) Priorities

- 1.** *Cabinet should direct all federal organizations to examine whether or how S&T programming can be modified to support development of a knowledge-thirsty society and market driven-technology development. Cabinet may wish to allocate future priorities for S&T spending based on each organization's achievement of the government's objectives for S&T.*

The Committee studied a sample of federal S&T activity. It would be inappropriate to suggest reallocations within that sample, as organizations not included could well have higher or lower assessments. Recommendations for reallocations should be based on an assessment of the S&T programming of all federal organizations.

In addition, it should be noted that the assessment of the selected organizations did not represent detailed evaluations or audits. The Committee did not draw conclusions about the current allocation of S&T resources from an organization's exact position in relation to the axes of the graph or indeed its position in relation to other organizations.

The Committee's assessment should be taken as a challenge to all federal organizations involved in S&T. To the extent that development of a knowledge-thirsty society and market-driven technology development represent key roles for government in S&T programming, all departments should be able to make some progress towards fulfilling those roles.

b) Method

- 2.** *The Economic and Trade Policy Committee of Cabinet, or its future equivalent, should review, and approve or modify, the distribution of federal S&T resources across federal departments and agencies at least once every five years, preferably every three years.*

This recommendation is intended to conform to the existing structure of government, so that implementation would not require new institutions.

- 3.** *The review of S&T spending distribution and any recommendations for its change should be presented to the Cabinet Committee in a joint submission signed by the Minister for Science and the President of the Treasury Board.*

The recommendation allows the submission to be presented by one Minister who is particularly knowledgeable about federal S&T activities (the Minister for Science), with verification of neutrality provided by the head of a central agency (the President of the Treasury Board).

- 4.** *The Ministers who present advice to Cabinet on S&T spending priorities should base their recommendations on advice received from a group (or groups) external to government as well as advice received from science-based organizations within the federal government.*

The views of independent, non-government advisors are more likely to be in tune with the needs of society for knowledge and of the needs of private markets for technology. Government should ensure that its advisors are broadly representative of the main sectors of economic and social activity. The Deputy Ministers responsible for federal science-based organizations should also contribute to the preparation of the recommendations to Ministers, as they are best qualified to identify S&T required to fulfil departmental missions and are being held accountable for management of S&T as a distinct entity within the department.

- 5.** *The Ministers who will present advice to Cabinet should provide general guidance, at the beginning of the process, on overall government priorities (such as development of a knowledge-thirsty society) to the external advisors and to federal science-based organizations.*

The Committee developed a policy framework of four principles for its assessment of government S&T programming, the most important of which were found to be development of a knowledge-thirsty society and market-driven technology development. Since the needs of society and the economy will inevitably evolve, changed or additional principles will be required. The Committee believes that such general direction is best provided by elected members of the Cabinet.

Annex One:

**Assessments of the Selected
Organizations**

AGRICULTURE CANADA

1. **Development of a Knowledge-thirsty Society**

Dissemination of knowledge has been a major purpose and role of the Department of Agriculture from its establishment to the present day. Agricultural extension services are still considered as a model for the diffusion of knowledge. This diffusion would be more efficient and probably less expensive, however, if there were better cohesion between federal and provincial activities in extension services.

The consultative processes of the Canadian Agricultural Services Coordinating Committee and the Canadian Agricultural Research Council (CASCC/CARC) also aid in the development of a knowledge-thirsty society. The Committee expressed two concerns about departmental performance in this area: first, that the consultative process does not focus on major food producers; and second, that the large number of small agricultural research stations may be unnecessary, ineffective and uneconomic given current communications and transportation networks.

The Committee suggests the department undertake the following actions to improve its performance under this heading:

- make adjustments to the consultative process to include major food processors and producers;
- continue its review of its many research stations, with a view to assessing the desirability of reducing their number and refocussing the work of the remainder; and
- encourage federal and provincial ministers to build cooperative farm extension programs.

2. **Market-driven Technology Development**

The Department is engaged in an effort to revise its policies so that research is more responsive to the needs of the private sector; this is positive. Agriculture Canada has a long history of consultation with those external to government. However, Members expressed some doubts whether the department was hearing from the full range of potential beneficiaries of agricultural R&D. Consultations appeared to include those who currently perform agricultural research, but not enough of those who could benefit from it. To achieve the full benefits of the consultative process, the department must continue to respond to the recommendations it receives; the response could be adoption of the recommendations, modification of them, or an explanation as to why they cannot be applied.

The Committee also found that the Research Branch of Agriculture Canada has an unfocused definition of its clients.

The Committee suggests that the department:

- broaden the scope of those with whom it consults;
- ensure that the consultative process includes a response from the department; and
- more clearly focus its definition of clients on agricultural producers (the full range of that broad spectrum) and processors.

3. Competitiveness

The agri-food industry is a significant contributor to the Canadian economy and agricultural exports are an important element of our merchandise trade surplus. The principal objective of the Research Branch of the Department is the long-term competitiveness of the agri-food industry and so research programs are directed to that end. The Committee also found that the food inspection activities of the department were an important element supporting the Canadian standard of living.

In developing its market orientation in the performance of research, the department should be careful to avoid unfair competition with private sector suppliers of agricultural knowledge. The objective of the Research Branch should be to complement the private sector, not to compete with it. Where research overlaps, the department should ensure that its commercial services are offered at comparable market prices. The Committee believes that more R&D should be directed to exploiting opportunities for adding value to agricultural products. The current organization of government which places responsibility for manufacturing and processing in ISTC - quite separate from Agriculture - has not been effective in enhancing value-added initiatives by this department. This difficulty, shared by other departments, is discussed in the Conclusions section of this Report.

4. Sustainable Development

The concept of sustainable development is at the core of the Department's purpose, although the manner in which the objective is pursued has varied. Sustainable development is now one of the department's main priorities. Several programs support the objective.

ATLANTIC CANADA OPPORTUNITIES AGENCY

1. Development of a Knowledge-thirsty Society

Although human resource development is one of the stated themes of ACOA programming, the Committee could not find persuasive evidence that the theme guides programming. The Agency's sponsorship of the Nova Scotia Technology Network is positive. However, the Committee believes that ACOA should also concern itself with the use of the network and the content of the information that flows through it; the infrastructure itself is of less importance than the use to which it will be put.

The Committee believes that the Agency's programming should be oriented towards assisting its clientele (firms within the region) to identify, gain access to, and apply technology to business operations. That process may require considerable education of firms at the front end. However, development of a more knowledge-intensive economy is a precondition for sustainable regional development.

2. Market-driven Technology Development

Much of ACOA's programming responds to the market signals of its clientele: firms within the region. As many firms within the region are not yet innovation capable, however, programs to support technological innovation are limited in their reach. The Committee was pleased to note that ACOA does not take a dirigiste approach in its programming; the decisions of private markets guide the allocation of funds.

3. Competitiveness

For ACOA, competitiveness is a key objective. The Agency recognizes the role of R&D and skills development in achieving this objective. This is a welcome evolution from regional development practices of the past.

Although the right policy statements appear to be in place, S&T spending of the Agency is very small in relation to its total disbursements. The Committee found that, overall, ACOA still has too strong an orientation towards support for real estate, equipment and infrastructure: what the Committee considers to be 'bricks and mortar'.

In the Committee's view, competitiveness in the region is more likely to result from soft (intangible) investments by government and industry over the long term. Such investments would include training and education of managers and the workforce.

4. Sustainable Development

ACOA does not include sustainable development in its objectives or its programming. However, the Agency participates in cooperation agreements with provincial governments to support sustainable development objectives; these seek to encourage the adoption of sustainable development principles within the private sector.

CANADIAN INTERNATIONAL DEVELOPMENT AGENCY

1. Development of a Knowledge-thirsty Society

CIDA is aware of the importance of knowledge to economic development. A substantial proportion of the organization's national initiatives are directed towards human resources development. The Agency supports training and education programs in developing countries and provides training for foreign students within Canada. Knowledge and technologies are transferred through technical assistance programs. Within Canada, CIDA supports some partnership and education programs to develop public awareness of development issues.

2. Market-driven Technology Development

Although CIDA has an industrial cooperation program, the Committee found little emphasis on the market and the private sector as the engine for technology development.

3. Competitiveness

Application of this principle was problematical in this case, as CIDA endeavours to achieve the competitiveness of countries other than Canada. With that accepted, Members observed that CIDA has some programs which support the development of competitive firms among their clientele. The Committee found that CIDA would have a stronger impact in building client country competitiveness if they were to build very strong private sector bridges between client countries and Canada.

4. Sustainable Development

The Agency has a sophisticated understanding of the concept of Sustainable Development, and assesses development programs accordingly. CIDA also funds a number of programs which specifically address environmental issues. Once again, the Committee found difficulties in reviewing programming under this heading, as the primary beneficiaries are intended to be non-Canadians.

CANADIAN SPACE AGENCY

1. **Development of a Knowledge-thirsty Society**

The Committee recognizes that the Canadian space program has enormous potential to generate new knowledge about earth and space, knowledge that could have great use both for science and business. The space program may also have an inspirational influence on the learning and career decisions of Canadian youth.

Members believe that the CSA could do a great deal more to disseminate knowledge and cultivate interest in space and earth sciences as well as in the use of such knowledge for wealth generation. The Committee suggests that the Agency broaden its perspective on technologies for use in space beyond the aerospace, robotics and electronics sectors; there may also be opportunities, in partnership with other federal departments, in agricultural, environmental and telecommunications technologies, to which Canadian researchers could contribute.

2. **Market-driven Technology Development**

The Agency undertakes a major consultative process prior to developing its Long Term Space Plans. The process provides an opportunity for the CSA to respond to external demands, including those from the science community, industry, governments and the general public. As most clients are specialized and not driven by national or international free (i.e., non-government) market forces, technology development is not strongly connected to the marketplace.

The Committee believes that a long-term space plan should include plans for less reliance on government and more upon the private sector. Such an approach requires examination of opportunities for the Canadian private sector. Again, sectors other than aerospace and electronics should be considered.

3. **Competitiveness**

Space and related technologies account for a relatively small proportion of merchandise trade, but it is an area of rapid growth. In part due to government-sponsored development projects, a few Canadian companies have established worldwide reputations for quality and have established product niches, in such areas as robotics, multiplexers and synthetic aperture radar. Research funded by the Canadian Space Agency (CSA) results in the development of the technologies of the future. A higher rating was not assigned due to the limited size of the domestic and external market and the uncertainties of successful spin-offs to larger volume commercial uses.

4. Sustainable Development

Technologies developed for the space program (such as WINDII) will assist in the understanding of global change and the forces that bring it about. Services such as GEOSCOPE will also contribute to that understanding. However, the CSA does not have any specific programs or program objectives in support of sustainable development.

COMMUNICATIONS CANADA

1. Development of a Knowledge-thirsty Society

A communications department could have a major role in the establishment of a knowledge-thirsty society by facilitating the provision and management of the infrastructure for more efficient distribution of information. This department has made some contributions toward that end. However, it could be argued that communications regulation impedes the flow of information.

The Committee believes there are significant opportunities for the department in the development of informatics and electronic information. The department should focus more on supporting the development of software and telecommunications-related intellectual property than on the bricks and mortar of physical telecommunications or electronic infrastructure.

2. Market-driven Technology Development

Although the department receives advice from an external advisory board, the Committee was not aware of that advice having had a significant impact on the direction of the department's S&T activities. Technologies such as SHARP (Stationary High Altitude Relay Platform) were not developed in response to market demand. The consultative process cannot achieve its full benefits unless the department has some obligation to respond to the advice or recommendations it receives. The response could be adoption of the recommendations, modification of them, or an explanation as to why they cannot be applied. The department's assumption that government must lead in the development of a national telecommunications infrastructure would appear to pre-empt the creation of such by private capital. The Committee acknowledges that some of the department's activities result from explicit government direction (such as the provision of communications services to remote areas); these are by definition independent of market forces.

The Committee believes that the department should ensure that the consultative process includes provision for a response by the department to recommendations received. The objective should be to develop programming, where practical, that is more sensitive to the needs of the market.

3. Competitiveness

Communications and informatics are technologies of rapidly growing importance to our competitiveness. They are important in their own right; a good communications infrastructure can be as important as conventional infrastructure, such as roads, perhaps more so. The technologies are also important for their use in all sectors of the economy. Communications systems are the physical underpinning of a knowledge-based economy. The communications and informatics industries in Canada have a reputation for strong performance in R&D.

The Department of Communications appears to have no direct role in building the industry or in encouraging wider scale use of the technologies. The Department appears focused on large scale projects and public infrastructure.

The Committee recommends that the department review the emphasis of its programming, to ascertain whether a better balance could be struck between soft investments and hard ones.

4. Sustainable Development

The Committee did not note any specific activities by the department in support of sustainable development.

ENERGY, MINES AND RESOURCES CANADA

1. Development of a Knowledge-thirsty Society

The department considers information and technology as its principal products and has in place a large number of systems and methods to ensure that information is diffused. The Committee also noted a significant awareness of international developments and opportunities.

2. Market-driven Technology Development

EM&R has an active system for keeping in touch with its external clients, through various advisory councils, conferences and forums. The department deliberately reallocates funds in response to changing priorities. The Committee found that EM&R has a strong focus on external clients.

The advisory council system can be made or kept effective by ensuring that the department responds to the advice received. The response could be adoption of the recommendations, modification of them, or an explanation as to why they cannot be applied. The Committee suggests the department ensure that its mechanisms for consultation include this important element.

3. Competitiveness

Exports of metals, minerals, oil and gas make a major contribution to our trade position and, despite changes in the nature of world trade, are likely to continue to do so for the foreseeable future. Although the industries are often perceived as relics from our past, the amount of value-added per unit labour cost exceeds that of many manufacturing sectors. Related, supporting exploration industries, such as the geophysical and remote sensing industries, have as yet a relatively small impact on trade; however, Canadian firms are in a very strong competitive position.

S&T within the department highlights the most efficient (and safe) methods for exploitation of the raw resource. It also focuses on provision of the data infrastructure for metal, mineral and hydrocarbon resource industries. Although some argue that EM&R should invest more of its S&T effort in the development of value-added applications for raw resources, the organization of government places such downstream activities within the purview of ISTC. Nonetheless, at the request of its clients the Department has broadened its research focus to include product development.

4. Sustainable Development

Many of the S&T activities within the department are directed to providing the basic survey data required for an understanding of the state of the environment. In addition, research facilities such as CANMET address important, practical issues such as recycling and the management of mine wastes. EM&R participates in the Green Plan and has developed specific projects.

ENVIRONMENT CANADA

1. **Development of a Knowledge-thirsty Society**

The department disseminates environmental information widely. Research is published in refereed scientific literature. Many of the research staff teach in post-secondary institutions.

The Committee believes that the department could build greater public interest in its work if it had more of an outreach approach, especially in providing more opportunities for personnel exchange between the department and the business and educational sectors. Considerably more could be done in all areas to develop interest in and knowledge about environmental problems, solutions and opportunities.

2. **Market-driven Technology Development**

A large proportion of the department's S&T activities are undertaken to support its mandate, such as forecasting the weather or monitoring toxic chemicals. This factor places limitations on the capacity of the department to respond to market needs. Some technologies are offered for commercialization, but this is not a major focus for the department. Where the department has more flexibility in developing commercial technologies, it appears willing to innovate: the Wastewater Technology Centre, for example, is established as a Government-Owned/Contractor Operated facility for the primary purpose of improving technology transfer from government laboratories.

In keeping with the observations that follow under the heading of Competitiveness, the Committee suggests that the department develop advisory councils for major industry sectors, with participation from private industry. At the start, these advisory councils could work to reduce the unnecessary and unproductive opposition between industrial and environmental concerns. Eventually the advisory councils can become a forum for identifying industrial opportunities in environmental technologies or environmental management and regulation. The Department of the Environment should work closely with ISTC in developing its councils, and continue a close connection in identifying industrial opportunities.

3. **Competitiveness**

The Committee considers acceptable environmental conditions to be an element of the high standard of living that should be the hallmark of a competitive country. Environment Canada has a role in achieving that objective. However, the Committee did not perceive a consistent awareness of the potential alliance between competitiveness and sustainable development; sometimes, the concepts are presented as inconsistent, if not opposed. Nor does the department appear to have a consistent view of the connection, whether positive or negative in effect, between stricter environmental standards and industrial competitiveness.

On the other hand, the department has supported commercial opportunities for environmental technologies, for example through its joint support (with ISTC) of the Globe '90 and '92 Trade Show/Conferences for environmental products. The Committee notes that there may be a further opportunity for the regulatory powers of the department to be applied, with some care and foresight, to encourage the development of new industries.

4. Sustainable Development

The department has a large number of environmental programs and policies, a major element of actions in support of sustainable development. This focus is consistent with the Committee's interpretation of sustainable development. In addition, the central focus of the Green Plan is sustainable development. However, the Committee perceived a heavy emphasis on regulation as a method of achieving objectives, rather than on cooperation or on new technologies and processes.

FORESTRY CANADA

1. Development of a Knowledge-thirsty Society

Technology transfer is among the stated purposes of the department. However, given the lack of take up in the industry, the Committee doubts whether the purpose is being achieved. Forestry Canada publishes material on such subjects as the state of the forest and sustainable forests, but the information appears to have limited impact on the behaviour of industry.

2. Market-driven Technology Development

Weak industry participation in R&D means that a limited amount of technology development is market-driven. Difficulties arise in gaining industry participation even when governments provide the bulk of the financial resources. Weakness in market-driven technology development also results from the peculiar jurisdictional structure of Canadian forestry: companies are harvesters, but not owners of the forests; the provinces are owners and regulators, but not researchers; the federal government is researcher and regulator, but not owner. Further observations on the jurisdictional difficulties appear in the Conclusions section of this Report.

The department's own research program is guided by an external advisory council which could provide the opportunity for the market input into R&D; however, the advisory council is not seen as important by the forest industry. As the department responds formally to the recommendations of its

advisory council, the perceived weakness of the council is not caused by any lack of meaningful government participation. The department should seek the advice of industry in building the credibility of the council.

3. Competitiveness

Forest products represent a substantial share of merchandise exports. Declines in industry activity can be attributed to both cyclical and structural factors; however, the perceived weakness in the industry's competitive position may be overstated and is, in any case, reversible. The Committee expressed concern about the impact of its relatively weak R&D performance on the industry's future competitiveness. Members also queried the impact of federal/provincial overlaps in jurisdiction over forestry on spending efficiency.

The departmental S&T budget is focused on the protection and enhancement of the resource base; this is essential to the long-term survival of the industry. Emphasis on the raw resource is partly deliberate strategy but also appears to be the consequence of the delineation of responsibilities between Forestry Canada and ISTC. The Department of Forestry has a relatively small share of the federal S&T budget, given the industry's importance.

4. Sustainable Development

As one of its major missions, Forestry Canada seeks to preserve the raw forest resource. The department's concept of sustainable development has become more sophisticated in recent years; programs such as the creation of model forests emphasize interdependence of ecological systems while permitting harvest for human use. There is also considerable focus on external factors affecting the resource, such as climate change.

HEALTH AND WELFARE CANADA

1. Development of a Knowledge-thirsty Society

Health and Welfare Canada communicates health information through a number of publications. However, the Committee could find no compelling evidence that the department is aware of the principle, let alone supports it.

The Committee believes that the department can do more to communicate information on disease prevention. In addition, as argued below, the Committee sees an opportunity for the department to participate in the dissemination of information on commercial opportunities in the health care and medical devices industries.

2. Market-driven Technology Development

The Committee understands and supports the Department's commitment to affordable, sustainable, quality health care. However, the department appears to have no interest in the opportunities for growth of firms in the Canadian health care industry. Indeed, new medical technologies are perceived as a burden on the cost structure of the health care system. While new technologies can add costs, they can also lead to reductions. The Department's perception seems not to be responsive to the cost reduction opportunities that can result from technological developments.

Officials identify clients of the department as Canadians. This leaves little scope for appreciating industry as a client, whether in the area of regulation or technology development. The Committee suggests the department develop greater awareness of the opportunities for Canadian industry in health care. Industry should be recognized as a client of the department. Health care technologies studied by the department could create significant commercial opportunities.

3. Competitiveness

A healthy population is a necessary part of the infrastructure for a competitive economy. The health care system is directly linked to our standard of living; its cost is an element affecting the efficiency of our economy. The activities of the department in maintaining food and drug safety are an important contributor to our standard of living.

The Committee did not find a strong awareness within the department of the connections between national health and competitiveness at a general level. More specifically, the Committee found little evidence that the department is directly concerned with the costs of maintaining the health care system.

4. Sustainable Development

The Committee noted one program was concerned with the maintenance of environmental quality and the avoidance of hazards. Work on epidemiology could also be considered supportive.

INDUSTRY, SCIENCE AND TECHNOLOGY CANADA

1. Development of a Knowledge-thirsty Society

In both mission and action, the department is fully aware of the importance of knowledge to future prosperity. ISTC leads or supports a number of programs to build public awareness about S&T. The department funds a scholarships program to provide incentives for students to undertake post-secondary studies in science, technology and engineering. A number of programs and specific initiatives support the diffusion of knowledge and technology to the private sector. Policy initiatives in such areas as intellectual property also support the diffusion of knowledge.

2. Market-driven Technology Development

The greatest proportion of ISTC grants and contributions is in response to requests from firms; in that sense, the S&T funding responds to the market. However, a disproportionate share is allocated to a relatively narrow spectrum of the industry sectors served by the department. The department receives advice from a number of external boards (some supported by ISTC) and responds to that advice. Indeed, a significant proportion of departmental activity is dedicated to industry consultation and consequential support.

3. Competitiveness

Competitiveness is the core of ISTC's mandate. S&T is recognized to have a pre-eminent role in achieving this objective, a role reflected in budgetary allocations. The industry sectors served by the department form the largest portion of our merchandise trade exports. The Committee notes that ISTC gives particular emphasis to such sectors as aerospace (especially in terms of direct financial support), but relatively less to other major contributors to our trade position. International trading rules limit the direct assistance the department can provide directly to non-defence-related industries but there are many other forms of allowable support, in such areas as pre-competitive research and the development of industry's knowledge infrastructure.

4. Sustainable Development

Some relatively small programs exist to develop environmental technologies. ISTC has an Environmental Affairs Branch.

NATIONAL DEFENCE

1. Development of a Knowledge-thirsty Society

With the exception of some support for civilian research in military or strategic studies, the department has a limited role in development of a knowledge-thirsty society. DND has recently increased its efforts in technology transfer.

In the Committee's view, there is an opportunity for the department to make an important contribution to the development of a knowledge-thirsty society, even within the constraints of national security. A significant proportion of military technologies are dual purpose (i.e., have a conceivable civilian use). Both with respect to its own research programs and the very considerable amount of research and technology prospecting done by the department, there is an opportunity to make this knowledge available to the industrial and educational sectors.

2. Market-driven Technology Development

The R&D function of the department (Chief, Research and Development: CRAD) considers the following groups as its clients: the three Forces, Canadian industry, allied Ministries of Defence, the Canadian S&T community and the Canadian public. The sheer diversity of the client base raises questions about the capacity of the department to be sensitive and responsive to its needs. However, even when the client base is limited to the Canadian Forces, there appears to be an uncertain relationship with clients. For example, only the Navy seeks research on domestically-designed weapons platforms. Procurement attitudes within the department do not appear to support Canadian development or design.

3. Competitiveness

The department's S&T programming, usually in support of government procurement, has contributed to the competitiveness of certain specific companies. However, such is usually a fortuitous result rather than an intended goal. The Committee found that operational requirements are not defined with any relationship to Canadian competitiveness.

4. Sustainable Development

The department has no formal role or mandate in this area. However, the department supports the development of waste treatment activities and has taken a more active role in environmental assessment and clean up of its activities. DND has appointed a Director General responsible for environmental activities.

STATISTICS CANADA

1. **Development of a Knowledge-thirsty Society**

The purpose of the organization is to collect and disseminate information. The Committee found that the Agency communicates effectively and develops interest in statistical measurement of a wide variety of economic and social phenomena.

2. **Market-driven Technology Development**

The Agency is advised by an External Council, which appears to have an impact on programming. Significant internal resource allocations are made in response to changed priorities. The organization appears to respond to market signals in the pricing of services.

3. **Competitiveness**

A good statistical system forms a vital part of the data infrastructure of a knowledge-intensive economy. Statistics on industry performance, trade and competitiveness allow identification of areas of strength and weakness; they also permit individual firms or sectors or other categories to benchmark themselves. The Committee views the RSA activities of Statistics Canada as very important to maintaining and improving our competitive position.

The Committee notes that the provision of timely, regular and accurate statistics on federal S&T spending is an important base for management of that spending. Reductions in the frequency or depth of data collection run contrary to the governments efforts to manage S&T as a priority.

4. **Sustainable Development**

The Agency is studying the integration of environmental accounting into the National Accounts; such would permit a greater statistical understanding of the national impact of the environment. Collection of health statistics also permits more precise identification of environmental threats. The Committee observed that it would be difficult for a national statistical agency to have any pronounced impact on sustainable development.

Annex Two:

Characteristics of the Organizations Assessed

Characteristics of the Organizations Assessed 1991 - 1992

Organization	Proportion of R&D vs. RSA	Proportion of Intramural S&T vs. Extramural	Proportion of S&T in Natural vs. Social Sciences	Mission Responsibilities	Economic Development Role	Engaged in Advancement of Knowledge
Agriculture	89:11	96:4	99:1	◆	▲	
ACOA	100:0	0:100	100:0		▲	
CIDA	19:81	3:97	59:41		▲	
Canadian Space Agency	92:8	16:84	100:0	◆	▲	◆
Communications	87:13	66:34	92:8	◆	▲	◆
EM&R	44:56	81:19	100:0	◆	▲	◆
Environment	17:83	92:8	86:14	◆		
Forestry	52:48	87:13	100:0	◆	▲	◆
ISTC	84:16	16:84	92:8		▲	
H&WC	24:76	75:25	73:27	◆		
National Defence	98:2	54:46	98:2	◆	▲	
Statistics Canada	3:97	100:0	0:100	◆	▲	

Annex Three:

**Names, Abbreviations
and Acronyms**

The Twelve Selected Federal Organizations

Official Name	Alternate Name	Short Form, Abbreviation or Acronym
Agriculture Canada	Department of Agriculture	Agriculture, Agr.
Atlantic Canada Opportunities Agency		ACOA
Canadian International Development Agency		CIDA
Canadian Space Agency		CSA
Communications Canada	Department of Communications	Communications, DOC, Comm.
Energy, Mines and Resources Canada	Department of Energy, Mines and Resources	EMR, EM&R
Environment Canada	Department of the Environment	Environment, Env.
Forestry Canada	Department of Forestry	Forestry
Health and Welfare Canada	Department of National Health and Welfare	H&WC, NHW
Industry, Science and Technology Canada		ISTC
National Defence	Department of National Defence	DND
Statistics Canada		StatsCan, Stats.

