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RECENT SCIENCE POLICY INITIATIVES AND THE ROLE OF THE SCIENTIST AND RESEARCH MANAGER IN THE PUBLIC SERVICE

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BACKGROUND AND PURPOSE

The employment of science and technology (S&T) in the federal government can be examined in a number of ways. S&T is viewed by departments and agencies as a major resource to be utilized in discharging mandates or in achieving identified goals and objectives. It is also used in responding to recognized national goals that would not necessarily be embraced within the mandate of an individual department or agency. In addition, the aggregate effort of the federal government in S&T is of such magnitude that it includes information and expertise that could be beneficial to other sectors, particularly industry.

Federal departments generally tend to view research, which is investment in additional knowledge, as a means or tool whereby various objectives might be realized, not an end in itself. Science activities must be performed in support of the mission of the department in fulfilling its regulatory, planning, standard-setting, operational, management, or testing functions. To complement and support these and other non-scientific functions where applicable, federal establishments should ensure that they have an adequate in-house S&T capability and competence to successfully undertake tasks entrusted to them.

Science thus has a major contribution to make at the federal level in fulfilling functions implicit in the statutory responsibilities of federal departments and agencies as well as through the introduction of scientific knowledge, analysis, and methodology to long-range planning. It is being used both in solving immediate problems and in examining long-term questions which may not yet be identified as problem areas.

As the results of government research may also benefit other sectors, policies have been formulated in recent years to encourage the performers of research in these sectors, particularly industry, to become aware of and more involved in providing the R&D requirements of government whenever this would be appropriate. Specific policies relating to contracting out have been in effect since 1972 and, more recently, a policy respecting technology transfer from government laboratories to industry has been approved. These directional thrusts have significant impact on the role of the government scientist and research manager. They indicate a need for a more explicit and coordinated approach to transmit these directions to those engaged in performing and managing science activities in the public service.

A statement on the role of the government scientist and research manager can be useful in all of the major phases of personnel management: staffing, job assignment, performance appraisal, training and development, promotion, and transfer policies. In this paper some of these science and technology policies and the current related administrative measures are examined, and their implications for scientific manpower in the public service are discussed. From this is evolved a comprehensive statement of government expectations related to its science activities and of the role and performance of its scientists in support of departmental missions. Such a statement would provide a common basis for developing the procedures pertaining to a scientific personnel management system in the public service and guidelines for agencies, and would also define a desirable role orientation for a federal scientist vis-à-vis his counterparts in industry and the universities.

POLICY INITIATIVES

I. Departmental S&T Missions and Objectives

The scientific and technological effort of the federal government embraces a wide range of activities and is associated with major goals and objectives of the government. The principal S&T functions implicit in the statutory responsibilities of federal departments and agencies can be grouped under the following headings:

* Development of the scientific and technological base required to support major government responsibility areas: defence, health, agriculture, communications, etc.

* Support of regulatory functions by setting standards and monitoring products and practices: food and drug, environment, communications, fisheries, etc.

* Provision of science-based services: surveys, mapping, environmental monitoring, navigation aids, etc.

* The application and use of engineering and the natural sciences to assist industry in Canada with the development of new improved processes, methods, products, systems, techniques and services.

The employment of science and technology in the achievement of departmental objectives can be considered from two points of view. The department looks upon S&T as a major resource which it may use to achieve its objectives. However, from the point of view of the government as a whole, the totality of science and technology programs of departments and agencies has additional meaning and importance in relation to broad national strategies and socio-economic priorities.[1]

The inclusion of government scientific and technological resources and capability in the development of public policy is a relatively new concept. The urgent necessity of reaching decisions on vital issues such as food, depletion of natural resources, conservation of energy, and other problems of this nature, has become obvious. In this area of policy development, both within departments and interdepartmentally, the government S&T capability is expected to contribute in such major areas as the provision of technological forecasts, the development of technological strategies and the effective allocation of scientific and technological resources. The NRC has further commitments as a national laboratory to (a) maintain a base of fundamental research in the natural sciences and engineering, and (b) to provide national scientific facilities for use by the Canadian scientific community.

From the foregoing, it may be stated that the primary function of the government scientist is to participate in the development of scientific knowledge and technology required by a department or a research agency in discharging its mandate. This effort covers the performance of basic and applied research oriented to solving problems and obtaining information identified by the department, or to undertaking functions in planning, regulation, standard setting, operations, management, testing, etc., as well as to providing in certain areas the technological base needed nationally by users outside the federal government.

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[1] Brief to the Senate Special Committee on Science Policy, presented by the Honourable C.M. Drury, Minister of State for Science and Technology, November 1975.

See also: C.M. Drury, "How the Federal Government Views Questions of Science and Public Policy". Science Forum, 47, October 1975, pp. 28-30.

II. Contracting-out

The federal contracting-out policy states[2] that, since the government has science and technology requirements to support departmental missions, it is in the national interest to encourage the fullest possible participation of Canadian industry in meeting these needs. This would in turn stimulate industrial technological capability and thus provide additional benefits to the economy. The government has therefore provided, subject to overall financial constraints, that "its mission-oriented science and technology requirements in the natural sciences and the human science fields of urban, regional and transportation studies be contracted-out to the private sector, and especially to Canadian industry. This is done to obtain a more even balance in the coming years between scientific activities performed by industry and by the government in support of department missions..."[3]

As a general principle, the government's mission-oriented science requirements are to be contracted-out to the private sector whenever appropriate. Intramural research would be performed by departments in accordance with the following criteria:[4]

a) to safeguard matters of security or policy sensitivity;

b) to establish and maintain a limited in-house competence:

- to enable the department to perform its mission;
- to assess the opportunities presented by the current state of the art; and
- to manage the department's S&T requirement performed in the private sector;

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[2] Treasury Board Secretariat, Policy and Guidelines on Contracting-out the Government's Requirements in Science and Technology, Ottawa: Administrative Policy Branch, April 1977, p. 4.

[3] Ibid.

[4] Ibid, p. 5.

c) to provide direct support to a regulatory function and associated planning activities;

d) to maintain S&T capability for the development and maintenance of a set of national primary standards and, in some cases, secondary and consumer standards including their relationship to international standards;

e) to the effective support and operation of in-house capital facilities which provide federal testing and research services; and

f) to perform the mission of the department where the S&T capability does not exist in the private sector, is inappropriate to the private sector, and would not be of optimum benefit to Canada to create one.

There has been significant expansion in the scope of the contracting-out policy when compared with its predecessor, Make or Buy policy.[5] Three significant developments have been made in the present policy. First, it is no longer restricted to R&D requirements in natural sciences. It now includes three areas of human sciences: urban, regional, and transportation. Second, it is to be applied to ongoing as well as new federal S&T requirements. Third, there should be a higher proportion of the total Canadian R&D performed by industry.[6]

The Treasury Board Secretariat has defined in detail the typical responsibilities of those involved in contract management:[7] the user departments, Department

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[5] MOSST, The Make or Buy Policy, 1973-75, Industry Branch, November 1975.

[6] Treasury Board Circular No. 1977-25, May 3, 1977; Circular No. 9048-1, January 6, 1978.

See also: Statement of the Honourable J. Hugh Faulkner on the government plans to implement the expansion of its Make or Buy Policy, News Release, April 26, 1977.

[7] The Make or Buy Policy, op. cit.

of Supply and Services and the private sector. The role to be played by the 'scientific authority' nominated by the user department in contract management is broad and encompassing. A wide range of questions of a scientific and technical nature is to be raised, defined, examined and evaluated by the scientific authority, the user department's representative on the project. The scientific authority is responsible for identification of S&T requirements; definition of technical parameters of requirements; and technical analysis of proposals. Once the contract is awarded, this person is also involved in management and technical evaluation of the work performed. Such departmental supervision over the contract varies, depending on the experience of the contractor. At the completion of the project, the department would also carry out a post-contract evaluation of results.

Summing up, from the foregoing discussion, it is apparent that by widening the mandate of the contracting-out policy and by defining its objective of involving industry to an increasing degree in providing S&T requirements of government, most science-oriented departments would be, in the near future, faced with developing appropriate skills, expertise, incentives and performance-appraisal schemes for the function of scientific authority or its equivalent.

III. Technology Transfer

In recognizing that federal laboratories represent an important Canadian source of technology potentially useful to Canadian industry, the government has agreed that technology transfer should be an objective of all government laboratories. This decision is directed at improving the transfer of technology from all departments, whether or not the technology is primarily developed for industrial purposes.[8]

The intent is not to bias research and development work in these departments away from their mission to support regulatory activities or other internal government purposes. Rather, it is to enable government laboratories to identify research that is of possible interest to industry and, with

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[8] Statement by the Honourable Judd Buchanan, Minister of Science and Technology, to the House of Commons on June 1, 1978 — "Measures to Strengthen and Encourage Research and Development in Canada".

suitable planning, to transfer the technology and knowledge derived from this research to industry. The policy is intended to assist R&D groups in departments and laboratories with the realization that improved technology transfer can be fully compatible with their mandate to provide support to departmental programs.

The above policy which is aimed at technology transfer suggests that there should be an awareness on the part of government scientists of the needs of the industrial sector, and of the necessity, where appropriate, to align departmental research programs with the economic and industrial strategies of the government. As with the associated contracting-out policy, the technology-transfer policy anticipates that adequate personnel incentives will exist within departments to support the vigorous pursuit of the transfer of technology from government laboratories to industry. Also, it is intended that the exchange of federal scientific personnel with industry should be encouraged, and the knowledge and experience gained thereby would in turn be of benefit to departments.

IV. Long-term Policies to Increase the Level of R&D

In addition to the above policies, the government has announced a number of long-term policies and immediate measures to increase the level of R&D, particularly industrial R&D, and to encourage Canadian industry to take advantage of the results of research conducted by government scientists.

The pertinent policies[9] relating to science state that departments and agencies should undertake:

- to use federal government procurement to stimulate industrial research and industrial development in Canada;
- to establish institutions and other mechanisms on the interfaces between government and industry and between universities and industry, that are responsive to national needs and are specifically devoted to the transfer of ideas,

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[9] MOSST, Research and Development in Canada: A Discussion Paper, June 1, 1978, pp. 16-17.

innovations, information, skills, manpower and technical capability; and

- to identify national goals as priority areas for research and development growth, and to use the effort necessary to achieve these goals to establish an industrial productive capacity in Canada competitive in world markets.

The long-range objective of the S&T policy is to improve industrial productive capacity in Canada by increasing the level of research and development in the industrial sector. It is implied that government scientists should be able to carry out R&D in the context of the broader problem areas, but this objective may not often be explicitly stated in the organizational mandates. These initiatives anticipate that the scientists will be further involved in programs that involve the transfer of knowledge and skills, development of R&D capabilities in other sectors, and formulation of S&T priorities that are aligned with national goals.

ADMINISTRATIVE MEASURES

The 1970s can be described as a decade marked by financial constraints and decreasing resources for federal departments and agencies. In view of this, there has been increasing emphasis on the efficient use of resources in federal programs so that their benefits are optimized with respect to expenditures. Consequently, over the past decade, the government has been extensively involved in providing policies and guidelines for departmental planning, budgeting and evaluation.

The Treasury Board Secretariat has been stressing to departments the value of rational resource allocation in the preparation of Program Forecasts and Main Estimates. Departments have also been provided guidelines for adopting budgeting techniques such as Program, Planning and Budgeting (PPB) and Management by Objectives (MBO). These emphasize the need for program objectives to become directly translatable to explicit benefits. Implicit in the techniques is the desirability of a cost-benefit analysis of programs during program forecast to bring forward a range of alternative courses of action for consideration by management and to make more apparent the probable effects of each course of action. With regard to scientific programs, it must be admitted that because of risks and uncertainties, it is difficult to predetermine the results. There are

other problems related to indirect benefits and costs, and to placing a monetary or other value on these costs and benefits. However, these problems are not limited to scientific programs but are also faced by other social and economic programs. What is important is that in a systematic approach such as the PPB analysis, the science managers would become more keenly aware of restraints, both internal and external to their responsibility areas, within which programs must be carried out. Such a program development exercise would also be helpful in providing a logical framework for any future review and evaluation of the program.

TBS has affirmed that departments and agencies should undertake periodic evaluations as a component of the management of their programs. A recent circular[10] states that: "Departments and agencies of the federal government will periodically review their programs to evaluate their effectiveness in meeting their objectives and the efficiency with which they are being administered". These evaluations along with an assessment in terms of socio-economic impact are expected to aid in changing the ways in which programs are developed and operated; clarifying program objectives; reducing or eliminating programs which have decreased in priority.

These evaluations (Zero-A Base Review, operational and management audit, performance measurement of a program) aim at assessing what was done in a specified period of time and at what cost. They further seek to interrelate the priorities identified by senior management and the jobs described in the work program. The intent is to orient the governmental activity in a program/project/job format and to assess its effectiveness in terms of the results both as physical output and as impact (expected effect).

In the case of most of the scientific activities, particularly those in research, the evaluations would require that both research managers and scientists should attempt to develop a clear description of a project which will meet the comprehensive objective within some time frame and for a stated cost. Such a management system may be relatively easy in applied engineering research projects (and the related scientific activities), but

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[10] Treasury Board Circular No. 1977-47, September 30, 1977.

poses a significant challenge to research managers in making decisions about the limits to be imposed on the long-range in-house background research component. However, the research component is essential to maintain both an ongoing in-house expertise, and to provide linkages with new 'jobs' and 'projects' being developed. What is important to note here is that the purpose and expectations of the research component need to be addressed, so they can be known and understood by the program managers, other managers and scientists within the program, and the central agencies. Many science programs are now subject to some type of project review or evaluation system which has been carefully developed in several of the science-oriented departments and agencies.

As noted, these examinations have assumed major significance at the present time when restraint is required in government expenditures. This situation will undoubtedly persist for some time as the former regular growth in essentially all areas of government expenditures cannot be expected to continue and budgetary control requiring the identification of priorities both within each program and among different programs will increasingly become the way of life rather than the periodic exception. Financial restraint will thus affect all programs, including R&D activities, and scientists should become aware of the situation and be kept informed of changes as they occur or are announced. Research managers who have to participate in the performance of the program evaluations are faced with the added responsibility of ensuring that the scientists working with them are informed of the existence, scope and implications of these restraints.

ROLE OF THE GOVERNMENT SCIENTIST AND RESEARCH MANAGER

Foregoing sections have discussed the principal new thrusts in government policies and administrative measures which are having an influence on the science missions of the federal government and thereby on the role of the research scientist and manager working in the public service. However, it must be stressed that, the new policies notwithstanding, science has a major contribution to make at the federal level, in fulfilling S&T functions implicit in the statutory responsibilities of federal departments and agencies as well as through the introduction of scientific knowledge, analysis and methodology to long-range planning. The federal research role is not

merely directed at finding short-term solutions but also at preparing for the unposed questions through carrying out exploratory background research.

Evolving from this discussion of government expectations of its science mission, the roles of the scientist and research manager, in implementing that mission, should be defined. Since the roles will be different, they require separate descriptions. That of the scientist should be stated as being:

- to develop the scientific knowledge and technology required by a federal department or agency to discharge its mandate;

- to carry out R&D work within a management system in general; however, exceptions could apply at the discretion of the manager for certain types of research which could be handled more effectively by another approach;

- to maintain an awareness of the potential application of the research results and be involved, wherever appropriate, through consultation and exchanges with 'user' groups;

- to identify and define S&T requirements that might be contracted out and, where appropriate, manage and evaluate the technical progress of the contracts;

- to participate, when necessary, in project teams involving personnel of different disciplines and backgrounds in order to respond to new departmental thrusts and government priorities; and,

- to maintain and enhance scientific and technical skills and capabilities for carrying out both the defined role in performing science and participating in newer functions such as technology transfer, contract management, interdisciplinary research, project management, etc.

The role of research manager is crucial. Management and coordination functions dealing with research and its development require that the research manager has knowledge of, and experience in, the functions being supervised. Also, he must have the capability to determine the nature and priority of objectives and the resources which

must be committed for their achievement. He must also be involved in the continual assessment of results in relation to departmental objectives and ensure that these are consistent with government science policies. Accordingly, it is necessary that he includes the ongoing and new expectations in all phases of personnel management: selection, job assignment, performance appraisal, promotion and transfer of personnel.

In summary, the principal functions of the research manager in dealing with scientific personnel should be:

- to ensure that a desirable level of scientific excellence is maintained, and a climate conducive to innovative and productive scientific and technical activities exists in the R&D organization;

- to ensure that scientists working with him are fully aware of new policies and procedures which could have an impact on their work or the conditions under which they are expected to perform;

- to encourage scientists to be aware of problem areas in other sectors related to their fields of interest;

- to involve scientists in the transfer of technology whenever appropriate;

- to involve scientists in contract supervision but assume management responsibility for major contracts;

- to use appraisal criteria that give appropriate recognition to all required functions of the scientist whether they are basic or applied research, contract supervision, technology transfer, 'acting' science management, or other functions related to the performance of science and dissemination of the results obtained; and,

- to ensure effective financial management of the R&D organization under his supervision.

DISCUSSION

This listing of government expectations of its scientific personnel raises some pertinent issues.

They indicate a need to develop a more explicit and coordinated effort to transmit changing expectations to those engaged in performing scientific activities in the public service. To match personnel requirements with policy and program thrusts, the principles enunciated can be applied to all major aspects of personnel management: selection, job assignment, performance appraisal, training and development, promotions and the transfer of personnel. Also, it is important that the principles developed here should not be limited to one particular scientist group but to all the occupational groups in the scientific and professional category which are engaged in natural sciences and engineering activities.[11]

With increasing emphasis on these new policy measures, it is necessary that serious attention be given to the importance assigned in performance appraisals to these new functions such as technology transfer and contract supervision by the laboratory management.[12] Specifically, these 'non-traditional' activities may suffer in comparison with other activities that are believed to better reflect the perceived objectives of the mission of the department, or that are more easily measurable, or just more prestigious. Laboratory personnel are, in fact, ordinarily assessed less mechanistically than is sometimes believed, but the average individual is bound to be in-

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[11] MOSST, Scientific Manpower in the Federal Government (Phase I), Second Draft, November 1977.

A study of thirteen scientific occupational groups in the public service was done. These included: Agriculture (AG), Biological Sciences (BI), Chemistry (CH), Defence Scientific Services (DS), Engineering (EN), Forestry (FO), Meteorology (MT), Medicine (MD), Pharmacy (PH), Physical Scientists (PC), Scientific Research (SE), Scientific Regulation (SG), Veterinary Science (VS).

[12] The revised 1978 Classification Standards for Scientific Research (SE) group, although implying the recognition of policy thrusts such as technology transfer, does not show any significant shift in emphasis from its earlier 1966 version.

fluenced by what he or she understands as being considered important by the laboratory management. Salary and promotion criteria in each laboratory can be designed to fully reflect all functions of the laboratory.

For example, scientists have sometimes complained that, although their scientific authority and expertise are often requested in various management activities, due recognition for the time spent is not always given in their performance appraisal. Work in defining the research objectives of a project, sorting out technical implications of technology-transfer processes, or providing scientific and technical supervision in the management of S&T contracts should also count.

There has been a tendency among research managers to protect their scientists from the encroachment of so-called non-research functions. This has been done by seeking to create intermediary positions such as 'contract analyst', 'technology transfer agent', or 'program analyst'. There is value in developing mechanisms to take away the 'form-filling' load from the scientist and to restrict the purely administrative role, but such an approach cannot fully substitute for the scientific function which can only be provided by those in scientific occupational or management groups. Consequently, such positions may be useful but involvement of the scientist would still be required.

In summation, as the phase one report pointed out, the selection, classification, training and development, and performance appraisal policies and procedures of the scientific occupational groups have been based on assumptions about the role of government science which may have been valid in the public service more than two decades ago. Changes resulting from recent policy and program thrusts now require that management procedures for scientific personnel are kept abreast of these changes by recognizing the current role for federal scientists and research managers.