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...ence and technology for development:

planning in the STPI countries

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Science and Technology for Development: Planning in the STPI Countries

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7. Development of Science and Technology Planning in India

Anil K. Malhotra

India differs from many other developing countries in that it had a flourishing scientific tradition in the ancient and medieval periods. The development of modern science has, however, not been an extension of this tradition. Instead it has been the growth of an implant by the British in a language that was alien to the Indian people.

The main S&T events after India became independent, in 1947, were the creation of an extensive institutional network, a chain of research laboratories, and the expansion of university and technical education. The Council of Scientific and Industrial Research, which was established in 1942, was reorganized on the lines of the former British Department of Scientific and Industrial Research; an autonomous Atomic Energy Commission was formed in 1948; the University Grants Commission was set up in 1956; and the Defense Research and Development Organization was established in 1958.

Pandit Nehru, who deeply believed that S&T was a key factor in national development, was the main architect in the laying of the foundation for the important S&T developments in the country. He introduced in Parliament in 1958 a scientific policy resolution that indicated the government's intent to support S&T to "secure for the people of the country all the benefits that can accrue from the acquisition and application of scientific knowledge." Since the enunciation of the resolution, scientific activity has quickened and broadened, so that now there is a substantial infrastructure of institutions and capabilities in a variety of technologies covering several fields, including agriculture, industry, medicine, defence, and atomic energy.

This rapid development of scientific activity in India is reflected in the substantial increase since 1958 in the financial resources devoted to R&D and the number of people engaged in it. Between 1958–59 and 1971–72 the budgeted expenditure on R&D in the public and private sectors increased from 0.23% to 0.54% of the gross national product, and the total number of scientific and technical personnel employed in R&D establishments increased from 20 724 to 103 767.

From 1947 to 1955, decisions on the setting up of scientific institutions and their funding were arrived at through a relatively unstructured policy process. Later, the government's Planning Commission was expanded and the responsibility for integrating science into development fell to it. The responsibility of the Planning Commission in the area of scientific research was spelled out in 1959 as the setting up of independent committees and panels of scientists as needed, and taking their views and recommendations into consideration in the planning of economic development and the attainment of national aims.

But during the preparation of the second and third plans only one such panel was set up to devise schemes for the research activities of the Council of Scientific and Industrial Research and the scientific organizations associated with the Ministry of Education. None of the other scientific agencies of the government were brought into the framework of a national plan for science.

With a view to designing a mechanism for obtaining scientific advice at the highest level, the government set up the Scientific Advisory Committee to the Cabinet in 1956 with explicit and wide-ranging terms of reference. This committee had, however, no mandate for the preparation of a national science plan, but it set up ad hoc working groups that included some scientists and technologists for the study of specific scientific issues. This Committee was replaced by the Committee on Science and Technology (COST) in 1968, chaired by the Planning Commission's person in charge of science. The new committee comprised agency heads and a few scientists, an economist, and a technologist as members. The terms of reference of this committee were a little wider but did not include the preparation of an S&T plan. The committee did, however, set up a number of standing committees, working groups, and ad hoc committees that included a number of working scientists, technologists, and industrial personnel to study many of the areas it wished to examine.

The National Committee on Science and Technology was set up in 1971, and one of its main mandates was to prepare an S&T plan.

Serious Deficiencies of the Indian Science Policy

The first such deficiency is the absence of rational science policies or guiding principles for making decisions on the magnitude and distribution of funds for scientific research.

There has been in the past no explicit policy on the allocation of funds for S&T activity, well over 80% of which is funded from the central exchequer. Each agency has submitted its proposals to the Planning Commission; the commission has appraised them from primarily a financial point of view, endorsed the plans, largely without modification, and recommended their funding to the government. The government, in turn, has accepted these recommendations and taken them to Parliament, which has usually been generous with funds. In sum, the overall funding of scientific research has been decided more by the absorptive capacity of the agencies and institutions concerned than by the economic or social importance of the research.

The absorptive capacity of the agencies and institutions has varied widely, partly because of the complexity of the technology handled, but also, in no mean measure, because of factors external to the complexity of the technology and to whether the scientists were capable of doing good work. These reasons have often had to do with such things as the organizational flexibility within agencies and departments, the status of the heads of agencies, and other factors unrelated to the requirements of the national economy. The result of this essentially laissez-faire attitude to the allocation of funds has been a growing mismatch between the distribution of funds for scientific activity and the economic and social importance of the areas of funding.

Thus, in 1970–71, whereas agriculture contributed roughly half the gross national product, the central and state R&D allocation for this sector was about 21% of the total. The atomic energy and space programs accounted for 20% of the total expenditure on R&D in the central sector; yet medical research, health care, and family planning accounted for only about 5%. Whereas the share of R&D funds for defence was 12% of the total expenditure on scientific activity in the central sector, that for natural resources (excluding oil) was less than 8% and that for irrigation and power was less than 2%.

The second serious deficiency of the Indian science policy is in the matching of the perceived demand for science with the available supply of science. The communication gap between industry and the industrial research laboratory remains large. When scientific institutions have had to interact with government departments, the latter have been unable to appreciate the imperatives of science and the requirements of scientists. Emphasis on financial trivia and a lack of appreciation of the cost of lost time are the chief characteristics of the existing situation.

The third such deficiency is the continued neglect of badly needed organizational and administrative reform of India's scientific institutions, including their personnel policies. When reforms have been recommended, they have not been fully implemented. The values and methods of decision-making in most of these institutions either continue to be feudal or tend to subordinate the role of the scientist to that of the bureaucrat.

The fourth important deficiency in the Indian science policy is the lack of adequate recognition that the indigenous scientific effort must be geared to complementing and, in time, displacing the imported technology. Also, there has not been a determined effort to use the capabilities already developed in the country. This lack of effort has largely been due to the absence of an agency that could actively promote indigenous technology.

The National Committee on Science and Technology

The scientific community in India was aware of the deficiencies in the country's science policy and its implementation. As a result, the Administrative Reforms Committee set up by the government recommended that a national council of science and technology be established as a high-level body to advise on greater aspects of the government's scientific research policy and the best means of developing and using national scientific resources and personnel. A conference of scientists, technologists and educators in December 1970 also recommended such a body. The conference participants proposed that it should be called the National Committee on Science and Technology, and that, among other things, it should prepare a continuously updated national science and technology plan identifying the projects of high priority. After the minister for planning took charge in 1971 he held discussions with scientists, technologists, and educators around the country to determine the form and nature of the nation's scientific efforts.

In November 1971 the government appointed a 10-person National Committee on Science and Technology to advise the central cabinet on all S&T matters. Its functions were as follows:

- Preparing and continually updating national S&T plans, both as 5-year plans and as "perspective plans." This would have to be carried out in close association with the Planning Commission and be intimately associated, in terms of relative priorities of allocation of resources, to national socioeconomic development plans.
- Arranging for periodic discussion of the draft plan and other important issues of science policy by a fairly large representative group of scientists, educators, industrialists, and policymakers.
- Assessing the pattern of development of S&T research and of intersectorial resource allocation, and designing measures to correct imbalances.
- Orienting the pattern of development to further the use of the nation's S&T resources; in particular, designing measures to strike a balance between domestic capabilities and foreign assistance.
- Establishing cooperation and communication between government, semigovernment, and nongovernment S&T institutions and professional bodies in the country.
- Handling S&T matters.

The Organization

The 10-member committee, presided over by the minister for science and technology, consisted of working scientists from a number of disciplines. The heads of important scientific organizations in the country were excluded from the committee in an attempt to involve working scientists in decision-making and to prevent institutional loyalties from being projected onto the national scene. All the members worked part-time, but one of their first tasks was to set up a full-time secretariat of high-level scientists and technologists to assist in the design of the S&T plan.

The Planning Process

To design the S&T plan the committee adopted a combined sectorial and national approach. The plan was structured in terms of 24 socioeconomic sectors that would each be studied critically so that suitable programs of research, development, and design, with time-bound targets, could be established. Work in each sector was coordinated by a panel of committee members that, in turn, set up a number of planning groups and task forces as basic instruments for the design of the plan. To aid the planning groups in tasks a general project profile was designed.

In devising the methods for the preparation of the S&T plan the committee was guided by the following considerations:

• The preparation of the plan was to involve the participation of the largest possible number of scientists, technologists, administrators, economists, town planners, and so on, so that a broad spectrum of skills would be reflected and an interdisciplinary approach adopted.

• The composition of the planning groups was to reflect the entire "innovation chain," from the educational institutions, the research laboratories and the engineering design organizations, to the production sectors of the economy and the consumers.

• The scientists, technologists, and others invited to participate in the planning were to function in their individual capacities rather than as official representatives of the agencies or organizations to which they belonged. Thus, institutional constraints would not be imposed on the participants during the framing of the various options available to the country at the initial stages of planning.

• The S&T plan was to take as its starting point the development profile for each sector as formulated by the task forces and steering groups of the Planning Commission to ensure that the S&T projects included in the plan were derived from committed development programs.

Although the entire economy had been divided into 24 sectors for the purposes of planning, these methods were not followed in all sectors. Instead, the 24 sectors were divided into three broad categories for each of which a different method was adopted. First, for sectors in which the program was basically to be implemented by a single agency (for example, agriculture, defence, space, aeronautics, electronics, atomic energy, and meteorology), the respective committee panels depended primarily on the plan proposals outlined by the respective agencies and organizations. The committee attempted to ensure that the planning process followed by the agencies reflected the criteria just mentioned, and that the plans were appraised and coordinated with the other components of the S&T and economic systems of the country. Second, for sectors covered by a number of ministries and agencies, the respective committee panels developed the sectorial plans in close collaboration and cooperation with the respective agencies. Third, for areas in which no agencies existed, as in solar and geothermal energy, and cryogenics, the committee set up special task forces to prepare a sectorial plan and to recommend the organizational arrangement needed to implement it. In addition to the projects generated by the various planning groups and task forces a number of surveys, state of the art studies, technoeconomic feasibility reports, and so forth were commissioned by the committee.

In short, the planning process has been both democratic and interactive. It has directly involved more than 2 000 scientists, technologists, economists, administrators, and others, and has led to a basic plan for the S&T work that the country is capable of undertaking. Furthermore, by involving individuals from an entire innovation chain even in the definition of S&T projects, it has been possible to follow a systems approach in the development of the S&T plan. This has meant, for example, that the first step of identifying a process or product technology led to the spelling out of the technological skills involved in the entire spectrum of engineering design capability, material know-how, and production techniques that might be critical to the manufacture of the equipment and machinery needed to commercialize that technology. Similarly, planning in the agricultural sector brought into consideration not only nonindustrial resources such as land and water, but also matters related to fertilizers, pesticides, post-harvest technology, and climatic control.

The Approach Paper

In January 1973 the committee issued a document that reflected its current thinking on the complex issue facing it in the preparation of the S&T plan, and enunciated the policy framework that it would follow in its deliberations. The reasons for issuing the document at this time were fourfold: (a) to indicate clearly that S&T policies must be an integral part of the country's socioeconomic plans, and that they have to derive their mandate from the national plans; (b) to ensure that all S&T activities in the country would come within the S&T plan under preparation; (c) to develop a progressive consensus of the policy framework for S&T planning (for example, to indicate to both scientists and politicians that S&T planning is more than a collection of R&D project proposals, and that the extent and pace at which S&T can contribute to national development depend in large measure on the policies evolved and the actions taken outside the S&T system); and (d) to generate discussion and debate among scientists and technologists (to elicit their participation in the preparation and the implementation of the plan and, indeed, in the reinterpretation of their roles in national life), managers and administrators (to make explicit to them the interdependence and interrelatedness of the S&T system and socioeconomic decision-making), and journalists and politicians (to create a consensus and an environment conducive to the implementation of the S&T plan).

To generate greater consensus the committee organized seven seminars in different parts of the country at which the S&T approach paper was discussed by scientists, technologists, and economists. Then, in August 1973, the final plan was presented to the cabinet.

The S&T Plan

The 5-year S&T plan indicated the strategy being followed by the planners and its objectives, and the details of the plan for the 24 sectors. Each of the sectorial plans was outlined in terms of the specific projects to be carried out by specified organizations and agencies.

Much of the extent to which S&T can contribute to national development depends on the policies evolved and the actions taken outside the S&T system. The maximum use of S&T in achieving the country's socioeconomic objectives requires not only investment and changes in the S&T system but also suitable adjustment in fiscal policies, lending policies of public financial institutions, foreign exchange allocation policies, industrial regulatory and import policies, and foreign investment policies. The following considerations, as pointed out in the fifth plan, are relevant:

> . . . The import of technology does not necessarily have to be linked with the availability of aids or credits. Secondly, institutional arrange-

ments have to be built up quickly for evaluating alternative types and sources of technology and for the selection of imported technology in areas where indigenous technology and expertise do not exist. And thirdly, the domestic scientific and technical effort must be committed not only to the operation of technology through research and development but also to learning, adapting, improving, and then displacing, imported technology.

There must be simultaneously a national commitment to increase substantially the total expenditure on S&T so that, for example, by the end of the fifth plan's period approximately 1% of the gross national product would be continually available for investment in S&T. The S&T plan attempted to reorder the financial allocations among the sectors to be more in tune with the declared national objectives. In this it may not always have completely succeeded, but it did avoid advocating investment at subcritical levels. Furthermore, radical reallocation of resources cannot realistically be done overnight, for not only will this be difficult organizationally, but also it could lead to avoidable waste of resources and talent. The directions to be followed for matching the allocation of resources committed to national S&T efforts with the enunciated national socioeconomic objectives were clearly stated in the S&T plan. It will be the task in the days ahead to move the S&T system even closer to the priorities inherent in the national socioeconomic plans.

The S&T plan was prepared in close collaboration with the pertinent administrative ministries as well as the Planning Commission. Once the plan had been submitted to the cabinet and accepted, the ministries were left to implement it by asking for allocations to the programs from their annual allocations budget. Shortly after the budget allocations for 1974–75 were presented by the administrative ministries to the Planning Commission, it was discovered that the allocations bore little relation to the 5-year S&T plan. There could be a number of reasons for this. Most important must have been that the annual plans of the ministries were drawn up at a time of acute financial stringency. The resources available even for completing the projects in hand were scarce, and any additional investments requested for the S&T plan would have been pared down mercilessly. It was at this stage that the committee, having noted that the resources being allocated to the various sectors were at great variance with those they had proposed in the S&T plan, sought an intercession with the political leaders. The case was presented to the Standing Council of Ministers for Science and Technology that the annual reallocation of funds would have a long-term deleterious effect on the national scientific, technological, and industrial fronts, and that it was necessary to ensure not only that adequate resources were made available but also that the funds were distributed among sectors in a reasonable and consistent manner. As a result of this intercession it was decided that annual S&T plans would be drawn up by the committee, who would keep in mind the stringent financial picture and select areas for investment.

This S&T planning exercise was the first of its kind in India. The formation of an S&T plan is, however, only the first step in the effective use of S&T for development. Although the plan charted a course for the future, its success would lie only in its effective implementation. And it is this difficult task that lay ahead in 1973.