Conflict in science policy declarations: An analysis of the Indian model

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With a view to establishing a vision in India, policies, strategies and structures for science and technology (S&T) have been evolved, under a planned development approach since 1950. It is now observed that S&T policies, when considered in the overall economic milieu, have interacted with the trade, fiscal, industrial and political-policy instruments of the country. The need for evolving an integrated approach is stressed for making the science policy declarations of India as comprehensive as possible and goal-oriented towards attaining global scientific excellence. Developing countries can benefit from the rich experience of India.

APPRECIATING the role of science and technology towards economic development, policy making and planning exercise is undertaken and legislative measures are enacted for enhancing the country's potential. It may require consolidating and strengthening the input-resources like natural resources, manpower utilization, technological innovations and financial allocation. The need for science policy formulation and implementation is far more important for developing countries, than the developed ones, where the choice is between the planned development of science and no significant development at all.

Developing countries, which are now emerging on the world-scene of science and technology, could derive a benefit from the experience of the Indian model of socio-economic development based on science and technology, where policy measures were undertaken from time to time, during the past almost 50 years[1–6]. While charting the development of science in India, the following paragraphs would indicate areas of conflict in science policy declarations that would require some remedial measures and fine-tuning/adjustment, so as to meet with the global challenges *vis-à-vis* societal advantages.

Science in India

Policies, strategies and structures for S&T have been evolved in India, under a planned development approach since 1950 (ref. 6). The Government's attempts at science policy making in India are directed towards

- making S&T an integral part of all sectors of national activity for achieving self-reliance;
- developing capabilities essential for fulfilment of S&T tasks in these areas;
- undertaking of well-defined S&T missions; and
- provision of fiscal measures[7,8].

The Government of India, with a view to providing avenues for economic development on the scientific basis, adopted a Scientific Policy Resolution (SPR), in 1958, which provided guidance by directing the attention of scientists to some of the critical problems of society for which S&T could provide answers[9]. Besides, a number of policies have been adopted at the sectoral levels, in the recent years, to have an impact on the performance of S&T in the country, e.g. policies for energy, education, electronics and computer, environment, materials, drugs and chemicals, housing, patents and copyright, etc. (Table 1). Thus, the existence of the nature of Acts for the promotion and protection of S&T can be taken as an indication of the national commitment to the development of S&T towards the economic growth of the country[10].

Science policies declarations of the Government of India have played a dual role in order to

- foster and promote research activities in S&T in areas of interest and concern to our scientists, and at the same time to
- ensure that S&T are harnessed to programmes which are geared to fulfilling the needs of society.

Nehru employed the Scientific Policy Resolution of 1958, as Magna Carta for the development of science in India, while the visions of Shanti Swaroop Bhatnagar, Homi Bhabha and Vikram Sarabhai led to the establishment of a chain of national R&D laboratories in the fields of industrial, atomic and space sciences respectively[6]. The Government of India has assumed a major responsibility in supporting several initiatives and aspirations. This has resulted in

- providing enhanced budget for promoting S&T in the

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Table 1. Emergence of science policy statements in India

Year	S&T policy declarations
1894	National Forest Policy
1927	The Indian Forest Act
1948	Industrial Policy Resolution (revised in 1956,1973,1977,1980,1990,1991)
1958	Scientific Policy Resolution
1968	Policy on Education
1970	The Patents Act
1972	Archival Policy Resolution
1978	Health for All (Population Policy)
1980	The Forest (Conservation) Act
1981	The Air (Preservation and Control of Pollution) Act
1982	National Health Policy
1983	Technology Policy Statement
1984	Ocean Policy Statement Computer Policy Telecommunication Report
1985	Textile Policy Policy Measures in Electronics
1986	Drug Policy National Policy on Education Computer Software Report Environment Protection Act R&D Cess Act Consumer Protection Act
1987	National Water Policy The air (Preservation and Control of Pollution – 1981) Act (revised)
1988	National Forest Policy of 1952 (revised) National Housing Policy The Water (Preservation and Control of Pollution – 1974) Act (revised)
1989	Motor and Vehicle Act Comprehensive Guidelines for Steel
1991	New Industrial Policy Statement
1992	Fertilizer Pricing Policy National Policy on Education, 1986 (modified)
1993	National Minerals Policy
1994	National Housing Policy New Drug Policy (revision of 1986) New Telecom Policy New Seed Policy
1995	The Technology Development Board Act (amended version of R&D Cess Act, 1986)
1997	New Textile Policy New Technology Policy (expected) Agriculture Policy (expected) Policy for Environment and sustainable development (expected) New Shipping Policy (expected) Patent Act modification (1970) (expected)

country, viz. Rs 20 crores in 1951–56 to about Rs.15,000 crores in 1992–96;
- creating infrastructure for the R&D establishments;
- establishing scientific, technical and educational institutes for generating the necessary S&T manpower, which now stands third largest in the world[11];
- supporting science in making all efforts so as to accrue all the benefits to the people by the application of S&T in India.

The pattern of development for further utilization of India's S&T resources, in particular, on measures for striking a balance between the domestic capabilities and foreign assistance has been the mandate of the apex science advisory bodies that has been identifying and recommending measures which would enhance the country's technological self-reliance with particular reference to Government's policy on foreign collaboration and import of technology[12]. With a view to achieving techno-economic development, India has adopted a two-pronged approach –

(i) development of indigenous R&D for building up an infrastructure for the transfer and application of technology towards industrial development; and
(ii) acquisition and transfer of technology from abroad and its gradual absorption, adaptation and dissemination in the prevalent system[13].

The development of S&T in India has been on the one hand, in relation to the great advances that have taken place in S&T in the world as a whole, and to the compulsion of ensuring that it is relevant and serves the overall purpose of the development of the country, on the other hand. The task has been formidable for a country like India with its large size and vast population. The efforts have met with real success in many areas and have provided experience in a few others – leading to capacity and capability buildings in S&T in the country.

Grey areas

The exchange of signals between the S&T policy regime and the other regimes has been influenced strongly by the perception of the political leadership and by S&T decisions on the nature and the extent of overlap between different regimes. These perceptions form constituencies of decision makers that are willing to effect adjustment and accommodation by accepting or ignoring signals from different policy regimes[14–16]. For example,

a) Table 1 indicates that there are some policy statements, while others are Resolutions and/or are Acts for the development and management of S&T in the country.

These declarations have different legal powers and jurisdiction and interpretations, whereas some of these have even non-statutory obligations[7].
b) Scientific Policy Resolution (SPR) was adopted in 1958, while the Technology Policy Statement (TPS) was announced, 25 years later in 1983, with the basic objective of developing the indigenous technology appropriate to national priorities and resources, thus leading to self-reliant economy in the country.

The SPR envisaged 'Effective utilization of the human and material resources through industrialization',

The emphasis has been on the development of the scientific base, expertise, and scientific temper. Evidently, the object was to develop scientific capabilities and manpower as well as awareness among the general masses.

The TPS stressed on 'self reliance' based on protected economy which guided the planning as well as R&D involvement for the past decades or so.

In order to protect indigenous technology, it stipulated, 'Technology acquisition from outside shall not be at the expense of national interest. Indigenous initiative must receive due recognition and support'.

A draft paper for a new Technology Policy Statement was circulated, in 1993, to the scientific community seeking their comments, towards further strengthening the technology base and to assist the nation in fulfilling its role in the global economic environment with confidence and a sense of urgency. This is still under revision.

c) The Industrial Policy Resolution was first announced in 1948. It was later modified several times say in 1956, 1969, 1973, 1977, 1980, 1990 and 1991, keeping in view the changes taking place in the industrial scene abroad and fine-tuning it with the demands towards global competition.

Though New Industrial Policy (NIP), 1991 emphasizes self-reliance and development of domestic technology through investment in R&D, 'self-reliance' here implies the ability of Indian industry 'to pay for inputs through its own foreign exchange earnings'.

It expects 'foreign investment would bring attendant advantages of technology transfer, marketing experience, introduction of modern managerial techniques and new possibilities for promotion of export and inject the desired level of technological dynamism in Indian industry' and the 'Greater competitive pressure will also induce our industry to invest much more in R&D than they have been doing in the past'.

Clearly, in the absence of market competition, the Indian industries belied the expectation of the Government of India categorically stated in the TPS 1983, 'There shall be a firm commitment for absorption, adaptation and subsequent development of imported knowhow through adequate investment in R&D to which inputs of technology will be expected to contribute'.

The delicensing, deregulation, decontrol and abandonment of import substitution strategies adopted in the NIP envision progressively decontrolled market-driven economy and global technical interdependence. It is, thus, a complete departure from the earlier concept and in reality opens up the Indian industry to foreign investment and technological collaboration.

In a major shift from the policy on public sector, it specifies that 'public sector will continue to play a pivotal role in technology development and building of manufacturing capabilities in areas which are crucial in the long-term development of the economy and where private sector investment is inadequate'.

d) The Technology Policy Statement (1983) advocates for the selective import of technology for the promotion of indigenous one while the New Economic Policy (1991) stresses the need for the free/liberalized import of technology and technological products in the country.

e) The Technology Development Fund, launched in 1996 demands the payment of 5% of royalty on the import of technology (by amending the R&D cess Act of 1986) while there is no such levy on the import of new technological products – which are made liberal under the new economic policy of India.

f) India does not have any policy for environment protection while there exist a few policy measures as regulations/acts for the protection of air, water, forest resources, noise, etc. separately. Several laws relating to the management of environment and environmental resources do not clearly state the social objectives they aim to achieve. Consequently, the interpretation of the administrative machinery implementing the legislation is often not in conformity with the intent and purpose of the law.

Some laws, particularly on land use and management of environmental resources, appear to have self-defeating social objectives. Where such resources are shared by more than one state, legislation enacted in one state may have adverse environmental implications for a neighbouring one. India needs an integrated approach to its forestry, with a national, well thought-out policy if it is to undo the damage inflicted on its forest land heritage by a long legacy of neglect.

g) There are a few areas of contradictions or overlapping in the policy statements for the growth of industry and environment, environment and housing, forestry and paper industry, etc. For instance, the growth of human settlement and industrial expansion would cause scarcity on the available land-resources and affect the environment. Similarly, the expansion programme of textile industry needing bleaching and dying chemicals – the exodus of its waste water into river would cause pollution of the rivers – thus one impeding the growth of the other.

h) The attainment of self-reliance has been the motto before the policy-planners in India so far. Self-reliance has eroded the spirit of competition, while the present scenario demands targetting beyond self-reliance, resulting thereby in achieving technological excellence in the global market.

i) The absence of

- coordinating of scientific efforts and infrastructure,
- proper linkages among the academic, R&D and industrial sectors,
- goal-oriented policy towards commercial instinct of R&D efforts, and

– Prioritization in science and technology programmes, have crept in great measures in the S&T system, resulting thereby in its 'just' good performance[17].

Thus, various science policy declarations of India have indicated grey areas depicting a wide scope for new subject function oriented policy instruments. This points towards evolving a comprehensive S&T policy for the overall development of future S&T system in India.

Institutionalization of policy instruments

Science and technology policy and plans cannot succeed unless efforts are made to develop the necessary S&T infrastructure, for performing R&D, developing manpower, determining and deploying instruments, providing feedback, monitoring performance, performing technology assessment and forecasting, creating technology culture, coordinating R&D efforts and providing technological information.

The process of policy declarations and the institution-building, for implementation purposes, in science and technology in India has emerged, at different periods of time, respectively (Table 2). Normally, it is expected that when a policy statement is announced on a subject first, its importance and application should then find stress/focus in the current national Five-Year Plan, aspiring its implementation through the building of a scientific infrastructure in the country. But on the contrary, this approach has not happened in India and a 'disorder' in the S&T system has occurred, i.e. either a policy statement has appeared first, and/or the subject has not received enough promotion in the Plan Document and sometimes the institution has not been created to implement it immediately or vice-versa[17].

Besides, there are several subject-oriented laboratories which are not at all associated with the relevant/concerned Ministries. And, many like-mandated S&T institutions are preferring to work in isolation, rather than working in tandem – for unclear reasons. A national coordination body, say, a National Science and Technology Commission may be established[17,18] which could 'synchronize' the science advisory policy instrument and the creation of organizational structure with the national commitment in plan S&T component/emphasis as indicated in the national Five-Year Plans so that the entire science planning exercise gears towards accruing all the benefits of science and technology to the masses as well as leading to economic development in India. The present liberalized economic and industrial policy allows free import of technology and inflow of foreign investment. The Indian technologies are therefore facing greater challenges in the market. There is a need for an integrated approach for indigenous technology development, which would require study of laboratory level research and different aspects of scale up, technology transfer, commercialization and project financing. Such an exercise will boost the competitiveness of indigenous technologies.

Future perspectives

While examining the strength and weakness of the various science policy declarations of India, several questions have emerged on the surface, for example –

i) What is the relevance of these science policy declarations (Table 1) in the present context, which were announced from time to time, during the past 50 years? As a signatory to GATT/WTO, how will India introduce amendments in the Patent Law (1970) in product vs process patent regime, or Environment Protection Act (1986) in accepting the dumping of waste materials of the developed countries?

ii) How will the free flow of technology and investment from MNC affect the technology base in the country? implying India's emphasis on basic vs applied research in the future.

iii) How long would the R&D institutions act as satellite laboratories for the developed world in (a) carrying out the assigned jobs, (b) generating and supplying educated and trained technical manpower, and (c) preparing the qualified personnel to suit the employment requirements of MNC in India?

iv) When will India start employing/developing capabilities and capacities to manage the challenges of the frontier areas in science or new and emerging technologies?

v) Since economic and trade policies would now govern the bilateral cooperation in science & technology, industry, etc., further amendments would be needed in the policies which were framed yesterday to enable these to become strong and relevant today and tomorrow. (The recent American pressure on Russia not to affect the sale of MTCR technology to India, impeding India's rocket launching programme because of India procrastinating in signing NPT, GATT/(WTO)/Patent Law testifies the main statement.) There will be a demand for patent information after liberalization in India, with a view to developing and promoting indigenous technology and to avoid repetitive import of costly technology from abroad[19–22]. Besides, emphasis on R&D for technological innovations would aid India on the decreasing import of new generation technologies from abroad.

So, what would be the impact of liberalized economy for technology transfer and its commercialization in India over the existent technology base and spirit of the people? The S&T system would then require some fine-tuning in relation to the emerging scenario of international developments[23].

Table 2. Disorder in the institutionalization of Science & Technology policies in India

Policy declarations (year)	Creation of an institution (year)
Scientific Policy Resolution (1958)	Ministry of Science & Technology (set up in 1951, and 1985)
Technology Policy Statement (1983)	Technology Policy Implementation Committee (1984) Department of Scientific and Industrial Research (1985) Technology Information, Forecasting and Assessment Council (1988)
Environment Protection Act (1986)	Department of Environment (1980) (now) Ministry of Environment and Forest
Energy Policy Statement (1980)	Department of Non-Conventional Energy Sources (1982), (now Ministry of Non-Conventional Energy Sources)
Ocean Policy Statement (1984)	Department of Ocean Development (1981)
R&D Cess Act (1986)/ Fund for Technology Development and Application (1995)	Industrial Development Bank of India Department of Science & Technology (1971) Technology Development Board Act (1996)

To conclude, we need a reorientation of the policies to meet simultaneously the challenges of an internationally competitive economy and to provide satisfaction of rendering basic human needs to the population. An integrated science and technology policy must have threefold objectives: Help India to emerge as an internationally competitive economy; effectively meet the needs of national security and be an active instrument of human emancipation; laying particular emphasis on meeting the basic needs of all our people[24]. Science and technology policies must be so designed as to actively assist India emerging as a strong and internationally competitive economy. The vision that must inspire us is that, in less than a decade, we should complete the transition from being a developing economy, to becoming a developed country, able and willing to face the challenge of global competition on an equal footing. Science policy in India has been evolved due to the appreciation of role of S&T for economic development by the political leaders as well as the generation of foresight studies which have pointed out towards the strength–weakness analysis of the existing S&T system and enabling India to undertake appropriate measures[25–27].

In order to attain global competence, an integrated approach to science policy declarations would be required, in respect of deciding priorities over capital intensive vs labour intensive technology – a factor that is very important for a developing country, like India, with meagre resources and large manpower. It would also require goal-oriented policy for setting 'targets beyond self-reliance', as the industrial scenario demands global competition and significant outward-looking economy, atleast in a few areas of techno-economic importance.

A coordinated and concerted effort among several policy measures when adopted, along with consolidated programmes and prioritization, for establishing a new science vision and yielding meaningful results for the prosperity of India, would be required for keeping alive her interests at the national and international levels – certainly an example for the developing countries to emulate for avoiding pitfalls!

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