

We publish below nine articles that were presented at the National Debate on 'Science & Technology and the Post-liberalization Era: Role of the Government and the Industry, organized by the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore in cooperation with the Rajiv Gandhi Institute for Contemporary Studies, New Delhi.

Editor

Science and technology in the post-liberalization era

[Guest Editorial]

India as a nation is passing through a difficult phase today. Whereas some of the old problems continue, there are a few new ones. Some of them are due to the change in the world order while others are our own creation. The crisis that the nation faces today has to be viewed in the context of several issues. One of the burning issues has to do with the very survival of science and technology in the country in today's scenario.

It was with this background that a national debate on a national crisis concerning S&T in the post-liberalization era was organized by the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, in cooperation with the Rajiv Gandhi Institute for Contemporary Studies, New Delhi, on 3 February 1993 at the Indian Institute of Science, Bangalore. It was attended by a large number of participants from academia, industry and bureaucracy.

The issues that were discussed in this debate were:

- Does India need to have a fresh look at its intellectual property stance? Is it not time to change our stance? What do we do?
 - Massive infrastructure has been created by the Government through publicly funded laboratories such as those in CSIR. What will be the new role of publicly funded R&D institutions in this post-liberalization era? How do we transform these laboratories into market-driven result-oriented laboratories?
 - What is the new role of the research laboratories in the sectors of space, defence and atomic energy? How can they integrate with the civilian sector and get closer to the market place?
- The anguish expressed by some of us individually over the past few months as well as through such a national debate appears to be having some effect. A special mention of S&T has been made in the budget speech of the Finance Minister. At least for some scientific agencies, there was a marginal increase in grants. One of the recommendations made during this debate was concerning the restoration of weighted tax deduction for industry for supporting R&D. This has also been accepted. However, this is only a small beginning. Significant funding to maintain India's competitive edge and continued assertion of government's commitment to S&T through positive actions alone will restore the lost faith of the S&T community.
- A draft of a new Technology Policy has just been announced by the Government. This is under discussion. We do hope that many points discussed during the Debate will help in the sharpening of India's Technology Policy.
- At the end of the national debate held at Bangalore, a consensus emerged concerning the possible approach that we could follow. The recommendations in brief were as follows:
1. A close integration of science and technology into national economic planning is urgently needed,
- The Government has a direct role in providing the infrastructure in terms of facilities for R&D, higher education, etc. In recent times, there are alarming signals that the Government inputs in these crucial sectors are declining. This will have disastrous consequences. What can we do to avert the impending crisis?
 - New forces, realignments and strategic alliances are emerging as a result of global integration of economy. What challenges and opportunities does one see in R&D, technology and business for India?
 - New technology challenges are also emerging. Green technologies, exportable technologies, export oriented technologies are crucial. What is India's preparedness, if any?
 - How do we make our industry competitive internationally? What would be the respective roles of the Government and the industry in this preparation? What can the Indian S&T community do?

without which we will not be able to achieve our ambitious social and economic goals. Science and technology and higher education must be treated as part of the infrastructure requirement for national development. Adequate budgetary support has to be provided to these sectors on a priority basis to retain whatever strengths we may have.

Economic liberalization alone would not lead to prosperity in the absence of an appropriate Science and Technology Policy that gives suitable responsibility to national laboratories, higher educational institutions and such organizations in national development.

There is some contradiction between the present Technology Policy and the Industrial Policy; a new policy needs to be formulated urgently.

2. Expenditure on science and technology should be looked at as an investment into the future. Similarly, technology is to be treated as precious equity. Rather than divesting from technology we must invest in it. The community of scientists and technologists in the country is concerned about the apparent disinvestment in S&T by the Government. The neglect of S&T in recent times is likely to cause irreversible damage to our future. It should be noted that a technologically advanced country like Japan has doubled its support for basic science.
3. Infrastructure and other facilities in institutions of higher learning and national laboratories are crumbling for want of funds. Support of science and engineering is crucial, since that is the only way India can gain a competitive advantage in technology and thereby an entry into world markets. A national plan for modernization of these institutions will have to be drawn and implemented urgently.
4. Apart from S&T and higher education, three crucial infrastructure areas that require immediate attention are *energy, transportation and communication*. Unless these areas show marked changes for the better, it will be difficult to attain a high level of industrial development or foreign investment. S&T in these essential areas has not received the importance it deserves. International or bilateral aid could be used effectively for infrastructure improvement.
5. Poor support to basic science and higher education, gravitation of bright engineers towards management degrees, large turn-out of graduates from poorly equipped colleges (approaching now three times those from recognized institutions) and such other factors have a deleterious effect on the quality of science and technology. The AICTE Act has been ineffective and needs an immediate review and change if the technical education sector has to provide the right inputs.
6. A wider societal recognition of scientists and technologists is required. An aggressive effort to sensitize policy and decision makers should be undertaken. A statement on the economic impact of the contributions of Indian science and technology should be formulated and disseminated.
7. It is recognized that at least 50% of the economic growth can be attributed to technology directly. Technology is a crucial instrument to compete internationally in a truly free market. The emerging technology challenges in the post-liberalization era need to be assessed quickly and an action plan drawn. In some sectors, a mission mode approach should be followed.
8. Short-term and long-term strategies for technology and business will have to be urgently worked out. In the short-term, factors such as quality, productivity, costs, response time and innovation need emphasis. In the long-term the emphasis will have to be on scale, technology upgradation, product design, strategic partnerships, attitudinal changes and new policies on patent law and rights. Science and technology should be at centre stage in all these endeavours.
9. That economic liberalization alone will bring in free flow of technology is a myth. Purchase of state-of-the-art technologies in the context of globalization will be difficult. In view of the following specific issues, inputs in S&T would have to be increased:
 - (a) India will no longer be considered a bottomless pit of domestic demand. Technology buyers from India will be seen as potential competitors in the world market. Conditionalities on technology sale will include marketing territory restrictions.
 - (b) The age of straightforward technology licensing agreements is giving way to technology-cum-market, technology-cum-stakeholding, technology-cum-product swap or tolling agreements. Technologies will be available to an Indian buyer only if he fits into the supplier's global scheme.
 - (c) There is a trend towards breaking up of technology into smaller elements and pricing each element separately. With forging of strategic alliances and acquisitions worldwide, the post-technology sale improvements are not simply available to the technology buyer. Technology suppliers are making technical

services as a part of a separate agreement. As a result, after the purchase of a technology, an Indian buyer will have to depend on the Indian S&T for debottlenecking, absorption and upgradation.

10. Quality will be a key competitive determinant for India. It will not only depend on technology but will encompass all elements and people involved in the business matrix. Substantial upgradation of productivity in terms of labour productivity and automation is needed. Technology will strongly contribute in maintenance, value engineering and in better manufacturing practices.
11. The need for cleaner and safer technologies is imminent as nations importing Indian products will demand technical audit of Indian plants. A technology audit of India's own manufacturing processes has to be launched at a national level. A plan towards development, acquisition and implementation of safer processes and technologies has also to be announced.
12. Fiscal manipulations by the government make environmentally safer processes (which use a higher level of technology) unviable in the current industrial climate. For instance, undue benefits have been bestowed on small-scale industries which continue to pollute in a massive way; dye-stuff industry being a classic case. New fiscal policies have to be geared towards punishing the polluters. The phobia of legislation control has to be got rid of and a promotional and progressive approach will have to be launched.
13. Increasing internationalization means rapid changes in legislation, trade flows, pricing etc. Indian industry has been slow to adjust and respond. This pace must quicken appreciably. India has the image of producing and supporting low-technology products. This image needs a change, both in terms of upgrading the existing technologies and bringing in new technologies and materials.
14. Industrial product design is a neglected area in India. In order to improve our competitive advantage, it will be necessary to bench mark and bring with speed new products and services with variations in features, styles, technology and consumer appeal.
15. Strategic partnerships with partners from abroad should be exploited in business, research and technology. Simultaneously, the joint venture concept with firms abroad should be brought in the system of research linkages also.
16. India is making a mid-course correction only now by opening up the industry to market economy and building gradually the competitive forces, in which industrial R&D thrives. However, the Indian industry, by and large, has not looked at technology as an instrument of growth. Out of the total industrial production, the portion that can be attributed directly to the contribution of R&D efforts in the country today does not exceed about 10%. An overnight change in the industry's attitude and commitment is not expected. A process of transition lasting a decade or so is on the cards. The question today is what happens in the transition period? Who does the R&D? Who pays for it? The Government obviously has a crucial role in managing the transition. After due time, however, we would expect industry to be a major partner in supporting S&T in the country.
17. Publicly funded R&D institutions will have to play an increasingly important role in the process of global competition, restructuring of the industry and economy and in upgrading the local industry to gear it to face the international competition successfully. This will only happen if an enabling environment is created with the support of the government and the industry in which these institutions will flower and flourish.
18. Most publicly funded R&D institutions have suffered badly in the last two years. For instance, CSIR's R&D support budget, rather than increasing, has reduced in the last three years from 28 crores to 16 crores. Some laboratories have even been forced to pay for their electricity and water bills through their earnings from industry. This is a major disincentive for the scientists to go out and seek funds from the industry. This also gives wrong signals at a crucial juncture, when organizations are trying to change. This needs immediate attention.
19. Publicly funded R&D institutions should be used as idea generators and providers of new concepts by the industry. We cannot look at them as supermarkets where off-the-shelf technologies are sold. The industry should willingly integrate national R&D resources into their business strategy. All this would be possible only when we can change the climate for an interaction between the national laboratories and the industry with an improved communication and understanding, faith in mutual growth and development of healthy working relationships.
20. There is a need for reorientation of the publicly funded institutions. With the changed economic scenario, unpackaged technology holds little prospect for marketing. A strong pre-marketing and post-marketing effort on part of the publicly

funded R&D institutions is needed. Imaginative marketing of all the components of knowledge-base such as invention sale, consultancy capabilities, training, S&T services, etc. needs to be done urgently and aggressively. R&D laboratories will have to be allowed to establish commercial arms to sell technologies, products and services. An environment to induct a new breed of professionals has to be created. Debureaucratization of these institutions needs urgent attention.

21. Publicly funded R&D institutions should not only have tie-ups with industry but also with several other agencies and institutions involved in technology generation, transfer, finance, etc. Formation of consortia with other R&D agencies, design and engineering consultants and financial institutions for technology packaging should be pursued.
22. The Government should create a scientific and technology environment, which will encourage industrial growth and competitiveness. There are a variety of direct and indirect measures through which this can be done. These would, for instance, include reintroduction of the fiscal incentives for undertaking R&D, that were withdrawn in 1985. Several other measures should be taken to make R&D tax-free for a limited period, allowing R&D companies to be promoted as commercial ventures without any tax liability, making income from technology sale tax-free, etc. The key is to re-establish the feeling of mutual trust between the government and the industry.
23. The new economic climate and India's need to join global trading arrangement is forcing us to discard many of the dogmas that underpinned our industrial development in the first forty years of nationhood. The Indian Patent Act, 1970 fulfilled a signal requirement in the economic and social development of India in the subsequent two decades. With India's economic policies undergoing a dramatic change, the question is whether the same service to the nation from this Act can be expected in the decades to come. In a phase of world trade with barriers removed, no nation will deliver competitive advantage to another except at a price. A major aspect of India's integration with the international economy will be in terms of the flow of technology. The issue of intellectual property has to be approached with a view to assessing how this technology flow can be best assisted.
24. Agencies in space, defence and atomic energy have performed admirably in mission-oriented tasks in strategic areas of importance to the nation. Since a large fraction of funding reserved for S&T is given to these laboratories, it is important to get the maximum benefits out of this investment. The new vision for these laboratories should, apart from the missions set up through a national goal setting mechanism, include programmes which orient these to the new technological, commercial, business and global-political realities.
25. Wherever possible, such agency laboratories should be opened to the civilian sector to explore the possibility of using the infrastructure facilities on precision fabrication, quality and performance testing facilities, etc. Reciprocally, the Indian industry should participate in indigenizing all key components, materials, machinery, etc. for the agencies. The use of costing methods used in the open and competitive commercial world will help enhance the competitiveness of the spin-off technologies from these agencies not only in the national markets but also on a world scale.
26. The spin-offs arising from the work in agency laboratories (such as advanced materials, electronics, etc.) should be exploited in setting up new industries. Corporations or commercial arms could be set up for this purpose, if necessary. Similarly, consortia of agency laboratories, industry and CSIR laboratories or inter-university consortia could be set up for improving the exploitation of facilities in these laboratories.

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