

nological information, including cost and other economic aspects, is a prerequisite for the appropriate choice of technologies. This will considerably enhance the possibility of obtaining favourable terms and conditions in acquisition of technology. Such a technology information base will be established.

6. Technology transfer

6.1 Diffusion

Special efforts need to be made for the diffusion of technology in use to all beneficiaries who can employ them optimally. Appropriate measures shall be evolved to facilitate technology diffusion, including: horizontal transfer technological support for ancillaries from large units; technology inputs to small units; and upgradation of traditional skills and capabilities.

6.2 International competitiveness and technology exports

It is necessary to maintain international competitiveness in products, services and technologies that have export

potential. Conditions for the marketing of indigenous technology and of products based on it will be improved. It is important in all such cases to conform to the highest international standards.

6.3 Technical cooperation among developing countries

A concerted effort will be made to participate fully in technical cooperation among developing countries. Encouragement will be provided for participation in technology development programmes with other developing countries which can contribute to mutual national development.

6.4 Protection: legislative framework

Development of technology calls for large investments and often involves considerable risk. Encouragement will be given to obtaining necessary protection in all cases of indigenous technology development. A mechanism will be set up to ensure that national interests arising from the generating of technology are fully protected internationally in terms of industrial property rights.

7. Implementation

The success of the Technology Policy and the speed with which the various facets of the policy are implemented will depend to a considerable extent on a system for efficient monitoring, review and guidance and a scheme of incentives and disincentives.

Government will evolve instruments for the implementation of this Technology Policy and spell out in detail guidelines for Ministries and agencies of Government as well as for industries and entrepreneurs.

Success in implementation demands a conscious integrated approach covering technology assessment, development, acquisition, absorption, utilization and diffusion, and connected aspects of financing, based on overall national interests, priorities and the attainment of the most challenging technological goals.

Above all, the entire population must be imbued with self-confidence and pride in national capacity.

Indian Science and Technology must unlock the creative potential of our people and help in building the India of our dreams.

The Draft Paper for a New Technology Policy — 1993

1. Preamble

This Technology Policy Statement of 1993 has been designed to further strengthen the Indian economy and to assist the nation in fulfilling its role in the global economic environment with confidence and a sense of urgency.

The nation's commitment to the use of science and technology as key instruments for national development has been articulated in the Scientific Policy Resolution of 1958. The present policy is aimed at giving a renewed sense of purpose to indigenous technology for its accelerated development and use in the context of the Industrial Policy Statement of 1991 and keeping in view the need to adhere to international quality systems as well as preserve the environment.

2. Technology and society

In order to enable large sections of our society to derive the benefits from science and technology, this policy is directed to:

- achieve a greater spread in the use of technological developments;
- ensure accessibility of technological devices to all segments of the society with a special emphasis on remote and rural communities in order to improve their quality of life;
- enhance infrastructural facilities;
- upgrade traditional skills and reduce drudgery keeping in view the special needs of women and the weaker sections of society; and
- encourage industries for enhancing human skills to upgrade existing techno-

logies to comparable international levels as well as to attain such levels for newer and emerging technologies.

3. Technology and environment

To facilitate optimal utilization of the finite natural resources for ensuring a sustainable benefit stream for a better quality of life, it is essential that the technology conversion process must be made as efficient as possible. This will provide a much higher output of the productive goods and services from the same material inputs and consequently reduce wastage which results in pollutants in the gaseous, liquid or solid form. This policy, therefore, aims at:

- adoption, adaptation and promotion of state-of-the-art technologies for waste

prevention and reduction by lesser consumption of raw materials with special emphasis on indigenous efforts;

- modification and upgradation of the process technologies for optimal utilization of natural resources;
- adoption of preventive approach for pollution control;
- promotion and use of cleaner technologies; and
- ensuring access to cleaner technologies available abroad.

4. Human skills

4.1 Deliberate steps would be initiated to continuously augment the number of scientific and technical personnel in relation to the country's population. A new balance of ratios between scientific and technical personnel will also be aimed at. Towards achieving this objective, attention will be directed to further enlarge the base of polytechnics, technical and vocational institutes, and engineering institutions and launch programmes for training and retraining industrial and technical personnel in numbers significantly more than what has been attempted hitherto. Industries will be involved in this process of upgrading the human skills.

4.2 Improvement of the quality of management of R&D institutions will receive special attention. Pursuit of R&D as a career prospect will be deliberately encouraged through further concrete measures so as to attract scientists and technologists to the challenges of creative science and innovative development with a target of doubling their number in R&D by 2000 AD. This will include innovative measures to attract and to utilize scientific and technological talents of Indians all over the world.

4.3 Specific programmes will be evolved to nurture and reward talented personnel contributing notably to technology development. Accomplishments by skilled technicians will be recognized and rewarded. The overall direction would be to create an atmosphere and opportunities to promote technological innovation and excellence.

4.4 Specific emphasis will be laid on induction of professionals fully conversant with the latest technologies in

Ministries/Departments which heavily depend on crucial technology inputs.

5. Thrust areas

5.1 Thrust areas for technology development will be related to:

a) Critical technologies regardless of whether they are currently available from abroad; and

b) those aimed at new products and services and technological refinements over currently available technologies.

5.2 Keeping in view the above directions, thrust areas will include:

i) energy-related technologies including those for alternative fuels, renewable/non-conventional sources, and energy conservation technologies with due weightage for domestic/local availability base;

ii) technologies for conservation of land, water and energy resources and their integrated management for sustainable development leading to their ecologically balanced management and obtaining higher efficiencies in utilization as well as those enabling availability of newer sources of water;

iii) local specific requirements of exclusive concern to our own milieu such as those based on our natural resources and characteristically indigenous industries like those in the small scale sector or based on traditional and household skills;

iv) extensive and intensive mapping and exploration of natural resources as well as estimation of reserves for optimal utilization of such resources to include beneficiation and new applications with special emphasis on integrated R&D in the mine, mineral, metal and material chain;

v) the necessity of protecting vast sections of people against natural hazards like earthquakes, cyclones, droughts and floods;

vi) agriculture, allied services and agro-based industries including development of non-hazardous pesticides, herbicides and fungicides;

vii) technologies for provision and maintenance of health services, as well as leading to development of new drugs, medical devices and instrumentation, vaccines and their delivery systems;

viii) technologies relating to better-

ment of infrastructural facilities such as transport, communication and housing;

ix) areas which are relevant to a whole range of modern systems like materials development, biotechnology, electronics and communications with emphasis on new product design;

x) manufacturing sciences and technologies to improve industries, including electronification as appropriate for higher productivity and upgradation of industrial processes with due consideration for employment productivity and automation;

xi) areas where continued imports are difficult to sustain. e.g. petroleum products and capital goods (e.g. instrumentation and equipment hardware);

xii) emerging and as yet unexploited zones of resources like oceans; and

xiii) speedily enlarging areas of recognized strength like software.

5.3 Specific short and long term programmes will be drawn up in each of the above areas through detailed analyses including techno-economic assessments.

6. Role for research, development & engineering (R&DE)

6.1 Recognizing the critical importance of innovative research, a far more prominent role for R&DE is envisaged in the decade ahead such as:

i) predominant role for R&DE teams in corporate and Government sectors;

ii) association of the relevant R&DE laboratory system(s) for technology acquisition particularly when these are imported since absorption, adaptation and upgradation are inescapable to obviate repetitive import of technologies;

iii) institution of measures to upgrade the efficiency and productivity of the technologies for ensuring quality and enhancing competitiveness;

iv) enlarged role of R&DE in our economy so that by the turn of the century the share of the right type of indigenous technology in total industrial production would rise markedly, targets being set by Government;

v) providing technology support and services for major export-oriented areas like leather, textiles, jute, jewellery, handicrafts and agro products;

vi) providing support for substantive value addition for export in areas which

may emerge due to rapidly changing global mix of technologies; and

vii) development of indigenous clean technologies which are urgently needed to preserve the environment and ensure the health and safety of our people.

6.2 It is also noted that R&DE could provide vital inputs for enabling small scale industry to grow and successfully compete with large scale industry. With emerging trend of new 'scale-neutral' technologies, it could decisively influence the growth of small scale industry in future.

6.3 In view of such a predominant role being envisaged for R&DE in the coming years, continual examining and reorienting the work programmes of the R&D institutions are necessary, based upon the emerging needs of the country and the areas where large foreign investments are taking place or substantial foreign technological inputs are needed. Such actions will be more and more market oriented and focused on applications. The linkages with industry, markets, customers and feedback for feed-forward research would become important and mechanisms to achieve these would be provided for.

6.4 Significant R&DE contributions will be rewarded by according notable recognition to team efforts and by enhancement of allocations to the institutions concerned.

7. Resources for R&DE

7.1 Noting that the Government directly invests in R&DE as well as stimulates industrial investments by both the public and private sector industries and the total R&DE expenditure is currently about 0.9 per cent only of the Gross National Product, it will be the aim of this policy to enhance and to encourage investments in R&DE especially by industry so that the target for R&DE by 2000 AD can be set to reach 2% of the Gross National Product. It is also recognized that the quality of results from R&DE and their applications are equally important.

7.2 It would be endeavoured that the private sector R&DE contributions would be significantly enhanced. Towards achieving the target for R&DE, the Government will provide for incen-

tives and other measures to stimulate contributions from the industry based on the annual turnover.

7.3 All Government-funded R&D institutions will be actively encouraged to earn revenues. Increased industrial contributions have a decisive role to play. Government would enable Government-funded agencies/institutions to retain the earnings resulting from the services offered by them to Government, industries or others, as an additionality to the Government funding.

8. Linkages

8.1 The strengths of our R&DE systems mainly comes from the expertise built over past few decades. The weaknesses are in the linkages with industry and time taken from the laboratory to actual applications. Implementation of this policy will endeavour to remove the weaknesses and build on strengths.

8.2 Realizing that there is an urgent need to shift from localized excellence to integrated excellence, R&DE collaborations will be deliberately and actively encouraged through;

i) funding national laboratories—academic institutions through linked projects;

ii) promoting university–industry linkages by diverse means, including adjunct positions for necessary personnel;

iii) instituting appropriate systems in all the research institutions for keeping track of the needs of industries and users as well as the R&DE projects undertaken by other institutions;

iv) encouraging use of national laboratory facilities and their expertise by industrial units by way of contract research projects paid for by the industry appropriately;

v) developing consortium approach involving academic institutions, national laboratories, including those of the mission agencies namely, Department of Atomic Energy, Space and Defence Research and Development, wherever feasible, and the user industry for goal-oriented programmes and new product development;

vi) enabling joint R&DE projects between Indian enterprises/institutions and those abroad, with equitable sharing of results;

vii) facilitating easy mobility of personnel among universities, laboratories, industry (including R&D institutions connected with industry) and the Ministries;

viii) decentralizing extramural funding selectively so that institutions and industries can develop productive linkages; and

ix) assigning multi-dimensional responsibility to the existing technical institutions.

8.3 In addition to the actions by the Central Government, industry, universities and the laboratories, the State Governments have a special role to play in encouraging R&DE and in providing linkages at the local levels. Community development in technology extension services through cooperatives, voluntary agencies, agricultural universities and other local institutions will be given special emphasis.

8.4 The above measures will be directed to result in reduced dependence on the Governmental initiative and financing and to move in an accelerated manner towards self-supporting R&DE. These will also help in the achievement of synergy of the strengths existing in the country's academic institutions, national laboratories, industrial units and voluntary organizations.

9. Policy implementation

It is recognized that a policy spells out directions, even so, a set of measures for its implementation is considered essential to be stated here and the following have been identified for early action.

i) It is necessary that in order to achieve the goals set forth in this Policy Statement, an integrated set of measures should be taken. To ensure this, appropriate executive actions or legislative measures will be taken.

ii) Since many of the technology programmes are bound to be multi-disciplinary in character, it is necessary to ensure multi-institutional involvement in the thrust areas for timely and successful achievement of the goals. Increased inputs from financial institutions, consultancy organizations, and user agencies are essential. Actual implementation will be done without undue centralization in government

departments and through empowerment of implementing institutions and teams.

iii) Keeping in view the climate of liberalization, technology development/acquisition and investment must take place in a competitive environment and for this purpose industrial R&DE must be appropriately reoriented in order to mitigate technological multiplicity. While technology imports can continue, the absorption system would be strengthened in order to minimize repetitive imports.

iv) In evolving specific measures to implement the technology programmes and plans in the socio-economic Ministries, appropriate S&T advisory groups and institutional linkages with R&D institutions would be further strengthened so that continuous inputs would become available ensuring their timely and successful implementation.

v) Specific and sizeable allocations would be made for technology diffusion for societal benefits.

vi) Recognizing the need for specific incentives to meet an intended target, a standing mechanism would be identified which will examine and bring about the required specific and appropriate fiscal incentives for industry from time to time.

vii) R&D institutions including academic institutions would be encouraged to interact with industry and other agencies for contract projects. Income arising out of such initiatives will become additional resources for furthering their infrastructure and other

R&DE activities.

viii) To encourage the use of indigenously developed technologies, measures like development contracts would be adopted.

ix) Suitable measures to create a market for domestic technology, like purchase preferences by the Government departments and organizations controlled by government will also be adopted.

x) In order to encourage innovations by individuals and institutions, and their commercialization, selective support would be extended for patenting and other forms of intellectual property rights.

xi) For successful commercialization of new technologies by entrepreneurs, a full technology package including design, engineering, finance and servicing of indigenous technologies will be encouraged.

xii) All measures will be taken to accelerate the process of transformation of a laboratory technology to an industrial operation through strengthening and involvement of design, consultancy and project implementation groups. Necessary fiscal measures will be introduced for equipment, accessories and consumables which are essential for proving developed technologies through pilot scale production and marketing of the products.

xiii) In order to protect the interests of consumers, it is intended to enlarge and strengthen systems and mechanisms

for testing, calibration, standards, inspection and other quality systems in industries and laboratories.

xiv) Rapid technological advancement bring about widening technology gaps with adverse effects in making many industries less profitable and leading to industrial sickness. Appropriate systems would be established to identify existing technology gaps and provide for essential inputs from advances in technology.

xv) Government will initiate specific goal oriented and time bound technology development and application projects and missions in key areas.

10. Monitoring and review

Every initiative taken to inject new technologies in the country from outside and from within has to be constantly and continuously monitored and reviewed to achieve sustained results. The approach to detailed technical evaluations on a continuous basis requires a combination of centralized and decentralized mechanisms. Special measures will be brought into being to set up dedicated systems for this purpose. Methodologies will be evolved for a comprehensive watch on the generation of R&DE results and their application in manufacturing and service industries. It will be further ensured that a feedback would be available to Government and corporate sector for taking timely and appropriate corrective measures.

Comments on 'The Draft Paper for a New Technology Policy — 1993'

A draft on New Technology Policy has been prepared by the Government of India and has been circulated for people to comment on it. The document was also sent to the Indian National Science Academy and Indian Science Congress Association besides other organizations. I have the following comments to offer.

The preamble of the document states

'Whereas the science Policy Resolution of 1958 inspired and led to the setting up of a broad-based infrastructure for science and technology in the country';

'Whereas the Technology Policy Statement of 1983, with its basic objectives of development of indigenous technology and efficient absorption and adaptation of imported technology appropriate to national priorities and resources, has facilitated demonstration of the country's technological talents and potential';

'Whereas the Government is further committed to carry forward the use of science and technology as key instruments for national development, with the goal of securing a prominent presence in the global technology scene

by the turn of the century' and after a few platitudes it ends with the statement that 'Now therefore the Technology Policy is designed with a holistic approach to assist the nation in fulfilling the objectives with confidence and a sense of urgency'.

May I ask if the confidence and a sense of urgency was lacking in the Technology Policy Statement of 1983? I am raising this pertinent point because of experience of the new National Policy of Education document of 1986. Let us recollect what happened to the

National Policy of Education document of 1966 which is popularly known as the Kothari Commission Report of 1966. It is very well known that major part of the report which was meant to be a document for 20 years was not implemented and we are facing its consequences today. In this connection I am reminded of the oft-repeated remark of late Kothari. He used to say that he had invited a large number of experts on education from various countries of the world. An expert from UK asked Kothari the purpose for which they had been invited. In his own humble way he replied that the country wished to gain from their experience in devising the policy document. To this the expert remarked that there was no need to invite experts from different parts of the world since he knew that Indian people know what should be done and it is only when the time of implementation comes that people from outside should be invited. How true!

Is the New National Policy of Education, 1986 being implemented? No, not the way it had been stipulated. When I had raised the question in 1986 as to what was new in this new policy except that because of the time lag of 20 years, something new had to come, I was told the new and the most important part of the document was that it was accompanied with a Plan of Action which was lacking in the Kothari Commission document of 1966. The new policy document had to be reviewed after five years to make sure that the policy was implemented in the right perspective. We know that the policy is not being implemented the way it should be and we had to come out with a new Plan of Action, 1992 and perhaps we will come out with new plans of action every five years and a newer policy document in the year 2006. Where are we? The new policy of education which had been accepted unanimously by the parliament had ensured that from VIII Five-Year Plan onwards, the outlay on education will uniformly exceed 6 per cent of the national income. We are far far away from this. While the finance minister has raised the central plan outlay, he has drastically reduced net central transfer of resources to states which, I am sure, will adversely affect state investment in education.

Let me revert to the draft of the new

Technology Policy document for which, perhaps, money will be spent throughout the year and will be brought before the parliament to show that we mean business and are actively doing something very important. Basically we are going to do the same thing which we did for the new National Policy of Education, maybe a few shades better because it is science and technology.

I have already referred to the preamble, let me now come to item 2, i.e. technology and society. It 'envisages to achieve a greater spread in the use of technological developments'. May I know what greater spread will be there than what had been included in para 3.6 of the 1983 document? It further states to 'ensure accessibility of technological devices to all segments of the society with a special emphasis on remote and rural communities in order to improve their quality of life'. How is it different from what has been given in the 1983 document which states 'The use and development of technology must relate to the people's aspirations. Our own immediate needs in India are the attainment of technological self-reliance, a swift and tangible improvement in the conditions of the weakest section of the population and the speedy development of backward regions' etc.? There is a difference, of course. The last statement is in the preamble of the 1983 document and not in any special para.

Under item 3, technology and environment, it is envisaged 'To facilitate optimal utilization of the finite natural resources for ensuring a sustainable benefit stream for a better quality of life, it is essential that the technological conversion process must be made as efficient as possible', etc. How is it basically different from what has been given in para 3.5 of the 1983 document under the heading Environment? Is it not just paraphrasing?

Under item 4, human skills, para 4.1 of the present document states, 'Deliberate steps would be initiated to continuously augment the number of scientific and technical personnel in relation to the country's population. A new balance of ratios between scientific and technical personnel will also be aimed at' etc. Was it not there in the 1983 document under 'Enhancing traditional skills and capabilities (para 4.3)? Para 4.2 of the present draft states 'Improvement of the

quality of management of R&D institutions will receive special attention. Pursuit of R&D as a career prospect will be deliberately encouraged through further concrete measures so as to attract scientists and technologists to the challenges of creative science and innovative development with a target of doubling their number in R&D by 2000 AD', etc. Are these not implied in the 1983 document under the heading 'Strengthening the Technology Base' in para 2.3? It is being envisaged that 'specific programmes will be evolved to nurture and reward talented personnel contributing notably to technology development'. Have there ever been incentives or dis-incentives in any area of our working? It will be a miracle if ever this happens.

Item 5 of the new document refers to thrust areas. Are items 5.2 (i); 5.2 (ii); 5.3 (iii) not similar to items 2.1 (i); 2.1 (j); 2.1 (a) respectively of the 1983 document? Yes, they are but because of the liberalisation policy of the Government of India, the document has to bring in a few new items under this heading. Is it enough reason to bring in a new Technology Policy document? The same is basically true for the rest of the items. Under item 7, resources for R&DE it has been stated that 'Noting that the Government directly invests in R&DE as well as stimulates industrial investments by both the public and private sector industries and the total R&DE expenditure is currently about 0.9 per cent only of the Gross National Product, it will be the aim of this policy to enhance and to encourage investments in R&DE especially by industry so that the target for R&DE by 2000 AD can be set to reach 2 per cent of the Gross National Product'. What has not been mentioned that by the year 1989, the investment had already reached about 1.1 per cent of the Gross National Product which has been brought down to the present 0.9 per cent. Again, it has been the policy of the Government of India to increase this investment to 2.0 per cent of the Gross National Product by the year 2000 AD and hence is nothing new.

What this country needs basically is to implement ideas which have been beautifully brought out in several documents in various areas. There is absolutely no need to waste time in bringing

out new documents or to clothe the old documents with new garments and to show that we are very active and kicking. But when had time been important in this country of ours?

I will like to end by giving two examples. It was the year 1958. The Soviet Union had already sent their *Sputnik* in space. The Americans were shocked and resolved that they must remove their weaknesses and by doing so they landed man on the moon within

ten years. There was no new policy document drafted; what was really initiated was action. Similarly, the famous Japanese economist Saburo Ohkita, who later on became a minister and unfortunately died recently envisaged, in early sixties, that the Japanese Gross National Product could easily be doubled within ten years and action was initiated. The target was achieved within seven years instead of ten without any change in policies and without drafting

any new document. We are, of course, immune to such examples and our way of working is so different. I wonder if this will ever change.

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MEETINGS/SYMPOSIA/SEMINARS

Second Congress of Asian and Pacific Society for Neurochemistry (APSN)

Place: Hyderabad

Date: 14-16 September 1994

Symposia and round-table discussions on frontier areas of neurochemistry are planned.

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Congress on Traditional Sciences and Technologies of India

Place: Bombay

Date: 28 Nov. to 3 Dec. 1993

Themes include: Architecture, agriculture and forestry, health, metallurgy, water management, textiles, industries, theoretical sciences and social organization.

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Indian National Dock, Harbour and Ocean Engineering Conference (INDHOEC)

Place: Pune

Date: 8-10 June 1994

Themes include: Hydrodynamics of estuarine, coastal and ocean waters; Marine structures; Dredging in marine environment and handling of dredged material, Coastal processes and ocean sciences; Marine geotechniques; Construction, management and maintenance of coastal/ocean structures; Environment: parameters, issues and remedies; Materials for marine applications, Navigation and ship behaviour; Modelling techniques—physical and mathematical; Instrumentation and measurement techniques for laboratory and field applications.

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