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**PROMOTION OF INTERACTION
BETWEEN UNIVERSITY-INDUSTRY-
NATIONAL R&D LABS-NATIONAL
ACADEMIES**

An Approach Paper

**THE STANDING COMMITTEE
ON
INDUSTRY-INSTITUTION INTERACTION**

PLANNING COMMISSION

Government of India

New Delhi

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Foreword

Changed global scenario, the process of globalisation of Indian economy and inadequate resource situation, have provided a different setting for national development and in this context all the concerned constituents of national development should respond adequately to meet the new challenges. Some of these major constituents are the Universities, Industries, R & D Organisations and the National Academies and Professional Bodies. Each may be contributing in their own way, but they would have done more if they had forged strong linkages among them. University-Industry-R & D Laboratories-Academies and Professional Bodies interaction becomes vital for their contribution to national development. Planning Commission, Government of India, having recognised this need, constituted a Standing Committee on University-Industry-R & D Laboratories-Academies interaction to act as a forum for consultation and deliberations on this important issue. The Standing Committee is widely represented.

The Standing Committee felt at its first meeting held on 4th May 1995 that it would be worthwhile to bring out an Approach Paper on the interaction between University-Industry-R & D Laboratories-National Academies and Professional Bodies. For this purpose, a Task Group was constituted under the Chairmanship of Prof. V S Raju, Director, IIT, Delhi. The Task Group did a wonderful job and their Report was discussed twice and the Approach Paper was finalised by the Standing Committee at its meeting held on 27th May 1996. This Report is the outcome of that exercise.

The Approach Paper identifies and discusses various issues pertaining to the Industry-University-R & D Laboratories-National Academies interaction. It is well recognised that there should be a change in the mind set of all the constituents of interaction. The role of the Government should be that of a promoter and a facilitator in the process of building strong linkages between these constituents. A number of suggestions and recommendations have been made in the Approach Paper, broadly falling into two categories - one relating to issues which will need policy decisions by the Government and other administrative agencies and the other relating to those that can be implemented by the various agencies concerned. Some of the policy issues suggested may need a national debate.

One may have to recognise that it is not an easy job to bring to fruition the process of interaction among the above constituents. There are known attempts made for interaction between Industry-Institution interaction and Industry-R & D Laboratories interaction but the idea of entry of National Academies and Professional Bodies into this chain seems to be of recent origin. Not only interaction between Industry and the other three constituents be strengthened but also interaction among the four should be encouraged. An attempt was made by me to identify the areas of interaction among these four constituents and a model for University-Industry-R & D Laboratories-National Academy interaction was presented and published by me. The Approach Paper for the first time brings out the need for stronger linkages between these four constituents and discusses ways and means of promoting such interaction. I hope the Report would stir up discussion on the subject.

I would like to place on record the excellent contributions made and the cooperation offered by all the Members of the Standing Committee in finalising the Approach Paper. Most of the credit should go to the Chairman, Convenor and Members of the Task Group, without whose effort, bringing out of this Approach Paper would not have been possible. The services and cooperation offered by the Foundation for Innovation and Technology Transfer (FITT), IIT, Delhi headed by Dr. A.K. Sengupta, who also acted as the Convenor of the Task Group, and the Education Division of the Planning Commission, currently headed by Shri N. Gopaldaswami, Adviser, are also duly acknowledged.



D. SWAMINADHAN
Chairman

Standing Committee on University-Industry-R & D Interaction

EXECUTIVE SUMMARY

Recognising the need for close interactive partnership between the industry on one hand and the academic and research institutions on the other, the Planning Commission in May, 1995 constituted a Standing Committee on Industry - Institute - R&D Organisation Interaction, under the Chairmanship of Professor D. Swaminadhan, Member (Education) in the Planning Commission. The Standing Committee entrusted a smaller Task Group to draw up a Plan of Action, in precise terms, for promoting meaningful interaction among university, industry, R&D laboratories and National Academies. The Standing Committee deliberated on the suggestions of the Task Group and finalised this Approach Paper containing its recommendations on the subject.

In this Approach Paper various issues pertaining to the industry-institution interaction have been identified and discussed. It has been pointed out that while all the stake-holders in this interaction would benefit significantly by collaborating with one another, there are a variety of factors which act as barriers to such interactions; such as lack of awareness about each other's needs, capabilities, strengths and weaknesses, lack of mutual trust and the plethora of rules, regulations and procedural bottlenecks that inhibit closer ties between the constituents. In the controlled economy which prevailed in the country for the first 40 years or so of the post-independence period, industry did not pay much attention to development of indigenous R&D capabilities, and had almost no interaction with the universities, institutes of learning and research organisations. Though in recent times, there have been some significant improvements in this matter, we still have a long way to go. This is in contrast with the policies followed and experiences gained by the developed countries of the West as well as some of the newly industrialising countries of the East, where a major share of expenses towards industrial R&D as well as costs of technical and higher education and research are borne by the industry.

The Regional Engineering Colleges (RECs) and private as well as state owned institutions in the country are particularly affected by the scarcity of State resources, leading to bottlenecks in the development of infrastructure and faculty. The industry which is the main beneficiary of the technical education provided by these colleges has to be persuaded to cooperate with, and contribute on a larger measure to the resources of, these academic institutions and their activities in the areas of training, research and development of technology.

In this Approach Paper a number of suggestions/recommendations have been developed for enhancing the interaction between the industry and the

institutions at large. These recommendations are broadly of two types. Some will need policy decisions at the appropriate level of the Government and the Administrative machinery. Others are those that can be implemented by the various agencies concerned, without waiting for any special directives from the Government.

It is suggested that the concept should be pursued as an institutional goal by all the concerned parties. The role of Government in higher education will have to change from one of funding agency and regulator to one as promoter and facilitator for enhancing ties with industry. State will have to intervene on policy level, such as enacting legislative measures, wherever necessary, to persuade industry to spend a certain minimum quantum of resources for indigenous R&D and higher technical education, offer fiscal and other incentives to industry as well as academicians and scientists in the institutions, and simplify rules and procedures. A suggestion has been mooted to set up a National R&D Fund, through contribution from industry as well as from the Government to promote industrial research and education, to be managed by an autonomous body, consisting of representatives from industry, institutions and government. All academic institutes and Government owned research laboratories will have to be encouraged to set up administratively and financially independent and autonomous marketing arms or an appropriate mechanism that can operate on a commercial ethos of flexibility and procedural simplicity. Introduction of Sandwich Courses at the under-graduate level, in which a student spends a significant portion of his time in industry, and similar innovative schemes at the post-graduate level may be taken up in some of the RECs and State colleges that have the academic freedom and flexibility to do so. Industry internship for a given period may be made a desirable requirement for students of engineering and technology.

The Standing Committee has also suggested a number of short to medium term measures which can be initiated by the institutions and the industry themselves and which do not require much financial commitment or capital investment. These include proposals for participation of industry in academic curriculum development, teaching and research; joint development and ownership of infrastructural facilities; continuing education programmes for upgradation of qualification and re-training of industry personnel; and representation of industry in the Governing bodies and Management Councils of the institutions. The institutions are advised to evolve procedures to encourage faculty and scientists to increase interactions with industry, by relaxing the limit on extra-mural earnings; by recognising the contributions made in the industry related activities (most of which are treated as confidential and cannot be published) in performance appraisal; by permitting to participate in the management activities of industry and so forth.

The recommendations of the Standing Committee have been listed separately in the Section 8 of the Approach Paper.

**PROMOTION OF INTERACTION BETWEEN UNIVERSITY-INDUSTRY-NATIONAL R&D LABS-
NATIONAL ACADEMIES
AN APPROACH PAPER**

1. **INTRODUCTION**

The New Economic Policy (NEP) along with the structural adjustment programme has brought on tremendous pressure on the Indian industry to face challenges of competition not only within the internal domestic sectors but also globally from the international arena. With virtual removal of licensing control, State protection and subsidy, the survival and growth of the Indian industry in almost all the sectors of economy depend on how fast it can catch up with the rest of the world in efficiency of operation and competitiveness in cost and quality. There is growing realisation across the board that while it may be necessary in the short run to turn to the developed countries in the west and the east for capital and technology in order to bridge the existing gaps, one has to quickly strengthen indigenous capability of evaluating, selecting and adapting know-how imports that are must, and also to be able to develop, innovate and continuously improve new products, processes and services so as to sustain the competitive edge in the long run. The need for interaction between the industry on one hand and the academia and the R&D fraternity on the other is now fairly well recognised, but the progress achieved so far has not been sufficient.

It is in this context that there is renewed interest and a sense of urgency regarding the need to put in place a mechanism for ensuring meaningful and profitable (for all the constituents concerned) interaction amongst the Industry, Academic Institutes and Universities, R&D laboratories and national academies. Over the years since Independence, there has been an impressive growth in the knowledge infrastructure in this country. We have some 195 universities, six Indian Institutes of Technology, four Indian Institutes of Management, seventeen Regional Engineering Colleges, a large number of research establishments under umbrellas of central government sponsored organisations like CSIR, ICAR and ICMR, a number of cooperative research organisations such as ATIRA, ARAI, IJIRA, NCCBM etc., and a thriving array of R&D organisations established to pursue national programmes in strategic areas like Atomic Energy, Space Exploration, Ocean Development, Telecommunication, Computing and Defence. There are also a number of publicly funded or privately managed colleges and institutes (around 200) and 500 research laboratories (SIROs), and also quite a few in-house R&D set-ups with public sector and private-sector industry houses (more than 1230) engaged in R&D, application engineering, and technological trouble shooting and consultancy

services. Until recently, however, the interaction of industry with such

* Source : AICTE, DST

knowledge infrastructure has been rather limited, apart from a few notable exceptions. The Academic Institutes have been viewed primarily as sources of educated manpower, and the CSIR laboratories, even though created for industry relevant R&D, were seen as organisations catering to esoteric research often unrelated to the requirements of Indian industry. The quality of manpower emerging from the educational and R&D institutions is found wanting, a lacuna which is largely due to the almost total absence of industry exposure for the students as well as the faculty and scientists.

The real reason for this lack of interest on the part of industry may perhaps be attributed to the environment of controls, protectionism and restrictions in the market forces that existed prior to the implementation of the NEP, and industry's consequent lack of felt need for indigenous R&D. The situation has changed dramatically in the last few years though. The threat of competition in the market place, especially from foreign business, has forced the Indian industry to look for expertise within the country, in our institutions of higher learning and research establishments, to help in technology development, absorption, adaptation and other exercises to provide the competitive edge. Earlier critical references to inappropriate skill development amongst the engineering and science graduates have now changed to willingness to participate in curriculum development and practice oriented training for students in engineering colleges and universities. Development of in-house R&D strength has become a priority in many industrial enterprises.

There is, however, another crucial angle in the new dispensation. The priority for allocation of financial resources of the State has shifted from industry and business to infrastructure development and social services. Even in the higher allocation in education and human resource development being proposed for the Ninth Five Year Plan, emphasis is likely to be on primary education and vocational training, rather than on higher and technical education. The Institutes of Technology, Engineering Colleges and Universities are already aware of the dwindling government budgetary support in real terms and the need for generation of resources from industry and other sources. There is a resource crunch for the research laboratories, who have been told to raise 33% or more of their budgetary requirement from earnings in the market place. These are compelling reasons for the academic institutions and CSIR laboratories to raise their level of efficiency, and to spread and re-orient their activities to the needs of the industry to a large extent.

It is in this background that the Planning Commission recently

constituted a **Standing Committee on Industry - Institution - R&D Organisation Interaction** under the Chairmanship of Dr. D. Swaminadhan, Member (Education) with a view to developing policy guidelines for the Government of India on this very important and contemporary subject. Constitution and the terms of reference of the Standing committee is given in Annexure I. The Standing Committee had its first meeting on 4.5.1995, at which, after extensive discussions on all relevant matters, it formed a smaller Task Group to prepare an approach paper on the Action Plans that are needed to be taken up. This Task Group, composition of which is given in Annexure-II, met on 11 July, 1995. The draft approach paper prepared by the Task Group were further deliberated upon by the Standing Committee on 16-5-96 and 27-5-96. This Approach Paper brings out collective thinking on the various issues, as discussed and finalised during the deliberations of the Standing Committee, and elaborates on the rationale behind the proposed recommendations of the Committee.

2. STAKE-HOLDERS IN INDUSTRY-INSTITUTE INTERACTIONS

It has been said that the next international confrontation will not be fought in the battlefields of war but in the arena of **Science and Technology**: in the laboratories, in university classrooms and in industrial factories. Even though S&T has a global character, from the national perspective there are a number of constituent partners who must interact, cooperate and collaborate in this battle for supremacy. These are the industry, the Academic Institutions, the R&D organisations, national academies, industry associations, professional bodies and last but not the least, the scientists and the faculty community in the labs and colleges.

It is, however, to be emphasised that the partnership and collaboration being discussed here are to complement, and at times supplement, the main functions of each of the constituents, and never to replace, or dilute the importance of, these main functions. For example, the **primary responsibility of educational institutions is to educate the students through teaching and research**; the research institutions are to devote on studies and applied research in new frontiers in technology; priorities in industry is to work for higher returns on investment by its shareholders. The cooperation between the stake-holders will be fruitful only when it leads to mutual benefits and adds value to the primary functions.

2.1 Industry Priorities

The objective of any business enterprise is to earn profits to the eventual gain of the company shareholders. An enlightened enterprise is also likely to provide increasing benefits to its own employees and to society in

general. The focus and timescale in industry, however, tends to be sharp and short and the trend is, to be sharper and shorter. Such a trend is valid not only in India, but in other countries also. Any institution, an academic institute or an R&D lab, seeking partnership with industry must recognise this. For industry, on the other hand, close interaction with research labs and academic interactions would provide an invaluable opportunity to access the expertise and knowledge residing there in addressing various problems - be it in the nature of R&D, short term consultancy or manpower training through continuing education, refresher courses and technology update.

From the perspective of long term growth, however, it is the emphasis on research and its eventual commercialisation that have been the vehicle for technological and economic progress of nations. Governmental budgetary allocation has been the main funding source for research on basic and applied sciences in India - through its grants to research establishments under various departments and academic institutions. But increasingly, in organised R&D for commercial purposes, the user industries are being asked to take over. In a separate chapter that follows, we shall deal with R&D funding in India, but at this stage it would be worthwhile to reiterate that the share of industry towards organised research in our country has been much less than the norm in most other countries, especially that in newly industrialising countries (NICs) in East Asian region. Development of any nation depends crucially on the extent to which its scientists and technologists can keep ahead of the rest of the world, through scientific discoveries, inventions and innovations, by changes in the use of materials and processes, reducing cost, improving quality and adapting to the unprecedented technological breakthroughs elsewhere. In a protected economic environment, industry in India did not particularly feel the necessity to keep one jump ahead. But that situation has drastically changed. Long term commitment on R&D is now being recognised as essential by almost all industry sectors. The existing infrastructure for research in the Governmental laboratories and academic institutes can come in handy for industry, especially for small and medium sector enterprises who can make use of such infrastructure for their own R&D. Even for larger industries, who may have in-house R&D facilities, long term scientific research can best be sponsored to these institutions on collaborative and cooperative platforms. What is required is a change in the mindset on both sides. The scientific community must accept the industry ethos of timeliness, focus and cost consciousness, and the industry leaders must respect the inherent thirst for knowledge generation and challenge that drives the scientists and academic talents.

2.2 Academic Institutes

2.2.1. Source of Manpower for Industry

As far as academic institutes of engineering and technology are concerned, industry has another enormous stake. It is estimated that more than 50,000 engineering graduates come out of the Institutes and colleges every year in this country. A vast majority (80% or more) of them eventually get employed in the industry both in private sector and public sector. Relatively a small number go for entrepreneurship; some find employment in Government organisations, and a few go in for higher education with the objective of taking up career in academia. Thus, the needs of the industry must constitute a most important factor in the design of the curricula, and pre-graduation (institutional) training programme of students. The National Policy on Education adopted by the Parliament in 1986 and the draft Technology Policy statement of 1993 have both emphasised the need for interactions between the industry and the academia in curricula design exercise in both technical and management programmes, to project the needs of the industry or the user system. It has been suggested that such interactions should not be restricted to curriculum design only, but should encompass programme planning and implementation; exchange of expert personnel; facilities and resources; research and consultancy and other areas of mutual interest. Such interactions will make graduates more readily useful to industry, thereby reducing the length of training programme in the industry.

There has been proposals to make training in industry mandatory for all engineering students before the degree is awarded, just as it is compulsory for medical graduates to undergo internship in a hospital. There is, however, doubt whether at the present time enough places can be found in industries and other professional sectors to accommodate all the undergraduates for short-term practical training. A start can be made in selected institutes, and with industrial growth expected to boom, hopefully in the not too distant future all engineering colleges can be covered. To implement such a scheme however, involvement, whole-hearted support and interest is essential on the part of Industry - in order to provide effective training to students and to get effective returns from student projects. It would be worthwhile for the industry to commit adequate resources for this activity; the students be paid 'stipends' for training and cost of the projects be borne. Industry would then, in their own interest, extract maximum out of the students under training or engaged in projects, which in turn will improve the quality of the students.

2.2.2 Benefits of Interaction

From the points of view of academic institutes, such interactions with industry can not but be welcome. Firstly, it would improve the

contemporary relevance of technical education imparted to students. In the post-liberalisation scenario, many industry units have acquired state-of-the-art technology, in hardware and software, imported from abroad. Close interactive relationship with such units would help faculty to have access to them, information on which would otherwise be considered too confidential to get disseminated. Secondly, apart from a few premier institutions like IITs, basic infrastructural facilities such as laboratories or workshops are generally poor in our colleges and there is need for enormous infusion of capital to rectify the situation. Success in fruitful interaction with industry would brighten the prospect of substantive industry funding for renovation and setting up of new facilities. Apart from major research facilities, at a more basic level one such facility that can be set up in institutions regionally is Industrial Testing Facility. In fact, many R&D projects had their origins in testing. Thirdly, practical training for students in industry needs to go beyond observation of operations to tackling real life shop-floor problems. Indeed, the industry generally have reservations about the utility of some of the existing industry exposure programmes, e.g. summer training and industry tours. Instead many are willing to refer live problems not only for Masters' and Doctoral level work, but also for short B.Tech. projects. There has to be, of course, sufficient interaction between the faculty and industry professionals to be able to identify such problems jointly, and get them assigned and paid for as industrial consultancy or sponsored projects. Fourthly, contributions made to the industrial R&D and technology development will strengthen the inherent developmental capabilities in our institutions, and industry's dependence on foreign technology suppliers will diminish considerably. Such interactions will also enhance the technology forecasting capability in a collaborative environment amongst the scientists, academicians and the industry professionals.

2.2.3 Less Privileged Academic Institutes

Among the academic institutions, however it would be prudent to differentiate between some fifteen to twenty premier institutes (such as the IITs, the IIMs, BHU, IISc., and a few RECs) and the provincial, state or private colleges. Even in a generally resource scarce environment, the premier academic institutions tend to be somewhat better endowed with public funds, attract the better students at the entry level, have more talented faculty and naturally corner almost all major sponsored projects offered by Government Departments or industry. As a consequence, the other technical colleges and universities are left much worse off, even though these constitute more than 90% of the institutional resource of the country. Not many students graduating

from the IITs and IIMs tend to take up career with industry, at least at the initial stages; majority prefer to take to higher education, go abroad or opt for administrative and management career. Thus the bulk of the technical manpower for our industry are provided by the so called 'other' institutions, and yet almost all of them perennially suffer from inadequate infrastructure (such as laboratories, libraries and even classroom), shortage of qualified teachers etc. For these colleges and universities, there has to be special effort and emphasis for interaction with industry, and focused regional/state level linkage mechanisms will have to be set up.

2.3 R&D Organisations and Research Institutions

As has already been mentioned, the number of research establishments in this country and the range of research areas covered are very impressive. These organisations represent the inherent technological strength and capabilities of the nation, in basic and applied research as well as in technological services to the industry at large and society in general.

The Department of Scientific and Industrial Research (DSIR) is the nodal department of the Government which oversees the Industrial Research activities in the country. The Council of Scientific and Industrial Research (CSIR) is the premier national S&T agency in the country under the administrative umbrella of DSIR, and have 40 national laboratories. In addition, DSIR also comprise of two Public Sector Undertakings, namely National Research Development Corporation (NRDC) and the Central Electronics Limited (CEL), apart from the National Information System for Science & Technology (NISSAT).

DSIR is also the Government agency that grants recognition to In-house R&D Centres; there are 1238 such recognised centres in Industry as on 31.12.1994. It also accords recognition to specific organisations like scientific associations, institutions, universities and colleges, which undertake research in areas of S&T including medicine and agriculture, as Scientific and Industrial Research Organisations (SIRO), making them eligible to avail fiscal incentives.

DSIR's emphasis in promoting technology development and technology transfer is demonstrated by the two fairly successful programmes it operates, namely the PATSER (Programme Aimed at Technological Self Reliance) and the SEETOT (Scheme to enhance the efficacy of transfer of technology). It also supports the Consultancy Development Centre (CDC), which promotes industrial consultancy as a profession.

Apart from closely interfacing with the industry, the Research

Institutions can and must increase their interaction, both qualitatively and in absolute terms, with the educational institutions. R&D organisations can offer their laboratory facilities to the faculty and senior students in the academic institutes; joint research projects may be undertaken where the expertise and facilities of both can complement each other; scientists from the laboratory can supplement the teaching faculty in the colleges, either full-time or part-time, and vice-versa; new courses can be developed in the academic institute on emerging areas of technology in which expertise resides in an R&D Institution. In some cases, the R&D Organisation may offer educational programmes on their own or in collaboration with an educational institution, and even be declared a Deemed University for awarding degrees and diplomas. Such examples are already there in this country; for example, the Shree Chitra Tirunal Institute of Medical Sciences and Technology, a public sector SIRO, has been given recognition as a Deemed University.

2.4 Manpower for R&D and Teaching

It would be worthwhile, at this stage, to bring in one other important concern into focus, that of right manpower for industrial R&D for the Research Laboratories and Faculty for academic institutes. In the last decade or so, there has been a perceptible decline in the number of people entering these professions. Almost every department in almost all the IITs has a large number of vacancies in the faculty positions. Almost all the CSIR labs suffer from adverse age-mix in their scientist community - fewer younger professionals have joined in recent years. Even the in-house industrial research organisations tend to be manned more by people from the ranks, rather than fresh young minds. This situation is the outcome of the failure of the Society in general, the Government in particular, and the Industry in specifics, to encourage pursuit of R&D and knowledge as a remunerative and challenging career prospect. In a free market syndrome, the brightest and the most resourceful graduating students are lured away in production, sales and management jobs in industry, where remunerations are often several times more than what academic bodies and research organisations can offer. A strategy has to be chalked out to bridge this gap and subside this flow of talent only towards 'consumerist' culture. The linkage among the industry, market, customer and academia, and feedback and feed forward research has to be so designed as to make pursuit of R&D and teaching more challenging, satisfying and remunerative so as to attract younger scientists and engineers in the country, as well as the hundreds of Indian expatriate scientists and engineers who are all too eager to return.

2.5 National Academies

The National Academies represent leading men and women of science and technology in the country, and can provide the collective wisdom of their

members in advising the Government and giving guidance to the professionals, scientists and academicians to follow correct path in problem-solving. There are four National Academies in India in science and engineering, namely, the Indian National Science Academy, Indian Academy of Sciences, National Academy of Sciences, and Indian National Academy of Engineering. Promotion of original research, disseminating scientific knowledge to the community and nurturing of scientific temper in professional activities are the three primary objectives of the Academies. Their involvement is essential in formulating education policies, designing of curriculum, and technology forecasting and planning. In this connection, mention may be made of a new programme launched by the INSA in 1996, called the Programme on Tradition, Values, Excellence in Science and Technology and Service to Society. One of the objectives of the programme is to evolve new interactions between leaders of Industry and Financial Institutions, and scientists and technologists to increase awareness and mutual comprehension, and to formulate as well as organise specific co-operation and joint actions. The National Academies, with their professional clouts, should be able to exert peer pressure on all the constituents to implement result oriented interaction schemes.

2.6 Industry Association and Professional Institutes

Finally, one other group of organized institutions that can promote partnership between industry, research and academia are the Industry Associations and Professional Institutes. In India we have a number of Chambers of Commerce and Industry, such as the CII, FICCI and ASSOCHAM, who can and do provide the platform for the industry members to meet the professionals from Institutions, individually and collectively, to brain-storm and chalk out joint or collaborative programmes. In many a high technology multi-disciplinary scientific subject, consortium approach through active participation of a number of industry partners, research organisations and academic institutions could be the optimum, and in such programmes the Industry Associations, National Academies and Professional Institutes can play vital part.

Industry Associations and Professional Institutes can do Yeomen's service to the cause of industry-institute cooperation by percolating information from industry to the Institutes regarding the changing occupational patterns, changing skill profiles and changing technology requirements - with a view to helping the institutes to continuously update their priorities, in course curriculums, student projects, training and research programmes. For a start, industry surveys can be conducted to analyse the changing quality and quantum of human resource required by the industry from the academic institutes.

Accreditation of educational programmes and courses in Institutions is

one area where involvement of Professional Institutes may be enhanced. For example, in USA, the Accreditation Board for Engineering & Technology (ABET), formerly known as Engineering Council for Professional Development (ECPD), consists of members who are undisputed leaders in their own professions and represent one or other Professional Bodies. The Professional Institutes can also join hands with the Educational Institutions in custom-designing courses for continuing education and retraining programmes for industry personnel.

Further, Industry Associations can help in promoting the cause by organising a series of workshops in various parts of the country on the subject where examples of successful collaborations can be publicised and all issues on the matter deliberated upon.

Figure 1 depicts pictorially the interaction potentials of the stakeholders.

3. BARRIERS TO OVERCOME

The stake-holders for effective industry-institutions interactions having been identified, the question arises then, quite justifiably, why such a concept is yet to take root in this country and what are the barriers that inhibit gainful interactions. There have been a number of knowledgeable treatise published on this question. The Report of the IIT Review Committee (1986) is one such authoritative document which has spelt out some of the major factors, most of which has to do with the mindset of the concerned people and their psychological hang-ups. The recent UNESCO Study Report (1996) and the earlier AICTE Report (1994) on Mobilisation of Additional Resources for Technical Education may also be referred to in this connection.

All the difficulties encountered in the interaction process can be attributed ultimately to three fundamental factors, namely, a) the mutual distrust and concern for commercial confidentiality, b) lack of adequate incentives on both sides and c) procedural constraints. These are, of course, apart from the general absence of felt need by the industry for R&D and indigenous technology development in a protected market environment that existed till recently.

3.1 Lack of Mutual Trust

Firstly, because of absence of any serious collaboration with the laboratories and academia in regard to substantial technology development in the past, the industry have little faith on the scientists and faculty about their capability to work on practical problems, and there are not many success stories on target oriented research in this country, except in the strategic high tech areas of space, atomic energy and defence, and some in the CSIR Labs. Capability of the scientists and academia in successfully accomplishing such kind of tasks, especially in hi-tech areas of R&D, has been demonstrated

in our country, whenever opportunities presented themselves and demands were made on the system. For instance, more than 100 educational and research institutions have collaborated with ISRO and delivered time bound results. On the other hand, industry in this country are perceived to have little interest in serious indigenous research and development and are also seen to be keen only on import of technology and that too of fairly antiquated variety. These perceptions have culminated in an atmosphere of mutual distrust and hesitation.

3.2 Confidentiality and IPR Issues

As a corollary to this, there are also some apprehensions in industry that involving research organisations or academic institutes in their work exposes them to the risk of leakage of confidential information, about their present status and any future technology acquisition or development, to their competitors and will lead to commercial loss. Such fears are, of course, mostly ill founded, and few evidences can be quoted. On the contrary, in a country of two hundred universities and three hundred research organisations, the number of patents granted for new inventions or innovations are relatively very low compared with even our neighbours in the South East Asia. The holding of patents and ownership of technology is the best guarantee against technological piracy. Culture of patenting can be most fruitful, however, only in an environment of effective R&D cooperation between industry and institutions of research and higher learning. As on today, only a small part of technology developed indigenously is protected by Intellectual Property Rights (IPR), but with a build up of mutual trust between the industry professionals and S&T protagonists in Institutions, one may expect a much greater emphasis on intellectual property protection.

3.3 Autonomy in Academic and Scientific Profession

Secondly, for most scientists and professors, the concept of freedom of choice with what they will do in their spare time (after completing the obligatory teaching and research assignments, of course) is considered to be very precious, and few will agree to part with this autonomy. For those who are research oriented, publishable theoretical research is often a preferred option which earns them peer recognition in national and international arena and also helps in quick promotion. Others, who are not particularly adept in original research, and they are the majority, would rather take up other pursuits that may be a source of additional income like examinership, book writing or even routine testing/vetting activities. Interaction with industry has so far not been either a money earning proposition or a route to promotion. It is absolutely necessary to change this state of affairs. Proven success in industrial interaction should be a visibly profitable feather in the cap of the scientists and professors, and steps must be taken

to make it attractive enough for them to actively seek out and participate in such interactive programmes.

Faculty members in many academic institutions, especially those at the state level, do not have an appreciation of the fact that interaction with industry through sponsored R&D, consultancy, short term refresher courses etc., also forms part of their duties and responsibilities. This is a serious barrier, as over 85% of all educational institutions in this country fall in this category. Lack of adequate motivation, lack of compulsion, insufficient incentives and sometimes even actual or perceived disincentives, are real problems in these institutions, thus inhibiting better interaction with industry.

There is every reason to believe also that once the cooperative interaction with institutions becomes a regular and on going practice, the industry will experience return on investment on a grand scale many times over. However, at the initial periods, these returns will be slow to come by and a number of R&D programmes may not yield expected results. It has been the experience in other countries, even in the West, that at such a stage of evolution of industrial development, incentives (in the form of tax relief and customs duty rebates) to industry do help encourage and sustain relationship with institutions. Such incentives are already in place in this country also, but they need to be enhanced, cover a wider area of activities and become more transparent and easier to avail.

3.4 Rules and Procedures

Thirdly, academic institutes, universities and research institutions under Government management have a number of statutory restrictions in view of their overall status as non-profit making organisations, and thereby, their operations are governed by a number of rules, regulations and procedural guidelines. Many of these rules and regulations can stand in the way of the working ethos necessary to be adopted while interacting with industry in a 'commercial' and 'achieving' environment, and result in unacceptable delays as well as problems in execution and outcome in collaborative programmes. The stranglehold of bureaucratic controls is understood to be more pervasive in state level organisations, compared to the premier institutions under central government ministries and departments where they enjoy a fair amount of autonomy. The Institutions must be provided with adequate operational freedom for efficient functioning.

4. RESOURCE MOBILISATION FOR INDUSTRIAL R&D AND TECHNICAL EDUCATION

4.1 R&D Funding in India

It has already been mentioned earlier that organised R&D happens to be a cornerstone policy for all industrialised countries, specially after the oilshock of 1970s and, this has given particularly spectacular results in the 1980s in the newly industrialised countries (NIC) of South East Asia and Latin America. In contrast, even though the Indian polity has from the beginning recognised the need for setting up a strong industrial R&D base in the country, in reality the resources spent on this head have been limited. Total R&D funding has grown from around Rs.700 crores in 1980-81 to Rs.5142 crores (US\$ 1.7 billions) in 1992-93. This may look impressive at first glance, but it still represented only 0.83% of GNP in 1992-93 compared to the world average of around 2.5%. More significantly, the industry's share in R&D expenses in 1992-93 has been only 26.4% (i.e. Rs.1357.48 crores or \$ 452 millions), the rest being spent by Government (Central & State), more than 57% of its share being spent in three strategically important sectors alone (i.e. Defence, Space and Atomic Energy) and another 13% in Agricultural Sciences. Government sponsored expenses in industrial and scientific R&D sector thus was only Rs.1050 crores (\$ 350 millions).

Incidentally, the private sector industry accounted for more than 56% of industry R&D funding (about Rs.760 crores in 1992-93). This, however, represented only 0.64% of their sales turnover. The average expenditure on advertising, publicity and entertainment by industry in the same year has been 0.7% of the sales turnover. Of the Rs.760 crores of R&D expenses, however, more than Rs.650 crores are consumed in the in-house R&D in these industries, and another Rs.110 crores in private R&D units (SIROs). The picture is similar in Public Sector industry also.

Channelisation of R&D funds from industry (for that matter, from Government also) to academic institutes, however, is negligible. It is estimated that sponsored R&D in universities, institutes and colleges together in the whole country would hardly cross Rs.100 crores, of which majority comes from Government Departments (such as Defence, Space, Atomic Energy and S&T), some from PSUs and almost nothing from the Private Sector. Most of the CSIR labs also depend totally on the funding from government budget, though in last few years there has been thrust on resource generation from alternate sources to the extent of 33.33% or more (as recommended by the Abid Hussain Committee). There have also been a few labs like NCL in Poona and NAL in Bangalore who have been very successful in collaborative work with industry, but these remain exceptions rather than rule.

4.2 R&D Funding in other countries

We may compare the national R&D efforts in our country with that in

other parts of the world. The R&D funding in the world today is estimated to

* Source : R&D Statistics, 1992-93, DST

be around \$ 450 billion.²⁶ The amount spent in USA, Japan and South Korea are around \$ 150 billion, \$ 80 billion and \$ 4 billion respectively. What is, however, more striking is that industry share in all these countries is inevitably larger than that of the Government. For example, around three quarters of Japan's R&D spending in 1985 were contributed by industry. In South Korea, domestic private industry contributed more than 80% of the national expenditure on R&D in 1987-88.³

This last statistics is all the more relevant from India's point of view, because in all our post-liberalisation debates, comparisons are made with the success of East Asian, especially the Korean, economy and its industrial resurgence in recent years. In 1970-71, the Indian expenditure on R&D³ as a percentage of GNP was 0.35%, and that in South Korea was even less, 0.34%. But soon thereafter, South Korea opened up its economy, and allowed technology imports in almost all sectors of industry. The industry was, however, obliged to provide clear programmes for absorption and adaptation of technology imported from abroad and was, therefore, obliged to set up their own R&D units or collaborate with publicly sponsored R&D organisations for chalking out a technology absorption path. South Korea also did not permit foreign controlled firms to operate without a clearly spelt out indigenisation programme for adaptation of imported technology. The free market economic policy in South Korea had an over-riding regulatory angle in the domain of S&T, and this regulation was performed by the Korea Institute of Science and Technology (KIST), an institute equivalent to our CSIR, and its successor Korea Advanced Institute of Science and Technology (KAIST). Success of this policy is clearly visible today, with South Korean Industry now competing on equal terms with industries of advanced nations, including Japan. Japan's economic miracle was possible, on the other hand, by close cooperation between the industry, institutions of research and learning, and the Government. The regulatory role in Japan's case was played by MITI which managed scientific resources and programmes with a national perspective.

Participation of universities in industrial development in USA, Europe, Japan and South Korea has also been significant. Forty (40) percent of all governmental R&D funds in Japan is spent in academic institutions. In USA, this is around 25%. In U.K., an average of 40% of total recurrent income of universities come from non-governmental sources including the domestic industry, in the form of sponsored R&D, educational programmes, short courses and endowments.¹⁰

Note : Superscripts refer to reference reading list, p.33

4.3 Involvement of Industry in R&D in India

As has been already argued, the R&D activities in India, be it in the academic institutes or in the research laboratories, have been almost fully supported by Government Funds. Considering our resource constraints, the sums spent so far has also been fairly colossal. Yet we have little to show in terms of civilian innovations of our own. We have been importing and reimporting technology for almost everything, from tooth brush to tractors, from bicycles to passenger cars and buses. In the controlled, and more or less closed economy that we had during the last forty years or so, the industry in this country had enjoyed a seller's market in a monopolistic, or at the best oligopolistic, environment. There is little doubt that one main reason for the failure of R&D in this country has been the lack of involvement of industry, who, had they invested in R&D, would have ensured that they got value for its money. There would have been great technical changes, in generating technological innovations, and putting new products and continuously improving new processes to compete in the market place.

4.4 Resource Limitation in Technical Education

Resource constraints have also been the bane of technical education in this country. It has been estimated that it costs the exchequer an average of Rs.40,000/- a year in subsidy for each student in engineering degree courses. We enrol more than 90,000 engineering students every year in 380 institutions recognised by AICTE, whereas 35% of the vast Indian population remain illiterate without hope of even primary education. Recently the Government of India has indicated that in the Ninth Five Year Plan period 6% of GNP will be spent on education as against the present level of around 3.7%. There is little doubt, however, that the increase in allocation of funds will mainly go for primary, secondary and vocational education. Cost of higher education, and specially higher technical education, will have to be increasingly borne by the beneficiary of such education and the users, namely industry and the employers. It should not, however, be forgotten that technical education has a multiplying effect on the national economy, and as such it will be in national interest to support this sector substantially.

4.5 Resource Mobilisation Opportunities

How does one motivate industry to commit resources for R&D and technical

education, from which there can hardly be any tangible return in the short term, and for which, so far, somebody else (in this case the Government) has footed the bill? Fiscal Incentives such as tax exemptions for expenses incurred in R&D and education are unlikely per se to prove a strong enough motive force to get industry aroused. According to a recent study by the CMIE, majority of the Corporate Companies in this country pay little or no tax, by virtue of a number of tax exemption/concession regimes already existing, such as on depreciation, export earnings, backward area location etc. In fact, the average tax pay out by industry as percentage of their turnover has been hovering around only 2% for the last few years, and the average tax incidence has actually dropped from 24% of the PBT to 15% between 1991-92 and 1994-95, even though the PBT increased by 55% (avg.) during the same period*. It is, therefore, quite obvious that the industry is not easily enticed to spend more on R&D and technical education merely by one more tax exemption/concession opportunity.

In this context, one may build on the suggestions made by the former Member-secretary, Planning Commission, Dr. Arjun K. Sengupta, while delivering the valedictory address in the 1994 Annual Conference of DSIR on "In-house R&D in Industry".¹² One of his propositions was to make it obligatory on the part of all manufacturing and service companies (including banks and financial institutions) to earmark a certain small percentage (say 2 or 3%) of the business turnover towards R&D and technical education. It may sound somewhat harsh, and contrary to the free enterprise paradigm, but it has been the experience in most newly industrialising countries that in the initial stages a small amount of coercion can be helpful in nudging the two partners, industry and the research/academic community, towards the ethos of mutual interaction and national development. (For example, in Malayasia a cess of 1.5% on turnover is levied on industry for National Skill Development Programme).

This obligation on the part of industry to commit a minimum amount of resources for R&D and technical education is however not to be treated as a cess, per se. On the contrary, the industry should be free to, and indeed encouraged to spend on their own industry R&D, in their own in-house laboratories or contracted/sponsored to other recognised R&D institutions or universities/colleges. They should support educational institutions and universities through endowments and academic chairs, grant of scholarships and fellowships to students and faculty, and interact by way of industrial consultancies and student projects, student trainings, continuing education programmes and so forth. There can not be any upper limit on the amount spent on this account, for which the company should be entitled to claim all available tax and other fiscal benefits. In case, however, the total amount spent by an industry firm in one full year in such activities falls short of a 'stipulated' percentage of its total business turnover, the remaining

portion should go to the national R&D and Technical Education efforts. The money thus collected can be used to build up a National R&D Fund, and one may suggest that a matching grant may be added to this Fund by the Government

* Source: CMIE

every year, from its budgetary allocations in education and industrial development.

The enlarged R&D Fund thus created can form the national resource to support long term fundamental or industrial research as well as to help, sustain and promote excellence in technical education, by way of assisting academic and research institutions in renovation of infrastructure, development of new courses, initiation of new research programmes, introduction of schemes for student grants/ scholarships/loans, setting up of pilot/demonstration plants on newly developed laboratory proven technology, etc. The administration of the National R&D Fund (NRDF) may be entrusted to an autonomous regulatory non-governmental organisation having representatives mainly from industry, financial institutions and academia, and some from the government, in its Governing Body, somewhat like the KAIST in Korea. Its operation will have to be transparent so that the resources are used to address the areas of Research and education most relevant to the overall interest of the country, after proper analysis, in consultation with and in collaboration amongst all sections of the industry and intellectual community. It may also be entrusted to audit, monitor and review progress on R&D and TE activities made by the individual industries. The role of the Government bureaucracy in this organisation should be of facilitation only, rather than control. The NRDF organisation would obviously have to be a high powered body, since, nationally it may have to handle thousands of crores of rupees collected annually.

On a rough estimate, if a scheme as above is implemented, it would be possible to mobilise between Rs.3000 and Rs.4000 crores (\$ 1 and 1.3 billion) every year. Initially, small enterprises can be excluded and loss making companies may be exempted. One suggestion is to start the scheme with only those profitable enterprises that declare dividends to their shareholders, and later encompass all others in a gradual manner. It is understood that a few sectors of industry (cement and automobile, for example) already contribute a cess to sectoral common pools for their R&D needs. Naturally once the NRDF is constituted, the proceeds of these cess will also go into the same fund.

In the beginning, industry may consider it an additional burden imposed by the Establishment, but in a few years time, as the benefits of R&D begin to show and the relationships with scientists and professors blossom, our R&D

sector will stand on its own feet. The Indian industry will soon find it easier to face the competitive environment, in increasing the productivity and efficiency, and increasing their returns on investment. As has been the experience elsewhere, the fiscal incentives that may be provided by the Government will no longer provide the only motivation, but industry on its own will meet more of the expenditures required for the growth of R&D in the country.

It may be mentioned here that an R&D cess is already being imposed (@5%) on the value of technology component of any import by industry. The amount collected is planned to be used to raise a Technology Development Fund, to be administered by the Department of Science & Technology (DST) on the advice of a Technology Development Board constituted of five Secretaries of the Government of India. The National R&D Fund (NRDF) proposed in this Approach Paper and the Technology Development Fund (TDF) as above may however be treated as two different baskets. While the NRDF operations may be managed primarily at the behest of industry, the TDF may be operated by the Central Government for national R&D efforts, such as in space, Atomic Energy, Defence, disease eradication, agriculture, infrastructure, generic and critical high technology areas.

The AICTE High Power Committee on Mobilisation of Additional Resources for Technical Education, in its report dated February, 1994, also made a number of worthwhile suggestions in this regard. These include a proposal for rationalisation of fees structure for students perusing technical education, and another for setting up of an Educational Development Bank of India (EDBI) that will have National Loan Scholarship Schemes for providing soft loans to needy students.

4.6 Obligations of the Research Organisations and Universities

The Research Institutions will also need to gear up, and each has to draw up concrete action plans to woo the industry by way of contract research and other interactions. The 1986 Abid Hussain Committee report of CSIR earmarked a target of one third of the budgeted expenses on CSIR labs to be resourced from sources other than DSIR. A clear policy enunciation is necessary regarding progressive reduction of Government budgetary support to the laboratories and institutions through time-bound targets for internal generation of their own resources. The Government or DSIR may, however promise to provide a matching grant to the labs, equal to the net amount generated by industry interaction. Effectively, it would mean a larger assistance, since industry will also be eligible for weighted tax benefits. Similarly, academic institutes must also gear up to sell its services to the industry and direct its R&D and other strengths largely to what industry wants

to do. Taking up industry sponsored R&D projects, consultancy and other forms of interaction with industry must be clearly included in the scope of duties and responsibilities of scientists and academic faculty. Thus the obligation, and the coercion, will be on both the industry and the institutions to develop the national network on R&D and technical education.

5. INCENTIVES FOR INTERACTION

5.1 For Industry

A number of tax incentives has already been introduced to the industry for encouraging research and educational activities. For example, 100% tax relief is allowed on bonafide R&D expenses, donations and endowments to educational institutions and Scientific and Industrial Research Organisations (SIRO); sponsored research expenses in some of the premier institutes like IITs and national R&D laboratories are eligible for weighted tax exemption to the extent of 125%. In some countries, like Australia, the incentives for interaction with universities are much higher, upto 175%. Therefore, the Government may be urged to increase the incentives given to a higher level, say 150%, to encourage industry to spend more on this account.

It is, however, essential that significant changes are made to the scope and operational aspects of the scheme. Firstly, the scope may be enhanced to include all activities concerning indigenous R&D (in-house or institutional), higher education and skill development and various types of interactions including continuing education and training programmes, and industrial consultancy activities. Secondly, all AICTE recognised academic institutions (authorised to award degrees and diplomas) and SIROs should be included for industry to interact in order to avail the weighted tax concessions. Thirdly, the procedures to avail the concessions must be made simple and transparent. At present, application forms for tax benefits on this scope are required to be submitted by industry in 12 copies. They have to be authenticated by the DSIR, rechecked by a number of agencies in various government departments and finally sent to the Income Tax authorities for the final decision on eligibility; and the time frame can be anything from 12 to 18 months. This cumbersome procedure is perhaps one reason for very few industries availing the benefit. This must be made simpler and more transparent. Fourthly, the tax incentives need not be uniform across the board, but can be graded according to the status of the enterprises, amount of total money spent, area of technology, and so forth.

R&D activities in industry may further be encouraged by offering a concession on tax liability (e.g. tax holiday for a year) on all savings or

additional incomes that can be clearly attributed to results of indigenous R&D, in-house or in an institution, such as new product development, process improvement, conservation of energy, better environmental management, safety engineering etc.

5.2 For Institutions

At the present time in most grant-in-aid institutions, revenue generated through extra-mural activities are off-set against expenditure, and the grant is correspondingly reduced. This acts as a great disincentive for institutions to go out and solicit funds for research, consultancies and so forth from industry. In IITs and some of the premier institutions, this practice is no longer followed. For other institutions also, the Government must allow retention and subsequent utilisation of all income generated through industry-institution interaction, without any corresponding decrease in Government grant. Indeed, the Government should chip in with additional matching grant to encourage such activities.

5.3 For Scientists and Academicians

For the scientists of the laboratories and the academic faculty, **fiscal incentives** may be designed as **tax concessions** (say at 50%) on all income arising out of collaborative R&D and technological consultancy with industry, government departments and other external organisations, international or national. Presently, an academic faculty in most universities and institutes is not permitted to earn in a year more than his current annual salary through extra-mural activities, e.g. industrial consultancy, honorarium and so forth. This **limit in income could, perhaps, be dispensed with** to encourage faculty to work more with industry and also to seek contemporary market charges for such assignments. There is little justifications to clamp such limits, provided, of course, the faculty fulfils his **primary obligations to the college/department/university as far as teaching and research commitments** are concerned. It is understood that in the CSIR, such limitations on additional income earned through industrial consultancy have been withdrawn, subject to certain obligations to the lab in which a scientist is employed (e.g., 50% institutional share, a maximum of 50 days of engagement in a year, etc.).

Apart from the financial incentives as suggested above, the faculty and the scientists need to be induced to interact with industry by the assurance of adequate weightage during their performance appraisal for such activities. For example, bringing in a sponsored/consultancy project worth, say Rs. 1 million, may be given the same weightage as publication of a review article in a reputed professional journal.

Enterprising scientists and faculty may also be encouraged to

commercialise the R&D outputs by starting own industry or joining hands with one existing, by relaxing some of the restrictive/regulative laws and statutory rules. Regulations on **Venture Capital Financing** involving new technology development or commercialisation may also need further liberalising. Of course before permitting such ventures, the **ethical aspects** and possible **conflicts of interests** have to be examined carefully by the respective institutions.

6. MODES OF INTERACTION AND MODELS

6.1 Building up of Trust

Obviously, to achieve a thriving, successful and ongoing interaction between the industry and institutions of research and learning, a wide range of complex, attitudinal and interface issues are to be addressed. A prerequisite is to demolish the prevalent environment of isolation and mistrust. The **intellectual exchange** between the two categories of professionals has to be much more, several order higher than what is happening today. **Scientists and professors have to spend considerable amount of time in the industry** - in their factory, in their laboratories, in their marketing set up, in their seminar halls, in their board rooms. These contacts may be of short durations or for longer contractual periods, on deputation or on sabbatical leave, full time or part time, as executive officers or Directors of Board, in the capacity of trainees or as expert technologists. Similarly, **executives from industry should be encouraged to establish, renew and maintain their link with universities and laboratories**, as students (for higher qualification) or as teachers. Bright and younger executives with good potential for growth within the company can be encouraged to improve their educational base, register for post graduate or Ph.D. degrees and remain up-to-date with current research programmes in the institutes. For this, liberal incentives in the form of paid leave of absence from industry could be given. On the other hand, experienced industry personnel may be regularly invited to address students, and academic and scientific staff in an organised manner, or be appointed as **'adjunct' professors and visiting faculty**. In some European countries, young and upcoming expert professionals from industry are often appointed as **"one-day" or "two-day" faculty** in the university, where they spend one or two full days a week in the university teaching and researching. Such schemes can be specially enticing to expatriate Indian scholars, for whom such a scheme would ensure twin satisfaction of industry work and research/teaching as well as the additional remuneration.

In this context, the value of organising **short term programmes** by the institutions for the industry personnel, in the form of continuing education courses, technology update and appreciation seminars and conferences, skill

development and training schemes etc. must be re-emphasised. These provide ideal platforms for industry professionals, scientists and academia to meet and get to know each other, develop kinship and mutual respect and pave the way for meaningful collaboration.

Development of close intellectual bond between the industry and the academia/scientist must be promoted and established on a firm base. To achieve this, little capital investment is called for; what is needed is a sincere approach and firm commitment on the part of the management of the constituent parties. This aspect is being harped on again and again, because without this all other plans of actions can not succeed; and it can be accomplished fairly rapidly without bringing in any significant modifications in the existing sets of rules, regulations and laws governing the operations of the institutions and industry in this country.

6.2 Student level interface with Industry

Let us now enumerate briefly some of the modes of interactions that proved to be successful in various parts of the world. Some of these can be tried, with some modifications, in the Indian context, on experimental basis, in selected organisations. First, we mention the student level interface mechanisms which have been immensely successful, especially in the Western countries.

- i) **Sandwich Courses** in undergraduate engineering levels are quite common in many universities in Britain, Australia and Europe. Here, students spend alternate semesters in the colleges (attending courses) and in the industry (as trainee/technical staff). The mandatory technical project relates to a problem or issue pertaining to the collaborating industry. Normally, the student is sponsored by the industry concerned, and after graduation, is absorbed therein.⁵
- ii) **Teaching Company Schemes**¹³ are quite popular now in Britain. In this scheme, graduate engineers employed in an industry work on a project, either at the industry or at the university or partially with both, jointly supervised by the academic faculty and the company Executives. These are often post-graduate programmes, leading to a PG qualification. The costs of the schemes are shared by the industry and the Government.
- iii) In Germany, a very successful industry-institution interaction scheme exists on a pattern of Dual System of Vocational Education, in which a student simultaneously receives Theoretical education in university colleges and practical on-the-job

training at work places in the industry in equal measures. The scheme, which is called "Berufsakademien", covers areas of engineering, business administration and social sciences, and leads to Bachelor's degrees, known as "Diploma".¹¹

Such schemes, as above cement ties between education and professional work and make available to the industry highly motivated and skilled workforce, a major competitive advantage. In India, several engineering colleges have already been operating one or two schemes of similar nature, for example, the Practice School in BITS, Pilani

6.3 Collaboration on R&D front

The second, and perhaps the most beneficial interaction mode for industry is of course to effectively access the academic and research community to complement their own efforts to develop and improve upon technology. The success of this strategy, of course, depends on integrating the research interests of the universities and the laboratories as a fundamental component of the overall research strategy of the company. In USA, Congress in the late 1980s passed laws to entice companies to adopt technologies developed in Government Labs and universities and to encourage researchers to team up with industry. Cooperative Research and Development Agreements (CRADAs),²² encouraged between government labs and industry or universities allow participants to share the cost of a collaboration. In return, the non-government and industry partners are granted some rights over any technology developed in the form of intellectual property, and also the first right to commercialise the same.

In this country, all the five IITs and IISc Bangalore have come together to take up, in partnership with industry, Technology Development Mission (TDM) projects in seven generic areas. The Planning Commission has earmarked an outlay of Rs. 60 Crores in the 8th Five Year Plans for the TDMs to be carried out under the aegis of the MHRD. Each Mission project is to have at least one industry partner, who will contribute a minimum of 25% of the total cost. In return, the industry partner will have the first right to commercially exploit the outcome of the Project, which are to have identifiable deliverables in the form of hardware, software, process or product know-how etc. A significant number of TDM projects have already been identified and taken up.

Apart from the cooperative R&D programmes with Government as a participant (at least as partial financier), there are also examples of a number of very successful R&D programmes sponsored jointly by a Consortium of industries and other agencies. These are generally concerned with research on generic technologies, in which the Industry as a whole are keen to continuously upgrade the knowledge base on a 'national' perspective to be on

the cutting edge level. Commercialisation of technologies thus developed is, however, normally, left to individual companies who may often compete with each other in the market place. Such consortium research are quite common in the West; in MIT Boston, eighty eight such consortium research programmes are in operation in 1995, some involving tens of millions of dollars. In Japan, under the umbrella of MITI (Ministry of International Trade and Industry) and STA (Science and Technology Agency), billions of yen are spent in R&D efforts in university colleges and laboratories, participated jointly by consortium of industries. In Europe, the British and the French Aviation industry have joined hands to development of Airbus, in which many independent research institutions and university research teams have participated.

Apart from the co-operative R&D programmes, such as above, researches in universities and institutions can take long term contract research projects with single or multiple industry organisations. Collaborations between the university departments and CSIR labs can also be an effective mechanism in executing industrial R&D programmes on Contract Research terms.

6.4 Science Parks¹⁰

One innovative model for close interaction between the institutions on one hand, and entrepreneurs and industry on the other, is that of the Science Parks, primarily a British concept implemented from 1970s onward. The Science Parks, or Science & Technology Parks (S&TP) as they are more commonly known in India, are normally industrial estates, intended to house 'high technology' companies, on lands near and having strong operational link with a university or other higher, educational or research institution. These are designed to encourage the formation and growth of knowledge-based business, and actively engaged in transfer of technology and business skills, often from the host education/research institution, to the organisations that are resident on site. There are some 35 such Science Parks operational in U.K., housing approximately 550 tenant companies. A number of these tenant companies are subsidiaries of larger industrial houses, centralising on R&D collaboration with host institutions and commercialisation of research efforts of university academics. A significant number of business in a Science Park are often small private entrepreneurs, using it to start up as Incubation Centres for novel technological ideas, with funding resourced from the State and financial institutions.

The institution of Science Park is found in other countries also. There are several industrial-university business estates, mostly on private funding in USA. In France, these are called Technopoles, which are very large, linked to the decentralisation policy of the State, and completely funded by the Government. In Japan, a particularly successful example is that of the Tsukuba Science city, linked with the University of Tsukuba, near Tokyo.

In India too, a number of S&T Parks have come about in recent years, such as the ones at Thiruchirapally, Hyderabad, Mysore and Kharagpur, attached to local technological institutions. These are yet to establish themselves on a strong footing, but with globalisation of economy, it is expected that their efficacy will get established soon.

6.5 Joint ownership of facilities

Infrastructure for research in hi-tech are normally highly capital intensive, and often beyond the financial capacity of universities and/or research organisation. A very useful mode of cooperation from industry can be setting up such facilities through funding by one or more industry in the university/institution premises and entering into an agreement of joint ownership. Such an arrangement is advantageous to both the institute, whose scholars can utilise the facility for research, and the industry who can make use of the same for critical investigative purpose from time to time, and also participate in long term R&D projects in association with the parent institutes. Utilisation of expensive and, often, esoteric facilities can be assured to be high, return on investment attractive, and pursuit of science economical in such arrangements. At the lower end of such joint facilities may be considered **Industrial Testing Laboratories/Facilities set up in institutional premises**. These help draw both the industry and academic/scientific community to a common ground.

There are also examples of R&D Companies established by joint investment by industry to promote basic and advanced technology, where creation of state-of-the art research facilities have attracted researchers from wide circles of industry, universities and other institutions. The **Advanced Telecommunication Research Institute International** of Japan is one such R&D Company which has successfully linked university research with the needs of the Private Industries in the area of electrical communication technologies.¹⁰ In this connection, it is also worthwhile to mention the **Steinbeis Foundation** of Germany which, funded mainly from commercial R&D, have set up a large number of **Technology Transfer Centres** in various universities and institutions, renowned for excellence in specific technology areas.

7. ORGANISATIONAL ARRANGEMENTS AND MANAGEMENT OF INTERACTION

Interaction activities with industry involve a substantially different work methodology compared to the normal academic and research commitments of university departments and R&D laboratories. Therefore, traditionally they are managed as a separate function. Two different organisational models are

known to be adopted.

7.1 Industrial R&D as an integral function

In all the IITs and a few other academic institutes, **Industrial Research & Development** activities are normally administered by a separate division or cell, independent of other academic engineering or science departments. Such divisions/cells are, as a rule, headed by a Professor, or Dean, and operate under the overall guidance of the Head of the Institute (i.e. the Director) himself. The Professor or Dean, however, devotes only part of his academic time to the assignment, as he normally retains his teaching and research commitments, though to a somewhat lesser degree. The IRD cells in IITs have often been quite successful in its own way; in IIT Madras, for example, the linkage with industry has been fairly close, especially through the **Industry Associateship Scheme** operated under its umbrella. The AICTE has recently started a scheme under which some of the RECs and state colleges have been provided funds and guidelines to organise industry-institute linkage cells (IILC) for promoting interactions with industry. Many of the CSIR laboratories have also separate departments for the same purpose.

All these divisions/cells/ departments have, however, one characteristic which is common. Each is a part of the parent organisation and has to follow its rules, regulations and procedures, which often inhibits the Cell to operate on a commercial ethos. It is to be remembered that all academic institutions and state owned R&D laboratories are categorised as non-commercial organisations and since they depend almost exclusively on governmental grants and donations, have to follow the usual governmental bureaucratic rules and procedures.

7.2 Autonomous Industry Interface Organisation

There is, however, another model for interfacing between industry and institutions. Many technological institutes in U.K., Europe, Australia and USA have established for this purpose a separate administratively and financially autonomous organisation. Such an organisation can be either a Company, owned fully or partly by the university/institution, or a Foundation or non-profit making Society whose surplus income is ploughed back to promote its own activities, and that includes generating resources for the parent institution. Such a Company or Foundation is free to frame its own rules and regulations, and can operate on a commercial basis, independent of its parent body. It can freely compete for assignments from industry with any other commercial entity, and can earn 'surplus income'. These organisations are manned by a core group of Professional Managers (or techno-crats as they are often called), who devote 100% of their time to interfacing with industry, without any incumbrance of teaching or research commitments as such. For such

an organisation, industry units are the clients and the faculty/scientists of the parent institution are the resource to be tapped and gainfully utilised and therefore, it has to look after the interests of both with equal alacrity and devotion.

The primary task of an interface set-up as above is to act as the marketing arm of the parent institution, disseminate information about expertise and facilities available therein, pro-actively make contact with industry, and negotiate terms and conditions of MOU and commercial contracts on behalf of the institution or the faculty scientist; in short, manage all the interface issues with the industry and the external world, leaving the faculty or the scientists to concentrate on core S&T issues. Similarly one important function of such organisation is also to provide the feedback from industry to the faculty/scientist, regarding the R&D, technological, manpower training needs. The basic organisational features are the focused technology objectives, freedom and flexibility in operation, facilitating and friendly working environment.

As stated earlier, there are a number of such organisations, successfully interfacing institutions with industry in other parts of the world. As examples, one could cite the case of the Foundation for Scientific and Industrial Research (SINTEF in short) of Norway, one of the first institutions known to have been set up, as early as in 1950. SINTEF is linked with the Norwegian Institute of Technology (NTH) in Trondheim and also with University of Oslo. In 1992, its turnover had touched \$ 25 million.

In U.K., almost all the technological universities have promoted such organisations, a move which mainly gathered momentum in 1980s, almost at the same time when Science Parks began to get established. One of the first ones was the Salford University Industrial Centre Limited, a public limited company wholly owned by the University of Salford near Manchester. It was established in 1982; by 1987 it was doing business over 5 million pounds sterling. In Australia, there are some 20 universities who have such interface organisations, such as the one at the University of Wollongong known as the Illawara Technology Corporation Limited (ITCL), founded in 1981.

In all these interface organisations the main areas of activity range from R&D programmes and Technology Transfer, Industrial Consultancy, Training and continuing education, speciality services (e.g. Quality Assurance Certification), developmental support to lab proven technologies which have good potential for commercialisation, to even financial support to entrepreneurs.

The Foundation for Innovation and Technology Transfer (FITT) is the only organisation of its kind in this country, which has been set up at IIT Delhi

as an autonomous organisation, modelled broadly on organisations like SINTEF. This was established in 1992 on the basis of the recommendations of the IIT Review Committee (1986) and was supported by a Corpus Fund allocated to IIT Delhi by the Ministry of Human resource Development (MHRD). FITT has a lean organisation consisting of a core group of professional staff; its primary resource is IIT Delhi; it plays a proactive role in bringing industry closer to institute. In the last two years, since it began to function effectively, FITT has been gaining confidence of both the faculty and the industry clients by providing a flexible and facilitating work ethos. An important feature of FITT is that it does not pose any financial liability to IIT Delhi and plans to be self-sustaining in 5 to 7 years whereby even the interest accrued from the Corpus Fund will not be used to maintain its day-to-day activities.

The National Research & Development Corporation Limited (NRDC) is a public sector undertaking (PSU), a Company under the Department of Scientific and Industrial Research (DSIR), set up in the 1950s, with the objective of commercial exploitation of technologies developed in the CSIR laboratories. Lately it has expanded its resource base to include other institutions (such as private R&D organisations, industrial in-house R&D units, IITs and other engineering colleges), and for the last ten years or so it has established itself as a self-sustaining, profitable and efficient technology transfer company. The INSAVALOR of France is the example of an organisation, in the mould of NRDC, and was set up in 1985 as a subsidiary company of the National Institute of Applied Science (INSA) of Lyon, representing its 36 laboratories in interactions with industry.

In recent times the policy of the CSIR in India has been changing distinctly, towards making every laboratory under its wing market-friendly and industry oriented, and providing them autonomy at individual institute level. The emphasis is on gradually making each lab self-financing, with great deal of freedom and flexibility in their operations. Scientists are given incentives to go out and earn additional incomes (apart from the salary). Many of the CSIR labs are planning to organise own marketing arms, as Section 25 companies. Memorandum of Understanding (MOU) have been signed with industry associations (like CII and FICCI) and financial institutions (like ICICI) with a view to identifying areas of collaboration and bankable projects, bringing clarity to IPR and other issues, and involving industry and finance experts in the management of the labs, all to bring about the culture of looking at research as a business proposition.

As far as the academic institutes are concerned, considering the perceived barriers of interaction with industry (as stated earlier) it would perhaps be worthwhile to organise bodies on the model of FITT, to bring in a sense of de-bureaucratised commercial ethos, and a flexible and autonomous style of functioning. While the larger institutions can each have separate

marketing outfit, for state level colleges, it would be perhaps prudent to have one body to cover a number of institutions, state-wise or category-wise. Such a decision will perhaps, need committed support from the Central and State Governments, in terms of financing, and modification of existing statutes and rules governing universities and colleges. This is particularly so for state level universities who suffer chronically from resource crunch and severe restrictive laws, rules and guidelines which are inherited from the days of controlled and licence based industrial policy. Formation of MITT like organisations may, however be relatively easier in IITs and some other universities/institutes who already enjoy a fair degree of autonomy.

8. RECOMMENDATIONS ON ACTION PLANS

Taking into account the large number of complex issues, the realities of industry - institution interface on the ground and the experiences and examples from other countries, the Standing Committee recommends a set of actions to be initiated by the different stake-holders, namely, the Government of India, the State Governments, the Institutions, the Industry and other Agencies. These recommendations are listed below. Some of these (marked*) relate to policy issues and may need detailed national debates before they can be implemented or necessary legislative actions are initiated. Others are measures which can be taken up by the institutions and the industry firms concerned on their own initiatives, and many of these would not even involve much financial investment. Such measures would, however, go a long way to bring a change in the mindset of all the players in the interaction game, namely the professionals in the industry and the academic and scientific community.

The Standing Committee strongly feels that both at the Universities and the Academic Institutions and at the R&D organisations/Research Institutions, interaction with the industry must be taken up as an Institutional Goal. It is to be realised that interaction with industry involves a substantially different method of working compared to normal academic or research activities. Institutions have to evolve their own flexible internal mechanisms and commit to speedily and successfully implement industry related assignments. The Industry on the other hand must accept its obligations to the nation building by committing enough resources for development of indigenous capabilities in science and technology. A mechanism has to be put in place to encourage involvement of industry in technical education, manpower training and national R&D programmes. The role of the Government in implementation of the recommendations towards enhancing industry-institution interactions should be one of promoter and facilitator. The scope of activities eligible for special tax incentives to the industry may be broadened, operational bottlenecks removed and procedures simplified for

claiming these benefits. A National R&D Fund has to be set up with contributions from Industry and the Government. This fund should be used to support basic research, technology development, skill development programmes and other educational and R&D activities in Institutions and should be managed by an autonomous body with adequate industry representation.

LIST OF RECOMMENDATIONS

IMPLEMENTATION ACTION BY GOVERNMENT OF INDIA

Sl.No.	Description	Other Agencies to be involved
1.	It should be made obligatory for industry to earmark a percentage of its turnover for R&D, Technical Education and Skill Development. (*)	Industry
2.	A National R&D Fund be created with contributions from industry, matched with that from Government. This fund should be utilised to promote industrial research and technical education, and be managed by an autonomous body consisting of representatives from industry, academicians, scientists and Govt., in a transparent yet commercial environment. (*)	Industry, Institutions & Financial Institutions
3.	Extensive fiscal incentives be given to industry for taking up R&D and interaction with institutions. Procedure for availing these incentives should be streamlined, simplified and reduced. (*)	Industry
4.	Tax Incentives be given to faculty who interact with industry.	Institutions, AICTE
5.	The Standing Committee on Industry-Institute Interaction, formed under the aegis of the Planning Commission, may be made the apex body to nationally coordinate all matters concerning developing policy guidelines and lobbying with the government for necessary legislative actions, to monitor the implementation of schemes and activities undertaken by the constituent partners and provide advise for mid-term corrections etc. (*)	--
6.	Similar Committees may also be organised at the state level or at regional level, comprising members from industry, academia and laboratories. These committees will have to be more proactive as the state level interactions are likely to require more persuasion, follow up and direct help, in local government and administrative level,	State Govt.

industry as well as institutional level. (*)

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- Notes i) The term 'faculty', whenever used in these recommendations, includes both academicians and scientists/research professionals
- ii) * denotes policy-related issues and may require extensive consultations with industry and other constituents before implementation.
- iii) The term 'Institution' whenever used includes both academic institutes and R&L Organisations.

IMPLEMENTATION ACTION BY INDUSTRY

Sl.No.	Description	Other Agencies to be involved
1.	Every Industry develop its own in-house mechanism specifically to interact with Institutions.	--
2.	Industry be urged to encourage sponsoring long term R&D projects to Institutions.	Institutions
3.	Industry and Institutions be encouraged to jointly develop, own and use infrastructural facilities.	Institutions
4.	Industry, or a group of industries (consortium) may adopt an Institute, or a specific course in the Institute, and provide necessary support and assistance for running the same.	Institutions
5.	Industry be urged to institute Academic Chairs in Institutions, and endowments to provide for scholarships and improvement of infrastructural facilities.	Institutions
6.	Industry, in association with faculty of institutes, to identify real life and shop floor problems to be studied by students as UG or PG projects and also support these projects.	Institutions
7.	Industry to provide opportunities to faculty and students to work at industry premises, with suitable safeguards with regard to ensuring confidentiality.	Institutions

IMPLEMENTATION ACTION BY AICTE AND STATE GOVT.

Sl.No.	Description	Other Agencies to be involved
1.	Representations of industry in the Governing Bodies and Management Councils of the Institutions be made mandatory.	Institutions Industry
2.	Industry's involvement in Technical Education will be enhanced by introduction of Sandwich Courses at the UG level, and other innovative schemes at PG level. To begin with, a few suitable institutions in each state/region may be identified for this purpose. (*)	Industry Institutions
3.	Industry internship for a given period (six	Industry

months or a year) will be desirable for students in Engineering and Technology, before a degree is formally granted. Industry should identify properly defined short projects in adequate numbers each year to be offered to Engineering Institutes.

Institutions

IMPLEMENTATION ACTION BY INSTITUTIONS

Sl.No.	Description	Other Agencies to be involved
1.	Institutions be encouraged to set up autonomous marketing arms or equivalent mechanisms that can operate on a commercial ethos of flexibility and procedural simplicity. The Governing Bodies of the institutions, especially the State Government owned colleges/universities, may have to be empowered to do so. (*)	AICTE, UGC, State Govt.
2.	Every Faculty member be encouraged to work on industry projects as short term consultancy or long term R&D problems without prejudice to the teaching and research commitments in the Institutions. He should be motivated to spend a length of time in industry; and industry related activities should form an integral part of his duties and responsibilities.	Industry
3.	Faculty be allowed to retain a reasonable portion of earnings from industry (such as consultancy and scientific fees, honorariums, royalties etc) without any annual upper ceiling.	AICTE, State Govt.
4.	Subject to a code of ethics, faculty be allowed to have direct links with industry as Directors or even as owners of new enterprise set up to commercialise innovative technologies.	GOI, State Govt.
5.	Industry professionals and R&D Scientists with wide experience be involved in curriculum development and student projects, and also as visiting/adjunct faculty.	Industry, Professional Bodies & National Academies.
6.	Industry lecture series be introduced as part of the curriculum of pre final year and final year students of all streams of Engineering and Applied Sciences.	Industry
7.	Qualified professionals from industry and R&D Organisations be allowed to register for higher degrees in the Academic Institutes.	Industry
8.	R&D Organisations should collaborate	--

with Academic Institutions on joint research programmes and technology transfers.

- | | | |
|-----|--|----------|
| 9. | Institutional arrangements be made for regular exchange of academic faculty and Research Scientists between educational institutions and R&D Organisations. | -- |
| 10. | Regular user oriented programmes be organised in the Institutions for the benefit of industry. Such programmes, to be offered for continuing education, upgradation of knowledge and qualification, and re-training of industry personnel, ought to be on a self financing (or net revenue earning) basis. | Industry |
| 11. | Institutions should regularly organise open-house for industry and publicise their in-house capabilities. | -- |

IMPLEMENTATION ACTION BY NATIONAL ACADEMIES AND PROFESSIONAL BODIES

Sl.No.	Description	Other Agencies to be involved
1.	National Academies must exert peer pressure on leaders in industry and institutions to enhance interactions and should have involvement in designing of course curriculum, research programmes and collaborative industry-institution activities.	Institutions Industry AICTE
2.	Industry Associations and professional institutes should conduct industry surveys, sector-wise, on changing skill profiles occupational patterns and technology requirements, with a view to assisting Institutions, AICTE and the Government to update and design course curricula.	Industry

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ANNEXURE-I

No.P-11061/11/93-Edn.
Government of India
Planning Commission
(Education Division)

.....

Yojana Bhavan, Sansad Marg,
New Delhi, the 6th March, 1995.

O R D E R

**SUBJECT: CONSTITUTION OF A STANDING COMMITTEE ON INDUSTRY -
INSTITUTION - R&D ORGANISATION - INTERACTION.**

.....

Sanction is hereby accorded of the Planning Commission to constitute a Standing Committee on Industry-Institution-R&D Organisation-Interaction.

2. The composition of the Standing Committee will be as follows:-

- | | | |
|--------|--|----------|
| 1. | Member, Planning Commission dealing with Technical and Higher Education | Chairman |
| 2. | Vice-Chairman, University Grants Commission | Member |
| 3. | Chairman, Board of Industry-Institution-Interaction (BOII), AICTE | " |
| 4. | Secretary, Department of Science & Technology | " |
| 5. | Secretary, DRDO | " |
| 6. | Secretary, Department of Education | " |
| 7. | Secretary, Department of Space | " |
| 8. | Secretary, Department of Atomic Energy | " |
| 9. | Secretary, Ministry of Industry | " |
| 10. | Director General, CSIR | " |
| 11. | Director, IAMR | " |
| 12. | Director, TIFAC | " |
| 13-14. | Two Directors of IITs (Director, IIT, Delhi plus one other Director by rotation) | " |
| 15. | One Director of IIM (by rotation) | " |
| 16. | One Vice-Chancellor of Technical Universities such as Roorkee, Jadavpur, Jawaharalal Nehru Technological University, Anna University (by rotation) | " |
| 17-18. | Two Principals of RECs (by rotation) | " |
| 19-21. | The presidents of Industry Associations (FICCI, ASSOCHAM, CII) | " |

22-23	Two Chairmen of Public Sector Undertakings	"
24-25	Two Chairmen of Private Industry	"
26.	Chairman of a major All India Financial Institution	"
27.	Adviser (Education), Planning Commission	Member-Secretary

3. The terms of reference of the Committee will be as follows:-

- i) To provide a forum for consultation and deliberations aimed at developing policies for the University-Industry-R&D Lab-National Academies Interaction.
- ii) To focus attention on the imperatives of Industry-Institution and R&D Organisation Interaction and to sustain a thrust on this important issue by all concerned agencies; and
- iii) To promote serious academic enquiry into the systematics of Industry-Institution-R&D Laboratories-National Academies Interaction and suggesting research studies into such aspects as status of Industry-Institution-R&D laboratories Interaction developing alternative models of interaction, evaluation of problems and generation of solutions etc.

4. The Standing Committee would be constituted initially for a term of three years.

5. The Chairman may coopt members as appropriate at any time in the interest of the effective functioning of the Committee.

6. Even though the membership of the Committee is largely ex-officio, it is expected that as far as possible the members themselves (and not their representatives) would attend the meetings.

7. The Education Division of the Planning Commission will service the above Standing Committee.

8. TA/DA to the non-official members will be paid by the Planning Commission.

sd/-
(GURJOT KAUR)
DEPUTY SECRETARY TO THE GOVERNMENT OF INDIA

To all concerned

ANNEXURE-II

**No.P-11061/11/93-Edn.
Government of India
Planning Commission
(Education Division)**

**Yojana Bhavan, Sansad Marg
New Delhi 110001
Dated the 18th May 1995**

ORDER

**Sub: Constitution of a Task Group for developing a Plan of
Action for University-Industry-R&D Organisations and
National Academies - Interaction.**

Sanction is hereby accorded of the Planning Commission to constitute a Task Group on University-Industry-R&D Organisations and National Academies-Interaction.

2. The composition of the Task Group will be as follows:-

i)	Prof. V.S. Raju, Director, IIT Delhi	Chairman
ii)	Sh. R.C. Tripathi, Adviser(Edn.), Planning Comn.	Member
iii)	Prof. Dayaratnam, Vice Chancellor, Jawaharlal Nehru Technical University, Hyderabad	''
iv)	Sh. S.K. Bijlani, Chairman, Technology Committee Confederation of Indian Industry	''
v)	Sh. P.M. Chacko, President, Institution of Engineers (P) India Limited	''
vi)	Prof. N.V.C. Swamy, Director, IIT Madras	''
vii)	Sh. Y.S. Rajan, Executive Director, TIFAC	''
viii)	Sh. K.C. Varshney, Executive Director, IDBI	''
ix)	Sh. R.A. Mashelkar, Director, NCL	''
x)	Prof. Unnikrishna Pillai, Principal, REC, Calicut	''
xi)	Dr. A.K. Sengupta, Managing Director, FITT Delhi	Member-Secretary

3. The terms of reference of the Group will be to suggest a Plan of action, in precise terms, for promoting meaningful interaction among University-Industry-R&D Laboratories and National Academies.

4. The Task Group would be constituted initially for a term of three months.

5. The Chairman may coopt members as appropriate at any time in the interest of the effective functioning of the Committee.

6. The Foundation for Innovation and Technology Transfer (FITT) in IIT Delhi will service the above Task Group.

7. TA/DA to the members will be paid by the concerned institutions.

sd/-
(GURJOT KAUR)
DEPUTY SECRETARY TO THE GOVT. OF INDIA

To all concerned.

List of Acronyms / Abbreviations

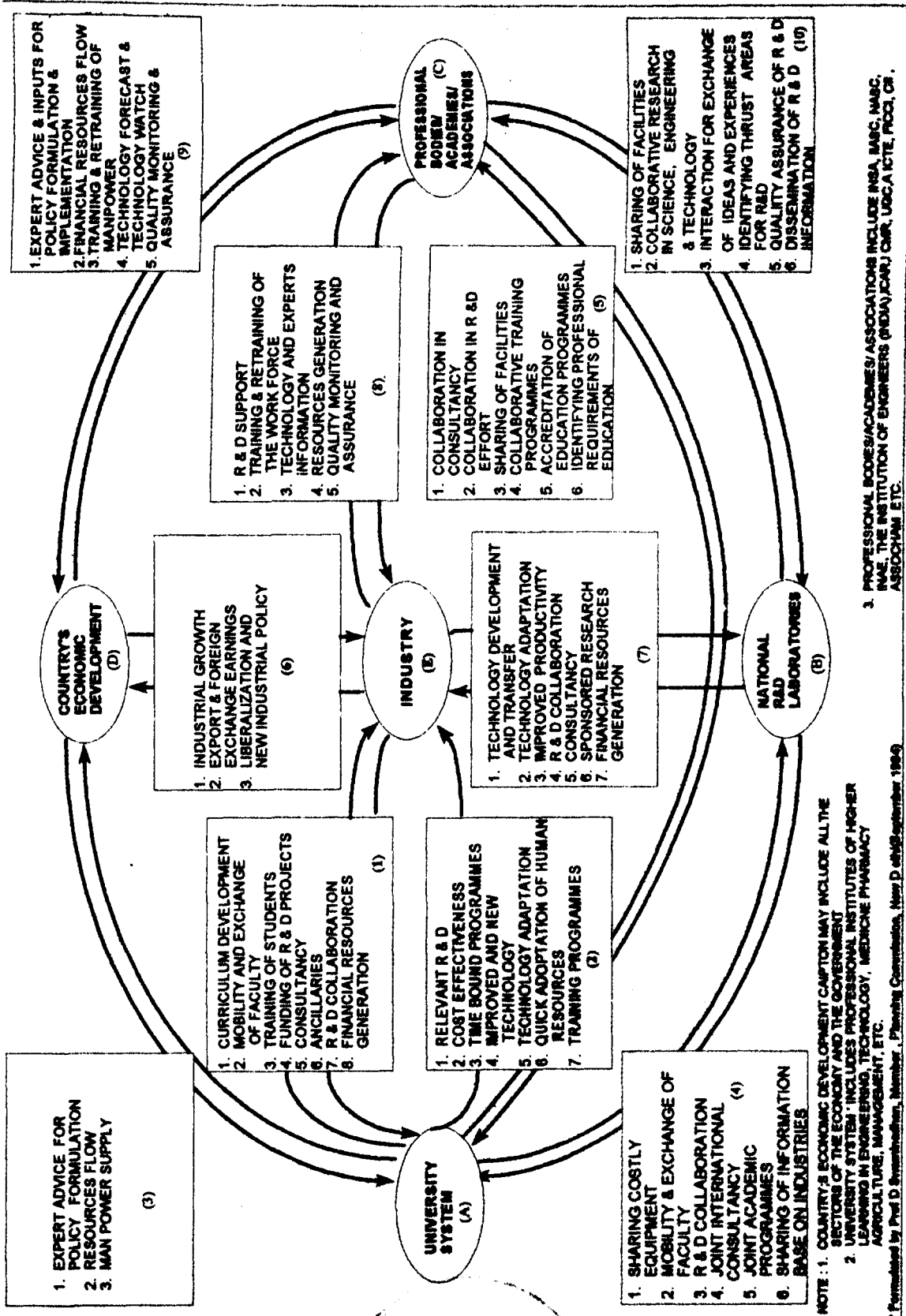
ABET	Accreditation Board for Engineering & Technology, USA
AICTE	All India Council for Technical Education
ARAI	Automotive Research Association of India
ASSOCHAM	Associated Chambers of Commerce & Industry of India
ATIRA	Ahmedabad Textile Industry Research Association
BHU	Banaras Hindu University
BITS	Birla Institute of Technology and Science, Pilani
B.Tech	Bachelor of Technology
CDC	Consultancy Development Centre
CEL	Central Electronics Limited
CII	Confederation of Indian Industry
CMIE	Centre for Monitoring Indian Economy
CRADAs	Co-operative Research and Development Agreements
CSIR	Council for Scientific & Industrial Research
DSIR	Department of Scientific and Industrial Research
DST	Department of Science and Technology
EDBI	Educational Development Bank of India
FI	Financial Institution
FICCI	Federation of Indian Chambers of Commerce and Industry
FITT	Foundation for Innovation and Technology Transfer
GOI	Government of India
GNP	Gross National Product
ICAR	Indian Council of Agricultural Research
ICICI	Indian Industrial Credit and Investment Corp. of India Ltd.
ICMR	Indian Council of Medical Research
IILC	Industry-Institution Linkage Cells
IIMs	Indian Institutes of Management
IISc	Indian Institute of Science
IITD	Indian Institute of Technology, Delhi
IITs	Indian Institutes of Technology
IJIRA	Indian Jute Industry Research Association
INSA	Indian National Science Academy
INSAVALOR	A subsidiary of the National Institute of Applied Science (INSA) for Valorization(promoting) Lyon (France)
IPR	Intellectual Property Right
IRD	Industrial Research & Development
ISRO	Indian Space Research Organisation
ITCL	Illawara Technology Corporation Ltd., Australia
KAIST	Korea Advanced Institute of Science and Technology
KIST	Korea Institute of Science and Technology
MHRD	Ministry of Human Resource Development
MIT	Massachusetts Institute of Technology, Boston
MITI	Ministry of International Trade and Industry, Japan
MOU	Memorandum of Understanding
NAL	National Aeronautic Laboratory

List of Acronyms / Abbreviations

NCCBM	National Council of Cement and Building Materials
NCL	National Chemical Laboratory
NEP	New Economic Policy
NICs	Newly Industrialised Countries
NISSAT	National Information System for Science & Technology
NRDC	National Research Development Corporation
NRDF	National R&D Fund
NTH	Norwegian Institute of Technology
PATSER	Programme aimed at Technological Self Reliance
PBT	Profit Before Tax
PG	Post Graduate
R & D	Research and Development
RECs	Regional Engineering Colleges
S & T	Science and Technology
SEETOT	Scheme to Enhance the Efficiency of Transfer of Technology
SINTEF	Foundation for Scientific and Industrial Research, Norway
SIRO	Scientific & Industrial Research Organisation
STA	Science & Technology Agency, Japan
S&TPs	Science and Technology Parks
TDF	Technology Development Fund
TDM	Technology Development Missions
UG	Under Graduate
UGC	University Grants Commission
UK	United Kingdom
USA	United States of America

APPENDIX

* SWAMINADHAN MODEL FOR UNIVERSITY-INDUSTRY-NATIONAL R&D LABORATORIES-PROFESSIONAL BODIES AND ACADEMIES INTERACTION FOR COUNTRY'S ECONOMIC DEVELOPMENT



प्लानिंग आयोग
 Planning Commission
 प्रतिलिपि सं. C. 5980
 आ.सं. २४.११.१७
 दिनांक ११/११/१७