



GOVERNMENT OF INDIA

MINISTRY OF EDUCATION
AND SOCIAL WELFARE

SHASTRI BHAWAN
NEW DELHI

Report of Working Group
on
Technical Education

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FOREWORD

Technical Education is a corner stone for national development. Large strides have been taken in the field of Technical Education during the last three decades and today India has the third largest scientific and technical man-power in the world. To meet the valid argument that there should be a proper assessment of qualified technical manpower with reference to demands including their employment, that facilities at various levels of Technical Education should be decentralised, that research and post-graduate programmes should be developed and that collaboration with Industry should be fostered, a Working Group was constituted in November, 1977. Care was taken to include in the Working Group and Sub-Groups representatives of all sectors (including the press and public) so as to make the deliberations relevant and meaningful. Recommendations of the Working Group submitted to the Government in January, 1978 were considered by the All India Council for Technical Education in February, 1978 and the final decisions are contained in this document. To the document are also appended the reports of the Sub-Groups so as to give the correct perspective to the decisions of the All India Council for Technical Education.

As stated earlier this is the first time in recent times that a comprehensive review has been undertaken on the Technical Education system. If Technical Education were to fulfil its legitimate role in national development, the decisions of the All India Council for Technical Education on the recommendations of the Working Group will have to be implemented speedily and with imagination.

P. SABANAYAGAM

Secretary

Ministry of Education & Social Welfare
Government of India

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**REPORT OF THE WORKING GROUP
ON TECHNICAL EDUCATION**

REPORT OF THE WORKING GROUP ON TECHNICAL EDUCATION

1. INTRODUCTION

1.1 PRESENT POSITION

During the last three decades a wide network of technical institutions offering different types of programmes have been established. More than 350 Industrial Training Institutes with an annual capacity of about 1,50,000 for craftsmen, 320 Polytechnics with an annual intake capacity of 50,000 students for technicians, about 150 degree-level institutions with an annual intake capacity of 25,000 students, and 60 centres of post-graduate programmes admitting annually 3,000 students have been established. Besides these, there are about 30 University centres (including Indian Institutes of Management) offering courses at the Master's Degree level in Business Administration and Industrial Management with an annual admission capacity of about 1,000.

1.2 DEFICIENCIES IN THE SYSTEM

Though technical education over the last three decades has made significant contribution to national development, one is rather constrained to find that the out-turn of graduates and diploma-holders is not keeping pace with the actual admissions

made. This shortfall is due to various reasons, important amongst them being students with different backgrounds, inadequate utilisation of the existing instructional facilities, lack of adequate departmental operating costs, lack of motivation of staff and students, etc., By the end of the Third Plan, most of the above institutions had been established. It was then considered necessary to lay special emphasis on consolidation, diversification and improvement of quality rather than on further expansion.

1.3 NEED FOR A REVIEW

Frontiers of knowledge are expanding rapidly, making it possible to devise newer and more efficient methods of solving problems of society. For harnessing science and technology to profitable and productive processes of economic growth and social wellbeing, the system of technical education has to be continually reviewed. It is necessary to identify the deficiencies in the system and to give further directions in which the system should develop.

1.4 SETTING UP OF A WORKING GROUP

In November 1977, the Ministry of Education and Social Welfare, Government of India, set up a Working Group (composition of the Working Group is indicated at Annexure) for Technical Education to review the present status of the nation's needs during the coming decade and to suggest re-orientation and improvements to the existing programmes. At the first meeting of the Working Group in November 1977, the following five subjects were identified which required indepth study and which could form the basis for further deliberations. 'Technical Manpower', 'Research and Development', 'Diversification and Re-designing of the existing programmes', 'Quality Improvement' and 'Industry— Institutional Collaboration'. The Group finally met in January 1978 and have made the following recommendations.

2. FUTURE PERSPECTIVE

2.1 MANPOWER NEEDS

- * Present manpower supply — adequate for next decade.
- * Additional manpower needs to be met by increased efficiency and effectiveness.
- * New educational programmes to be based on well-established manpower needs.
- * Establishment of a National Manpower Information System.

2.2 MEASURES AND IMPROVEMENT

2.2.1 Courses/programmes — modification

- * Flexibility in programmes through credit system and multi-point entry.
- * Application oriented research projects and consultancy centres tuned to needs of industrial and rural development.
- * Integration of relevant management education in technical courses at all levels.
- * Selected Polytechnics ensuring transfer of technology to rural community to be designated as 'Community Colleges'.
- * Advanced technician courses with Central assistance.
- * Continued review of curricula to cope with technological changes and manpower needs.

2.2.2 Staff — Selection, development and appraisal

- * Staff selection based on merit and on All India basis.
- * Appointment to senior teaching positions on renewable contract basis.
- * Personnel promotions to motivate deserving staff.
- * Staff appraisal for developmental needs.
- * Pedagogical courses for teachers of degree institutions also.
- * 'Adjunct professorship' for engineers from the Industry and 'Industrial residency' for teachers.

2.2.3 Students

- * Selection based on aptitude and ability.
- * Remedial programmes to help weak students.
- * Student participation in academic bodies.

2.2.4 Instructional Support Services.

- * Improvement in library services through competent library staff and reprographic facility.
- * Establishment of 'Learning Resource Centres'.
- * Modernisation of Laboratories considering equipment obsolescence and curricula changes.

2.3 MANAGEMENT OF THE SYSTEM

- * A single agency to plan and organise technical education from the level of craftsmen to that of post-graduates.
- * A single agency to plan, organise and fund post-graduate activities in Universities, Indian Institutes of Technology, Indian Institutes of Management and affiliated colleges.
- * Reorganisation of Directorates of Technical Education for effective professional and academic performance.
- * Administrative autonomy and powers of financial control to Government institutions for effective functioning.
- * Academic autonomy to selected institutions.
- * Staff College for training and development of senior educators and administrators.
- * Setting up of a National Evaluation and Accreditation agency.
- * Statutory powers to the All India Council for Technical Education for maintenance of standards, on the pattern of the Indian Medical Council.

2.4 FINANCING OF TECHNICAL EDUCATION

- * Plan allocations for technical education to be commensurate with developmental outlay of user departments.
- * Expenditure by Industry on technical education to be exempted totally for income tax purposes.
- * Central share of assistance to be given direct to institutions— earmarking funds for technical education.

3. MANPOWER NEEDS

3.1 A tentative overall quantitative assessment of engineering and technical manpower requirements for the next decade indicates that the present annual admission capacity of 3,000 for post-graduate courses, 25,000 for first degree courses and 50,000 for diploma courses is adequate. Same is true also of facilities in management education vis-a-vis manpower requirements. It should be possible for the existing institutions to increase the supply of manpower by improving the efficiency and effectiveness of the system through optimum utilisation of available resources and improvement in the instructional process. Changes in demand in different specialties (disciplines) should be made by appropriate shifts in disciplines within the existing total sanctioned intake capacity.

An objective review for reorientation of the existing course facilities should be made to provide for diversification to meet the emerging specialised manpower needs.

Within the approved annual intake capacity each institution should increase the supply of technical manpower by improving the efficiency and effectiveness of educational processes. Shifts in the intake capacities between disciplines may be effected to cater to the emerging manpower needs.

3.2 All new courses should be based on established and well defined manpower needs.

3.3 A reliable information system is a prerequisite to planning, specially in the field of technical education and training. In the absence of up-to-date and meaningful manpower information, it will neither be possible to anticipate areas of growth in the field of science and technology nor plan for technical manpower development. Such a system is at present not available; the necessary data not even collected, much less updated, systematised and stored suitably for retrieval as and when necessary. From the available data it is not 'possible to undertake studies relating to productivity of the educational programmes or absorption patterns of the educated in the employment market. A number of personnel with the background of science education is also deployed in Industry. It is necessary for any Survey of Technical Manpower to take cognizance of this factor. It is, therefore, necessary to establish a national manpower information system. In order to make such a system operational, it is necessary to establish effective coordination of efforts among the data generating and collecting agencies through a well-knit country-wide organisation. The Regional Engineering Colleges and other selected technical institutions could assist as nodal points in the operations of the information system and thereby benefit from the system. Manpower information can also be used usefully for purpose of placement through agencies such as the Board of Apprenticeship Training.

A reliable information system is a pre-requisite to Planning, specially in the field of technical education and training. A national manpower information system should be established with a lead centre in the Institute of Applied Manpower Research for the storage, updating, retrieval and analysis of manpower information to assist technical education planning. The Institute of Applied Manpower Research should be suitably strengthened for this purpose with provision of requisite facilities.

4. MEASURES FOR IMPROVEMENT

4.1 COURSES/PROGRAMMES TO MEET INDUSTRIAL AND COMMUNITY NEEDS.

4.1.1 There should always be opportunity for self development. A person starting his career as a craftsman should also have the opportunity to develop himself as a technician or engineer, if he has the right aptitude and abilities. The present pattern of courses is based on rigid entry and exit points and does not encourage horizontal or vertical mobility.

The adoption of a credit system with the prescription of maximum and minimum number of credits that can be taken in a semester/academic year will bring in an amount of flexibility in the system. This will enable multi-point entry options to persons depending on their initial preparation/professional background, thus providing opportunity for continuing/further education at their pace and abilities. This provision can also lead to diversification, inter-disciplinary programmes and modular courses.

Credit system with provision for multi-point entry in part-time and full-time programmes, be introduced.

4.1.2 The impact of research and development activities so far undertaken has been felt in the various sectors of development including rural and community services. Although 'problem-oriented' and 'application oriented' programmes have been undertaken, there is a need for a greater emphasis on such research programmes which will tackle industrial and rural development problems in keeping with the national needs.

Industrial and rural development problems be identified, and greater emphasis on research programmes to tackle such problems keeping in view the national needs, be given. Technical education institutions having the potential and capability to undertake problem-oriented and application-oriented programmes should be selected and properly supported to facilitate substantial contribution to rural and community development.

4.1.3 Involvement in consultancy work, and testing/service activities on selection basis will promote interaction between the institution and the industry, which will be mutually beneficial. It will build up expertise and confidence of the staff and students

and the image of the institution. To undertake and promote such activities, a Consultancy Centre should be established in each institution. A separate development fund should be created from out of the earnings through consultancy, which could be used for further development of the Consultancy Centre.

Institutions should be encouraged to set up Consultancy Centres to promote consultancy activities.

4.1.4 Managerial skills are crucial for engineers and technicians, who are very often required to perform the managerial functions in industry.

Relevant management education be integrated with professional courses at degree and diploma levels.

4.1.5 The pattern of courses in management at all Management Institutions is heavily oriented towards large scale industries. Considering the great need for managerial manpower for small and medium-sized industries, it is suggested that at least a part of the present intake of recognised management institutions be diverted to this sector. Sectoral needs of transport, power, health, education and agriculture should also be taken care of through specialised management programmes offered by these institutions.

Courses in management education be restructured to provide for managerial manpower for small and medium-sized industry as also for sectoral needs such as transport, power, health, education and agriculture.

4.1.6 Some Polytechnics have shown initiative to interact with the environment by organising programmes and activities to meet the community needs. Such institutions could act as focal points to promote transfer of technology to the rural sector. Development projects beneficial to the community could be undertaken towards this end.

Selected Polytechnics act as focal points to promote transfer of technology to the rural community. Such Polytechnics be designated as 'Community Colleges' and adequate support provided.

4.1.7 Professional role of a technician varies from industry to industry. The education of a technician in the institutions necessarily, therefore, is broad-based. However, when once the technician takes up employment, he is called upon to occupy a variety of job positions. It is necessary to give him the skills required for this purpose to cope up competently in this role with his responsibilities. To meet diverse requirements and challenges in his profession, a technician will have to be provided facilities for his continuous education and for acquiring new competencies. Advanced technician courses would be useful in this context. Quite a few of the Polytechnics in the country have the potential to conduct such courses and to contribute to the development of diverse manpower needs.

Selected Polytechnics should be given central assistance to conduct advanced technician programmes.

4.1.8 The technical education to be relevant, has to keep pace with the changing practices in science and technology. The role of curriculum development in this context, is a crucial one, and can hardly be over-emphasised. A continuous review of curricula should, therefore, be a permanent feature in the technical education system. Considerable curriculum development work has been done at the various centres established for this activity, particularly at the diploma level. Such efforts are to be co-ordinated and strengthened. Dissemination of information and ideas from these centres to all concerned agencies should take place freely.

Support be provided to strengthen the work of curriculum development and research related to problems of technical education.

4.2 STAFF, STUDENTS, DEVELOPMENT, APPRAISAL.

4.2.1 The minimum qualifications for recruitment to teaching posts laid down by the UGC/AICTE is considered generally adequate. The only lacuna identified is the inadequate emphasis on industrial experience. Faculty recruitment should be based on precise job descriptions.

In addition to minimum academic qualifications laid down by AICTE, one year's industrial experience for Lecturers and two year's for Senior staff is considered essential. All recruitment should be strictly on merit, by open competition and on All India basis, subject to reservation because of constitutional requirements.

4.2.2 To ensure sustained high quality performance appointments to Senior teaching posts (i.e., Professors and Heads of Institutions) should be on contract basis for five years, renewable after assessment.

4.2.3 Due to lack of promotional opportunities at senior levels, bright young faculty with proven ability have to stay in the same category for long periods of time. Such a situation is detrimental to the motivational climate of institutions.

Personal promotion schemes should be established to enable promotion of deserving young faculty stagnating at a particular level. Such promotion be restricted to 20 % of the sanctioned strength.

4.2.4 At present teacher appraisal is done primarily for administrative purposes. Confidential reports hardly represent profiles and the strength and weakness of the teachers. The appraisal by the students is also considered desirable and should be taken as an important factor in assessing teacher's competence.

An appropriate staff appraisal scheme based on a methodology acceptable to the faculty be introduced. This would also enable identification of the needs of staff development.

4.2.5 Most of the existing faculty members at the collegiate level already possess Master's Degree, which is the minimum qualification prescribed. It is desirable that faculty in engineering colleges upgrade their qualifications for effective discharge of their responsibilities. It is, therefore, recommended that more opportunities be provided under the faculty development programme for Ph.D.

Master's Degree training under the Quality Improvement Programme be phased out and in its place, additional provision be made for doctoral programmes. Considering the number of teachers involved, it is suggested that provision be increased to enable 250 teachers every year to enrol for doctoral programmes.

4.2.6 For a teacher to be effective, in addition to subject-matter competence, he should have expertise in educational technology his pedagogical skills must be well-developed. This is important both for Collegiate and Polytechnic teachers.

Provision be made to organise short-term courses for Polytechnic and collegiate teachers in educational technology.

4.2.7 For Polytechnic teachers, a Bachelor's degree has been prescribed as the minimum qualification for initial recruitment. A very large proportion of the Polytechnic teachers are only Diploma holders. It is essential that opportunities are provided to these teachers also to acquire Bachelor's degree.

Selected Engineering Colleges should organise under Quality Improvement Programme, three-year courses to enable Polytechnic teachers with Diploma qualification to get Bachelor's degree.

4.2.8 Higher attainment for Polytechnic teachers should be in tune with the requirements of Polytechnic education. Master's Degree courses are not appropriate to fulfil these requirements. For Polytechnic teachers, the courses should be primarily industry-oriented or in the fields of technical education and its management.

Polytechnic teachers should be sponsored under the Quality Improvement Programme for Industry-Oriented Post-Graduate Diploma courses organised for the purpose.

4.2.9 The expertise and capability of executives, managers and technical personnel from industry, research institutions and professional bodies would be of benefit for the educational programmes in institutions. Improvement of quality of instruction is possible through the faculty acquainting themselves with the

variety of live problems in the industry. This would also enable identification of industrial problems and open up avenues for consultancy in problem-areas.

In order to ensure purposeful and meaningful interaction and collaboration between industry and institutions, "Adjunct Professorship" in the institution for willing and capable personnel from the industry, be instituted. Similarly 'Residency' for institutional faculty be provided in the industry. Additional budgetary provision of staff to the tune of 20 % be made to finance these schemes.

4.3 STUDENTS

4.3.1 Selection of students with proper aptitudes and abilities plays an important role in the development of the right type of technical manpower. Reliance on the percentage of marks obtained by the students at the qualifying examinations does not seem to be fair, in view of the fact that there is wide variance in the standards of different examining bodies. Further, in view of the different grading systems being followed now, admission procedures need a change.

Admission to both degree and diploma courses be on the basis of carefully designed entrance tests. These tests could be conducted state-wise, common to all institutions.

4.3.2 In spite of the best methods of selection, the student body always has a percentage of weak students, who need special attention. This problem is particularly acute in the case of students admitted under reserved quotas.

In order to reduce drop outs and other forms of wastage, it is necessary that special efforts in the form of remedial courses be carried out to help weaker students.

4.3.3 Opportunities for continuing education should be available to those who are already in the profession to enable them to professionally advance according to their abilities and conve-

nience through part-time/full-time courses based on the credit system and multi-point entry.

Flexible programmes of continuing education through part-time/full-time courses be introduced at all levels for serving personnel.

4.14 Participation of students in the academic bodies would generally result in greater commitment of the student community.

Representation be given to students in academic bodies of the institutions.

4.4 INSTRUCTIONAL SUPPORT SERVICES.

4.41 The non-teaching technical supporting staff has a direct bearing on the technical education process. Apart from assisting in laboratory experimentation and workshop practice, they are primarily responsible for the maintenance of laboratory equipment, instruments, etc. Training needs of this category of personnel deserve immediate attention to ensure optimum and effective utilisation of resources for instruction.

Schemes for training of technical supporting staff be started under "Quality Improvement Programme".

4.42 With the vast amount of published literature and the newer methods of information retrieval, the role of library in the teaching-learning process has become important. To get maximum benefit from this resource, it is essential that the efficiency of the library services should be improved.

To ensure better and more effective library services, qualified and trained library staff be provided.

4.43 Developments in the field of educational technology have made available a variety of audio-visual aids and reprographic facilities, which could make the instructional process more effective.

Adequate support be given to institutions to organise audio-visual and reprographic services.

4.4.4 The role of resource centres in the instructional process is very significant. Such centres can help individualise the instructional process and make it more student-oriented. Remedial instruction to weaker students become easier through a variety of instructional alternatives, which the students could choose according to their level and background. Learning resource centres also offer facilities to the teacher to design his instructional strategies around and material and equipment available and to prepare his own instructional material and aids.

On an experimental basis, Learning Resource Centres be established in a few selected institutions.

4.4.5 There is a definite shift in the approach towards the aims of laboratory instruction. Conventional laboratory experiments of the 'verification of theory' type are found to be ineffective and these are making way to 'learning by doing' type laboratory assignments. Some of the laboratory equipment acquired by institutions in the early 60's have become obsolete, in view of curricular changes. To keep up with this trend in laboratory instruction and to meet the requirements of curricular changes, the laboratories should be gradually modernised with relevant and useful equipment and components.

The replacement of laboratory equipment, which have become obsolete due to technological and curricular changes, be examined. Laboratories be modernised gradually with relevant, and versatile equipment, with more instructional potential.

5. MANAGEMENT OF THE SYSTEM

5.1 The tasks of planning and organising the education system, to cater to the technical manpower needs from craftsmen to technologists, can be effectively performed through an integrated approach. To ensure such an approach for balanced deve-

lopment of the system, all the tasks mentioned above should become the responsibility of a single agency.

The tasks of planning and organising technical education from the level of craftsmen to that of technologists be brought under a single national agency, both at the centre and the states to ensure balanced development through an integrated approach.

5.2 Effective co-ordination of post-graduate and research efforts is essential for ensuring optimum utilisation of resources, balanced development in tune with national needs and dissemination and exchange of innovative ideas. Such a co-ordinated approach will also prevent duplication of efforts. At present, planning, organisation and funding of post-graduate activities are under the auspices of different agencies. It is essential to avoid diffusion of efforts. It is recommended that effective support to all centres based on potential and proven capabilities be extended. This equally applies to management education at the Indian Institutes of Management and University Departments.

It is essential to optimise the utilisation of available resources and provide impetus to all the centres engaged in post-graduate programmes and research. The planning, organisation and funding of post-graduate and research programmes conducted at Universities, Indian Institutes of Technology, Indian Institutes of Management and affiliated Colleges be undertaken by a single agency at national level.

5.3 At present short-term courses are being planned and organised by a variety of agencies like the Indian Society for Technical Education and other Quality Improvement Programme Centres. Co-ordination of the efforts of the various agencies will optimise the impact of these courses in terms of quality improvement of faculty and instructional processes.

A national agency be set up to co-ordinate the organisation of short-term courses.

5.4 The available potential of the industry to provide facilities for training of students during or at the end of educational programmes should be effectively utilised.

The Regional Boards of Apprenticeship Training be adequately staffed and strengthened with a view to ensure purposeful planning and supervision of apprentice training programmes.

5.5 The AICTE recommended that the State Boards of Technical Education be made statutory. This is a very important step towards reorganisation and reform of Polytechnic education. The Boards of Technical Education should be what the University is for degree education, with the difference that there will be only one Board for each State.

The State being the implementing agency for most educational programmes, the State Directorates have a variety of academic, professional and managerial roles to play. This requires reorganisation of the State Directorates.

The State Board of Technical Education be reorganised and vested with statutory powers to be more effective in their functions. The Directorates should have organs dealing with manpower assessment, planning, co-ordination, controlling, monitoring and evaluation of educational programmes. Re-organisation of Directorates to enable them to perform these professional functions effectively be undertaken as a matter of urgency.

5.6 It is necessary that institutions are in a position to react to the needs of the region in which they are situated. They should also be alive and alert to the changing requirements and organise programmes accordingly. This is possible only if the Principals and the Faculty members have the freedom to design courses and undertake projects and implement them. To enable such a situation to develop and grow, institutions need autonomy not only

academically, but also administratively and financially. Such autonomy will release tremendous energies now available and remaining dormant in technical institutions.

Administrative autonomy and powers of financial control be given, by bringing all technical institutions including Government institutions, under suitably constituted governing councils and academic autonomy be given on a selective basis.

5.7 The concept of 'Adoption of Polytechnics' by industry already recommended by the All India Council of Technical Education be pursued.

5.8 The efforts towards improvement in instructional processes for the education and training of the right type of technical manpower will bear fruit only when the organisational climate in the institutions is conducive to development and growth. This, in turn, calls for effective management based on scientific management principles with regard to resources utilisation, human relations, organisational development, etc.

Short-term courses under Quality Improvement Programme, in Educational Management be organised for training Heads of Institutions and Heads of Departments.

5.9 Technical Education in the country has reached such a stage of development that the growing innovative efforts in the institutions will have to be supported, encouraged and optimised. Increased professionalism on the part of the 'managers' of technical education in the areas of administration, planning, decision-making and organisational development has become vital. A Staff College for technical education could provide a solution to this problem by offering facilities for training in educational management, assisting government agencies to plan and bring about policy changes in technical education and to monitor and evaluate the effect of these policy changes. This would also enable the technical institutions and other concerned agencies in the promotion and diffusion of new ideas.

Setting up a Staff College for Administrators of Technical Education be examined by an Expert Committee.

5.10 An objective assessment of the existing programmes should be undertaken and further support should be considered only on the basis of proven performance. Even for starting of new courses in the existing institutions, identification of new centres, support for research activities and project work, etc., it is desirable that an evaluation of the institutions, both from the point of view of their professional competence and future capability for advanced work, is done.

Continuous evaluation of institutions for maintenance of standards, as also total performance in respect of programmes, is essential. This will also enable identification of institutions with professional competence and capability to launch new programmes and projects and consolidate the existing programmes.

A National Evaluation and Accreditation Agency be set up.

5.11 The All India Council of Technical Education has played a very important role, in the first two decades after independence in maintaining uniformity of standards in the technical education system in the country. Recent trends, however indicate that many important recommendations of the Council having a direct bearing on the improvement of quality of technical education have either been neglected or overlooked. Quality of technical education is vital to the maintenance of standards. If the All India Council of Technical Education is to be effective in ensuring balanced development of technical education in terms of quantity and quality, the Council should be vested with statutory powers like the Indian Medical Council.

The All India Council for Technical Education be vested with statutory powers for ensuring effective implementation of policies and programmes and maintenance of standards.

6. FINANCING OF TECHNICAL EDUCATION

6.1 Linkage of engineering education with general education starts in the way of making adequate Plan provisions in tune with the objectives of engineering education. As with other sectors of professional education—like health and agriculture—technical education should be organised, managed and administered separately from general education, since it is essentially an investment for national development.

The plan allocations for technical education be commensurate with the developmental outlay of the other user departments, since technical education is developmental investment.

6.2 It is always not possible to get adequate financial support: from Government agencies alone. In order to meet the increasing cost of technical education and provide proper inputs, it is increasingly necessary that Governmental efforts should be supplemented by all user agencies including public and private industry. In order to encourage industry to support technical education, it is recommended that as in the case of industry contributions for scientific research, contribution for technical education be deducted for purposes of Income Tax by amending Section 35 (1) (ii).

To provide the necessary incentive to industry, expenditure by industry on technical education including management education be deductible for purposes of Income Tax assessment.

6.3 Because of financial constraints at the State level, even the Plan funds agreed to during the Plan discussions for purposes of technical education, are not always available, since allocations are not ear-marked for technical education. This has seriously affected the implementation of the approved schemes of technical education. To enable the system of earmarking of funds being spent on technical education, it is recommended that the pre-Fourth Plan funding arrangement of making available directly to the institutions the Central Government's matching share of expenditure on approved schemes, be restored.

The system of making available the Central Government's share for approved schemes, directly to the institutions, should be restored.

ANNEXURE

THE COMPOSITION OF WORKING GROUP FOR TECHNICAL EDUCATION

- 1 Shri P. Sabanayagam **Chairman**
Secretary
Ministry of Education and S.W.
New Delhi.
- 2 Shri Samar Guha
Member of Parliament
New Delhi.
- 3 Dr. B. Ramachandra Rao
Vice-Chairman
University Grants Commission
New Delhi.
- 4 Dr. A. L. Mudaliar
Chairman
Imperial Chemical Industries (India) (P) Ltd.
Calcutta.
- 5 Prof. G. R. Damodaran
Dean of Post-graduate Studies and
Director, PSG Industrial Institute
Coimbatore.
- 6 Shri Ravi L. Kriloskar
Chairman and Managing Director
Kriloskar Electric Company Ltd.
Bangalore.
- 7 Shri Nanu B. Amin
Chairman
Jyoti Ltd., Baroda.

- 8 Dr. C. J. Dadachanji
Administrative Managing Director
National Organic Chemical Industries Ltd.
Bombay.
- 9 Shri Harish Mahindra
Chairman and Managing Director
Mahindra Ugine Steel Co., Ltd.
Bombay.
- 10 Shri M. S. Padmanabhan
Technical Director
Tata-Merlin and Gerin Ltd.
Thana.
- 11 Shri Satyendra Tripathi
Science Correspondent
Indian Express
New Delhi.
- 12 Dr. A. Ramachandran
Secretary
Department of Science and Technology
New Delhi.
- 13 Dr. Ajit Mozoomdar
Secretary
Planning Commission
New Delhi.
- 14 Shri V. Krishnamurthy
Secretary
Department of Heavy Industry
Ministry of Industry
New Delhi.
- 15 Prof. M. G. K. Menon
Secretary
Department of Electronics
New Delhi.

- 16 Shri B. B. Lal
Addl. Member Mechanical and
Addl. Secretary to the Government
Railway Board
New Delhi.
- 17 Dr. S. Varadarajan
Chairman and Managing Director
Engineers (India) Ltd.
New Delhi.
- 18 Shri N. B. Prasad
Chairman
Oil and Natural Gas Commission
Dehra Dun.
- 19 Shri A. C. Banerjee
Director (Technical)
Steel Authority of India Ltd.
New Delhi.
- 20 Dr. C. S. V. Rao
Managing Director
National Mineral Development Corporation
Hyderabad.
- 21 Shri S. K. Bose
Joint Secretary
Department of Coal
Ministry of Energy
New Delhi.
- 22 Rear Admiral Krishna Dev
Vice-Chairman and Managing Director
Shipping Corporation of India Ltd.
Bombay.
- 23 Prof. A. K. De
Director
Indian Institute of Technology
Bombay.

- 24 Dr. S. Paul
Director
Indian Institute of Management
Ahmedabad.
- 25 Dr. Y. K. Alagh
Adviser
Perspective Planning Division
Planning Commission
New Delhi.
- 26 Prof. Malathi Bolar
Director
Institute of Applied Manpower Research
New Delhi.
- 27 Dr. Y. V. N. Rao
Principal
S. V. Regional College of
Engineering and Technology
Surat.
- 28 Prof. T. Subbarao
Principal
Technical Teachers' Training Institute
Madras.
- 29 Dr. S. N. Saraf
Chief (Education)
Planning Commission
New Delhi.
- 30 Prof. D. Banerjee
Director of Technial Education
Government of West Bengal
Calcutta.
- 31 Shri P. K. Umashankar
Joint Secretary (Planning)
Ministry of Education and S.W.
New Delhi.

- 32 Shri H. S. Shahani
Joint Educational Adviser (Tech.)
Ministry of Education and S.W.
New Delhi.
- 33 Shri C. S. Sridharan
Asstt. Director General (Agricultural Engg.)
Indian Council of Agricultural Research
New Delhi.
- 34 Shri B. N. Guha Biswas
Director of Training
Directorate General of
Employment and Training
New Delhi.

Secretaries

- 35 Shri K. R. Sivaramakrishnan
Director (Technical Education)
Planning Commission
New Delhi.
- 36 Shri M. S. Srinivasan
Deputy Educational Adviser (Tech.)
Ministry of Education and S.W.
New Delhi.

APPENDIX I

Position Paper for the Working Group on Technical Education

POSITION PAPER FOR THE WORKING GROUP ON TECHNICAL EDUCATION

I INTRODUCTORY

The last half of this century has transformed our environment, perhaps radically, and brought more changes in our lives and thinking than in any corresponding period in history. These are the consequences of discoveries of sciences and applications of technology. The concept of absolute knowledge in the sense of storing all knowledge is perhaps no more relevant today. Our efforts for reconciling the traditional concepts and ways with the demands of technological age cannot provide simple solutions for our difficulties and complexities based on such stored knowledge. Frontiers of knowledge are themselves expanding rapidly making it possible to devise newer and more efficient methods of solving problems of the society. Education must therefore make efforts for securing knowledge and mastering modern skills and methods than merely storing and distributing the traditional ones. For this purpose of training of mind and mastering of skills and for harnessing science and technology to profitable and productive processes of economic growth and social well-being, the technological education system has to be continuously reviewed and adopted. This has indeed been the basis of our efforts during the last three decades, the result is that there is a well-organised structure and a wide network of technical institutions offering different types of programmes: craftman courses, technician (diploma) courses, graduate and post-graduate courses, etc., catering to the various levels of knowledge, skills and competences required by the economy.

II REVIEW OF THE PRESENT POSITION

CRAFTSMEN COURSES: FACILITIES AVAILABLE

(1) **Vocational Training** — Training is imparted in 32 Engineering and 22 non-engineering trades approved by the National Council for Training in Vocational Trades to young people within the age group of 15 to 25 years. For this purpose 357 Industrial Training Institutes with an overall capacity of 1,55,000 training places have been established in the various parts of the country. Period of training ranges from 1 year to 2 years. The Industrial Training Institutes are also used as Basic Training Centres for the Apprenticeship Training Programmes under the Apprentices Act 1961. The 103 trades designated under the Apprentices Act follow our national classification of occupations and cover 216 industries.

Craft Instructor Training — There are seven Central Training Institutes for training of Instructors under the Directorate General of Employment and Training. These Institutes conduct regular, refresher and retraining programmes for the Craft Instructors in various engineering and non-engineering trades. The Instructor-trainees are deputed mostly by the various Industrial Training Institutes and Industrial Establishments in the country.

At the end of the last decade, it was realised that higher or advanced levels of skills were required by the industry both in Public and Private sectors for working on the more modern and highly specialised type of machine tools and equipment coming to be used extensively. To meet this need the following institutes have been established:—

(i) *Advanced Training Institute, Madras*—The advanced Training Institute, Madras, imparts training in Advanced Vocational skills such as Tool Design, Tool and Die-Making, Heat Treatment, Metallurgy, Machine Tool Maintenance and Advanced Welding etc.

(ii) *Foreman Training Institute, Bangalore* — The Foreman Training Institute, Bangalore imparts training not only in developing further skills but also in managerial skills for first line supervisors.

(iii) *Central Staff Training and Research Institute, Calcutta*—The Central Staff Training and Research Institute set up at Calcutta is charged with the responsibility of conducting training programmes for officers and staff of the Central and State Governments and from industry, who control, regulate and direct Vocational and Apprenticeship Training Programmes. This Institute is also involved in the Research and Developmental activities in the field of vocational Training.

(iv) *Advanced Training Institute in Electronics, Hyderabad*—The Advanced Training Institute in Electronics, Hyderabad, has been set up last year to provide training at Craftsmen and Technician level for the electronic personnel required in the country.

TECHNICIAN COURSE: FACILITIES AVAILABLE

(2) **Post-Matric Technical Education** — Diploma level courses for the training of middle level man power needed for a wide range of professional duties, for application of knowledge in field operation, in production and construction, testing and development etc., and such functions are offered in 291 polytechnics with an annual enrolment capacity of about 50,000 students. They offer a variety of specialization in engineering and technology as well as in a few non-technological fields. The list of courses offered at these institutions is placed at Annexure 'A'. The courses are normally of three years duration where full-time institutional instruction is offered and 3½ to 4 years when instruction is on a Sandwich or on part-time basis. Recently a number of diversified courses and facilities for evening part-time education have also been provided in some polytechnics situated in metropolitan cities where the demand for such courses exists.

About two dozen Women Polytechnics with courses of special interest to, and employment potential for, women, have also been established, particularly to cater to the needs of the socially/economically inhibited classes who might be reluctant to take advantage of the facilities generally available in the regular polytechnics.

The products of the diploma course are expected to take up supervisory positions in field and industry.

DEGREE LEVEL: FACILITIES AVAILABLE

(3) **Degree level**—For the professional engineers and technologists, facilities for technical education are available in 141 engineering colleges offering courses leading to the award of Bachelor Degree in Engineering and Technology. The total admission capacity annually for these courses is of the order of 25,000. The types of courses at these institutions is given in Annexure 'B'. The duration of most of these degree courses is five years and with the new pattern of Secondary Education of 10 + 2, it is expected to change over completely by 1981-82 to a duration of four years.

POST-GRADUATE COURSES: FACILITIES AVAILABLE

(4) **Post-Graduate Courses**—For the benefit of those who have higher level academic achievements as also for undertaking research and development activities in engineering and technology, post-graduate courses have been offered widely in the various selected institutions offering degree courses. The number of the institutions offering such post-graduate courses is 65 with an annual intake capacity of about 2,000. The types of courses offered are listed in Annexure 'C'. These courses normally lead to the Master's Degree in the concerned discipline and are of two years duration. Facilities also exist at these centres offering part-time courses at the Post-graduate level for those who are already in service. Duration of such courses normally is three years.

MANAGEMENT COURSES: FACILITIES AVAILABLE

(5) **Management Education**—Any effort at improvement of the utilisation of available resources and maximisation of results has necessarily to take into account better concepts of management and organisational development of the system as a whole. With this in view a chain of institutions numbering about 30 mostly in the University sector offering management courses both at the First Degree and Advanced levels has been started. The courses offered at the various institutions to date cover training at the Master's Degree level for the M.B.A. degree with an annual admission capacity of about 1000.

III INSTITUTIONAL FRAMEWORK

As has been mentioned above, the Vocational Training/Craftsman Courses are offered at the Industrial Training Institutes. The Diploma courses are offered in the Polytechnics which are widely spread over all the States and Union Territories and are affiliated to the respective State Boards of Technical Education who lay down in general the levels and standards of the courses and guide the system of evaluation of the students appearing at the examination. Degree and Post-Graduate courses are offered in colleges affiliated to the various Universities, certain University Departments, and institutions declared as of national importance or as deemed Universities.

(2) **Indian Institutes of Technology**—These are our apex institutions for engineering education and research. Each Institute conducts a First degree course and Master's Degree course in a wide range of subject fields, and also offers facilities for Research and Doctoral work. The main emphasis at the Institutes is on the Post-Graduate studies and Research with an inter-disciplinary approach. To this end each Institute has developed good departments of Physics, Chemistry, Mathematics, and Social Sciences which inter-act with the departments of Engineering and Technology. The student enrolment at the Institutes at the Undergraduate level is limited to 1250 and admission at the Post-Graduate level is designedly kept at about the same order as in the under-graduate courses. The Institutes are in various stages of consolidation and development; the courses being offered at the various Institutes are listed in Annexure 'E'. As part of the national plan of science and technology, five Centres of Advanced Study and Research have been set up in the Indian Institutes of Technology in Energy Studies (Delhi), Material Science (Kanpur), Cryogenic Engineering (Kharagpur), Ocean Engineering (Madras) and Resource Engineering (Bombay).

(3) **Indian Institutes of Science, Bangalore**—The Indian Institute of Science, Bangalore the oldest and leading post-graduate and research centre in Science and Engineering has facilities in special fields which include Electronics and Communication Engineering,

Aeronautical Engineering, Heat and Power Engineering, High Voltage Engineering, Power Engineering, Bio-Chemistry, Chemistry, Physics and Mathematics. A major Centre in Automation and Control Systems and another in Electronics Design Technology are in the process of establishment.

(4) **Regional Engineering Colleges** — Fifteen Regional Engineering Colleges have been established in various States as a joint and co-operative enterprise of the Central and the State Governments concerned. Each Engineering College is functioning as an all-India institution admitting students and recruiting faculty from all parts of the country. Fifty percent of the admissions of these institutions (each of which is being equipped for a total annual students intake of 250) is reserved for students from the other States than the ones in which they are located. In addition to the under-graduate courses these Colleges (which are academically affiliated to the Universities in the respective regions and administratively autonomous being managed by Board of Governors) also offer Post-graduate courses in various subject fields. A list of courses offered both at the Under-graduate and Post-graduate levels at these institutions is at Annexure 'F'. Special feature of some of these institutions are the industrially oriented Post-Graduate courses in Engineering and Technology to train specialist Engineers for Design, Construction and Production work.

(5) **State Colleges and University Departments** — In addition to the above institutions offering courses at degree and post-graduate level, there is a wide net work of engineering colleges established and administered by the State Governments, Universities and private agencies; they are also affiliated to the respective Universities, and offer degree courses in a variety of subject fields. Some of them are more than a century old and have been pioneers in engineering education in the country. Many of these State colleges and University Departments are making significant contribution in the field of technical education.

(6) **Special Institutions** — In additions to the above institutions there are certain specialised institutions which offer education/training in specific fields—

(i) *Indian Institutes of Management* — Three Institutes of Management have been established at Ahmedabad, Calcutta and Bangalore. Ahmedabad, and Calcutta Institutes were established quite some time ago and the Bangalore Institute has just graduated its second batch of full time students for the M.B.A. programme. These Institutes, in addition to the offering of the M.B.A. courses at pre-employment stage for fresh University graduates, offer advanced fellowship programmes in various areas of their specialisation. They also conduct a number of in-service Executive Development Programmes and are concentrating on different sectors of the economy such as Rural Development, Energy, Transportation, etc.

(ii) *National Institute for Training in Industrial Engineering, Bombay* — offers a two years post-graduate programme in Industrial Engineering as also a number of Executive Development Programmes and Unit based programmes in various areas of specific interest to specific employing agencies.

(iii) *National Institute of Foundry and Forge Technology, Ranchi* — offers a special post-graduate training programme of 12–18 months duration in Advanced Foundry and Forge techniques for personnel from the industry.

(iv) *Indian School of Mines, Dhanbad* — which has been declared a deemed University is a specialised Centre for Under-graduate and Post-graduate studies and research in Mining, Applied Geology, Petroleum Technology and Geo-Physics.

(v) *Technical Teacher's Training Institutes* — at Bhopal, Calcutta, Chandigarh and Madras offer special 'training' to serving teachers of polytechnics.

(vi) *Other Institutions* — There are also other institutions offering courses in architecture and town planning (such as School of Planning and Architecture at New Delhi which offers degree course in Architecture and Post-graduate course in Town Planning with specialisation in Urban Design, Housing and Community Planning, Transportation and Traffic Engineering). Sugar Technology (National Institute of Sugar Technology, Kanpur), Food

Technology Industrial Design (National Institute of Industrial Design, Ahmedabad), Marine Engineering (College of Marine Engineering, Bombay), etc.

IV QUALITY IMPROVEMENT PROGRAMME

UPGRADING OF THE FACULTY AND IMPROVEMENT OF INSTRUCTION STANDARDS

By the end of the Third Plan in 1966, most of the above institutions had been started and it was considered necessary to lay special emphasis thereafter on consolidation and development of the facilities rather than on setting up of additional institutions. Accordingly a special scheme of Quality Improvement was launched for raising the standards of instruction/training at these institutions. The measures under the Quality Improvement programme included the development of faculty, revision and improvement of curriculum including laboratory practices, and schemes for industrial training and refresher courses for the teachers. Facilities are provided at 14 Centres including the I.I.Ts, Roorkee University, and the Indian Institute of Science, Bangalore for enrolling serving teachers sponsored by the various institutions/agencies for Master's Degree and Doctorate Degree programmes. In this efforts of updating and upgrading the level and standard of the faculty, provision was also made for appropriate industrial training for periods of 1-3 months. Short-term and Winter Schools offering special orientation courses, refresher courses etc., were also organised both at these advanced centres and others wherever facilities could be identified and organised. So far about 26,000 teachers have taken part in these programmes. (Annexure 'H' gives the number of teachers participating in the various programmes). Curriculum Development Centres were also set up in respect of the various branches of Engineering and Technology to update the curriculum at the under-graduate level in consultation with the users of the institutional products. These Curriculum Development Centres have also engaged them selves in developing concepts for laboratory lay-out, workshop practice etc.

(2) On a similar analogy of the teachers for degree level institutions, considerable efforts have also gone in for the training of teachers for the technician courses. Because of the large number involved and the specialised training required it was considered to have a specific institutional frame work for this type of programme and accordingly four regional institutions were started for this purpose. These Technical Teacher's Training Institutes at Bhopal, Calcutta, Chandigarh and Madras have been offering a regular two-years course for serving teachers from the polytechnics in the respective regions. This two year programme consists of updating of subjects of the concerned teachers, industrial training and pedagogic training. In addition to these specific programmes, these institutes have also done work in areas of curriculum development, Short-term courses, refresher courses, production of teaching materials and textbooks etc.

APPRENTICESHIP TRAINING PROGRAMME

(3) **Apprenticeship Training Programme** — With the sparsely distributed and relatively under-developed industrial base in the country and with a large number of technical institutions having been situated not within the easy access of industrial establishments, it was not possible in the earlier years of planning to arrange for in-industry training of all technical students. Nonetheless it was recognised and it is imperative that the institutional training should be supplemented with appropriate field/industrial training for adequate practical exposure to practical experience. With this end in view a practical training stipends scheme was operated in a limited way in cooperation with the then existing industrial establishments. Later on, however, a massive apprenticeship training programme was introduced in 1962 for the vocational training level and in 1974 for the Diploma and Degree levels under the Apprentices Act, 1961 as amended. While for the craftsmen course, training is provided within the course framework, the training at the degree and diploma level is provided after the institutional courses for the duration of a year. This is expected to be both an extension of the educational process as also a preparation of the candidates for later employment.

V CONTINUING EDUCATION

Recognising that opportunities for technical education might have been denied to some on various considerations of economic/income constraint and other factors, efforts are being made to provide for a vertical advancement of the personnel from one level of a technical education/training to the next higher one. Thus a worker with a National Trade/Apprenticeship Certificate, can take on a diploma course and similarly facilities for some who have a proven ability for academic achievement might go for specially designed degree courses in some of the institutions. Availability of part-time courses, evening courses, etc., in certain of the centres also provides for this vertical mobility. These are, however, offered at present on a limited scale and within the structure of diploma/degree courses. Part-time post-graduate courses for serving engineers also cater to those who are desirous of these facilities at higher levels.

VI PROBLEMS AND PERSPECTIVES

Significant as the achievements in creating facilities for technical education in the country over the last three decades are, there appears a good need now for total review of the system that has been built up, with a view to make it more relevant and effective to the national needs. For historical reasons, the technical education system has been more or less inward looking; the impact of the system on the other elements of the economy is yet to be objectively assessed. The professional engineer or technologist is not a solitary individual unconnected with the happenings in the other spheres of the system. Of immediate concern, perhaps, for the professionals is, no doubt, the chosen field of his profession but the interaction with the allied professionals, as also the neighbouring community has also to be taken into account to determine the professionals, place in the whole system.

(2) **'Wastage' in the System** — To take first the building of the competence of the professional itself, we might try to understand the efficiency with which the system has worked so far. Considerable

facilities have been created in the institutions over the last number of years and even on the basis of the non-uniform and separate evaluation results themselves, one is rather constrained to find that there is a large wastage in the efforts put in the institutions. The figures of intake and outturn at the degree and diploma level are given at Annexure 'F', which reveal that the wastage at the degree level is of the order of about 20 to 22 % and at the diploma level nearly 52 %. The figures for the outturn at the degree level include those of the IITs also. Taking into account that the wastage at the IITs is very marginal, the wastage naturally is largely accounted for by the other institutions and we may, therefore, say that this would be of the order of about 30%. Similarly at the diploma level this is as high as 52 %. These figures, if we remember our experience with the system for the last three decades, are not flattering. The Institute of Applied Manpower Research made a study of this problem some time ago. From a survey made by the Institute of the reaction of a few of the students that had undergone these courses, the possible reasons for wastage were stated to be:

- (i) lack of necessary aptitude for the course among the concerned students;
- (ii) inadequacy of instructional facilities;
- (iii) ineffective teaching, possible because of the teachers not being trained; and
- (iv) a heavy curriculum.

Valid as these reasons are even today, there may be many other contributory factors also such as:

- (i) non-selective admission of students to the institutions;
- (ii) changing mix of urban and non-urban background of students without corresponding modifications/orientation of educational methods contributing to the detriment of the non-urban element;
- (iii) inadequate utilisation of even the existing instruction facilities;

- (iv) in spite of adequate capital investment and hardware provided in the institutions quite often, the lack of appropriate matching provision for adequate departmental operating and training costs;
- (v) insufficient development of the correct attitudes to the professional education by both the teachers and the students; and
- (vi) external factors, such as lack of motivation because of inadequate or assured employment opportunities at the end of the course.

(3) The intensive study of this problem of wastage is very necessary. This is needed on both academic and planning considerations. Any effort for improvement of existing courses, introduction of new courses, diversification of programmes etc., would be helped a great deal by such feedback information as would be available from such a study. From the planning point of view, any effort to reduce wastage would contribute to the efficiency of the system as such and thus provide for out-turn of additional manpower that may be required without further inputs.

(4) **Improvement of the System** — Any efforts at improvement of the system have naturally to take into account the various elements which contribute to its weaknesses as mentioned above. Under the “Quality Improvement Programmes” some steps have been taken to tone up that aspect of the system which concerns the teaching-learning process. Apart from these efforts, which, of course, require to be strengthened to a very great extent, there are other steps which might enhance the effectiveness of the system. Some of these are enumerated below:

(a) *Special remedial courses for non-urban/non-elite students* — It would appear that the courses at present offered, based as they are on urban aptitudes, situations and characteristics, tend to cater to the needs of the elitist group. A majority of the students are from the non-urban sectors and from the institutions in the mofussil/interior areas. The background of the students also is not uniform in that many of the students may be first or second

generation learners. Because of the lack of communication facilities on the same basis as his urban counterpart, such a student would require to be given special orientation/remedial course to be brought on par with the other students. Not only that, even the programmes sometimes have to be appropriately changed to suit his non-urban experience and background.

(b) *Multiple entry and flexibility* — At present the attitude and aptitude of the students who take these professional courses have no obvious relationship with the professional courses offered to them. Quite often both because of the lack of aptitude, or absence of developing the correct attitude, or because of various other factors such as the duration of the course, the sudden change the student has to undergo in the professional courses as compared to his earlier academic experience, etc., have an adverse effect on his performance. Again for reasons beyond one's control or because of economic and social background etc., the student might have taken up a different course and might like to opt for a professional course at a later stage. Even within the professional courses, the student might like to change either the branch or particular study which he has chosen earlier, or the orientation of this particular course. Occasionally the possibility of the student having to migrate from one place to another within the country itself also exists. The present systems is rather a straight jacket one, with more or less a single entry point and perhaps a rigid course structure. To allow for different types of contingencies, it is necessary to think in terms of multiple entry points (depending upon the earlier academic/field experience) as well as of flexibility of the course structure and organisation.

(5) **Need for review of course content** — It is necessary to have a good look at the courses being offered now not merely for the organisational purposes of "graded" facilities. Mere accumulation of information is not knowledge, and complete knowledge by itself does not give the necessary wisdom. The purpose of education is not to produce "educated" individual at one stretch by putting all information and knowledge into course at one time, but, on the other hand, it is to take the individual to progressive stages where he would be in a position to acquire what further information

and knowledge he wants for his future activities. If we accept this philosophy, it is to be conceded that what is important is not to "load" the curriculum but to arrange it in such a way that different requirements and needs of the individual's calling are provided in the process of life-long education. The credit system no doubt can go quite some way in this regard. But a deliberate attempt is to be made to recognise the fact that many of those who pursue these courses of studies will remain as technologists whereas quite a few of them might end up as managers. Further even a technologist has to have sufficient insight into the marginal areas of the allied fields, if not indepth study in that field itself. The course content therefore should be so modified as to allow for the technologist to have an overall view in addition to this core discipline, e.g., the professional may have to have managerial training in addition to his professional calling. The education in our institution campuses should break away from the rigid stand of a uni-disciplinary approach and a fixed framework but cater to a larger interest to acquaint and give an insight in various fields of expertise of which the institutional faculty and facilities are capable of, by offering on a massive scale refresher courses, study programmes, etc. Attempts should also be made even in the undergraduate programme to provide for an intensive managerial training for those who desire it within the course frame work apart from those who want to pursue the technological programme. Complementary courses might also be provided for the technologist to acquaint himself with the necessary management techniques and practices, and vice versa.

(6) **Diversification, new courses, etc.** — The infra-structure that has been built up appears to be quite adequate to meet the major requirements of the system for most of the efforts mentioned above. However, with the changing technology and development there may be many areas where specialised personnel are required. Many of the emerging areas have been enumerated in Annexure 'G', for industrial and rural requirements, etc. A cluster of courses might be required, organisation of diversification on a large scale and occasionally new courses also might be called for. This has to be looked into by appropriate agencies taking care at the same

time to see that the fresh inputs for any such effort would be marginal and capable of diversion, whenever required. This is easily said than achieved in practice, but nonetheless the issues are important to be considered.

(7) **Proliferation of courses** — The facilities available at various levels right from the craftsman to the post-graduate level are adequate and any further expansion of these facilities has to be gone into only after a deep study and with caution. The ratio between the graduate, technician and craftsmen in some of the more industrialised economies is of the orders of 1:3:5; facilities for education being also provided for in that order. With us, the facilities provided at the graduate and technician level are in the ratio of 1:2, but in the output the ratio comes down to about 1:1. Organisation of any new course/diversification at one or the other levels has to take into consideration a systematic study of the manpower requirement and utilisation, linked, with the occupational structure of the various employing sectors. It is, therefore, necessary to keep this in mind while organising any new course/diversification at any level right from the craftsmen to the post-graduate so that the entire spectrum of activities in the employing fields are kept in mind. This is not to forget the needs of the research and development activities where academic considerations might point to growth potential at a particular level.

(8) **Sisterhood programmes** — While there is no doubt that certain segments of the Technical Education system have built up strong potential (IITs, University Departments, some of the State Colleges, for example), there are others which are rather weak. It is here that practicable and effective system of co-operation programmes between institutions of different types at different levels are to be organised. Desirable are the programmes of exchange of teachers on short-term and long-term, on a massive scale planned in relation to specific levels and goals of development, providing opportunities and appropriate programmes for making available at specific and for known periods the facilities available at the better institutions for the use of the staff of the not-so-well-off institutions, organising of special programmes of refresher

courses, extension lectures, etc., by the faculty of the better institutions at the other institutions etc. Efforts at curriculum development, faculty development etc., though now well organised and recognised, have yet to be gone through on a much larger scale and in a more purposeful way. Preparation of manuals for lectures, workshop practice etc., production of text-books, preparation of teaching aids etc., also have to be undertaken by all the institutions by pooling the resources that are available.

(9) **Industry-Institution collaboration** — For the improvement and further development of the system it is necessary that there is interaction between technical institutions and industry and other field organisations. There has been an awareness of the need for such interaction: creation of agencies such as Industrial Liaison Boards in the States, Co-option of Industrial representatives on the various academic bodies such as the Boards of Management, Boards of Studies etc., and the system of Visiting Professorship/guest lecturers etc., has helped to an extent in breaking this ground. But much more remains to be done in this direction. This initiative so far has been with the technical education system with the industry and field organisations, unfortunately, not always showing more than lukewarm interest. This attitude had radically to be changed in that both technical institutions, who produce manpower for the industry and the field organisations, and also the latter themselves are partners in the same enterprise of developing the economy; and it is high time that this responsibility, is duly realised by setting up this interaction. The employing sector should go all out to associate and involve itself in all matters and at all levels of technical education, planning and implementation. On the other hand, the technical education system should make this possible by appropriate incentives and safeguards for such involvement by personnel from the industry and employing organisations. A stage has been reached where purely academic consideration in a system of professional education should not be the criteria in determining about the suitability of personnel for technical education. Sufficient credit should be given by the educational authorities for giving appropriate recognition for field expertise while considering the faculty requirements. Schemes such as

adoption of institutions by industry etc., which have been initiated, should be encouraged totally by the industry.

(10) **Improvement of teaching methods** — Production of textbooks, other teaching material and teaching aids which have been started now on a small measure have to be considerably stepped up. Manuals for better utilisation of the laboratory and workshop equipment, use of the library as a resource centre both by the teachers and the students have to be encouraged. In all these attempts of preparation of teachers and students materials, emphasis also has to lay on the possible slower comprehension of the non-urban student to the methods employed in the urban situation.

(11) **Integration of practical training with the institutional courses**—Because of the lack of sufficient 'training' places in industry and field organisations, the provision of training under the Apprenticeship Training Programme has been after the institutional course. For a more effective and co-ordinated approach, it is necessary to think in terms of integrating the practical/industrial training with the institutional course itself, at appropriate stages of the course. This will lead not only to better supervision but also better comprehension of the field precepts and practices by the student.

VII RESOURCE BANK FOR TECHNICAL i.e., DOMESTIC AND INTERNAL

In terms of the magnitude of human resources and expertise available, and of physical facilities created over the last three decades, the system of technical education has become a formidable reservoir of technical expertise, which, perhaps, no other sphere of the economy has developed in such a concentrated, manner. What is, therefore, required is to utilise this bank of expertise for the improvement of the system itself as also for the improvement of other elements of the economy.

2 As pointed out, the potential for technical education system both in terms of human and physical resources are so large that

it is worthwhile for us to now think from the national stand-point to have a pooled bank for technical expertise and aid, both for domestic or 'external' purpose. A well organised and processed pool of such resources would be of great advantage for any need in any sector of the economy of the country including the technical education system itself for delivering many of the responsibilities for which now outside help is sought. Indigenous expertise has been sufficiently appreciated and, perhaps, in most of the other countries, we might not have anything better or even as good as what we have among the professionals in the country. Except, therefore, in special fields and areas of highly sophisticated technology, perhaps our expertise could be easily drawn up even for giving appreciable aid to many of the countries in the neighbourhood and elsewhere. Concerted efforts have, therefore, to be made to channelise all this expertise available in the technical education system so that it will permit the system to grow vertically and also to support itself since the resources generated that way could not be in any way less considerable. This will also ensure job satisfaction to those who have expertise and higher attainments in sophistic technology and thus braindrain from the country.

VIII RURAL AND COMMUNITY DEVELOPMENT AND SERVICES

As mentioned above, in addition to his own field of specialisation and the group in which he works, the professional has also to discharge his responsibilities satisfactorily both to himself and others in the community. It is necessary, therefore that the professional instead of being in isolation as an individual under training, has also an in built training/education in the environmental aspects so that he will be able to appreciate when he later enters the profession of the various aspects that come to play on his role as a professional in the community.

(2) Even as a professional he is not to be considered as if he is in his ivory-tower. It is necessary that the institutions also are considered as part of the total community activities. While

considering the totality of his activity, it becomes imperative that the courses offered at institutions relate to the various demands of the neighbourhood in particular and the community in general, both at present and in the foreseeable future. The education which is offered in the institutions should be of relevance to the various problems that are posed by the society. It is not correct that in their attempts to attain excellence or even the highest standards that the immediate need of the society are forgotten. The various sector such as rural development including food and agriculture, energy, natural resources (water, mineral oils, forests, etc., both renewable and non-renewable), transport and communications all require immediate attention from the institutions and the courses offered therein. Here it should be recognised that this sort of platitudinous statement is easily made than could be practicable. In our current system of technical education, the main elements of human resources, i.e., the faculty expertise and the student power, if these are to be utilised for the benefit and advantage of the community in the specific sectors mentioned above, a great deal of attention is to be paid as to what exact role these elements have to play in the total set up, as otherwise the danger of the institutions degenerating into more social service organisations, forgetting their real objective of technical education and training is always present. The academic curriculum for the students should be so organised as to give appropriate credits for practical projects/service to be made by the students as part of their curricular programme in the investigations taken up by the faculty in the above sectors. Without dilution of the vigorous and curricular content and bringing to bear upon it professional requirements, the possibilities of dovetailing the investigations in the programmes in institutions has to be worked out carefully. Similarly, the investigations carried out with the existence of the students should be amenable to proper supervisions, scrutiny and appropriate assessment by the faculty who in turn will carry it on further for the benefit of the community without sacrificing the permanent interest of either the institution or the community into which they are looking for the time being. This again underlines the factor that any attempts to take all social projects naturally will have to consider projects of long-term and permanent benefits instead of

issues of local popularity or short-term propaganda. This sort of interaction with the problem of the society would help the institution/faculty/the individual students to grow both professionally as also in relevant fields.

IX FINANCING OF TECHNICAL EDUCATION

(1) **Increasing costs** — This brings us to the issue of financing of the technical education system as such. By and large, the efforts at building up and development of the system has so far been under official auspices – either Central and/or States. However, looking into the enormous costs involved, the maintenance of these courses/institutions and the increasing prices around of men and material, it would not be difficult to envisage a situation where let alone the sponsored agencies, but even the Government agencies, would find it difficult to adequately meet the rising cost of technical education. This is a matter of serious concern and has to be faced squarely before it is too late when this system which has been built with so much of care might crumble because of lack of adequate attention.

(2) **Resource Generation by Technical Institutions** — It is true that considerable efforts have to be made by the institutions themselves for augmenting their resources, by way of various measures for resource generation such as consultancy practice, servicing and testing, production, etc. However, as was pointed out earlier in connection with the involvement of the system in community services, here again one should not lose sight of the primary objective of the system as such. Any attempt at raising the resources should have only a secondary role that too complimentary to the academic culture of the system and not for its own sake. If this obvious principle is accepted then the limitations on the institutions raising their own resources will become evident. So, we are left with the major issue again of the provision of adequate funds for the technical education system. It is here, perhaps, one should consider the ways and means by which large users of the products of the system also share the responsibility adequately for the cost of production. There have been suggestions

over the years in this direction for motivation by way of incentives, or raising of resources by levying a technical education cess on the users etc. Certain incentives, of course, have been offered by giving to an extent exemption for industry in Income Tax, towards contribution to educational programmes and for a cess in the research and development establishment for R & D purposes. But, however, this has not resulted in a large shift and on the whole most of the burden has been solely on that of the Government. This has been because technical education has been considered as part of social service and governmental responsibility for the social welfare programmes has had to take care of such programmes. It is now necessary for us to have a detailed and fresh look at this issue.

X NATIONAL ASSESSMENT AND ACCREDITATION AGENCY

BOARD OF ASSESSMENT OF QUALIFICATIONS

The Board of Assessment of Qualifications of the Government of India, which also deals with professional qualifications and equivalence of various awards has a limited view of assessment for a specific purpose, i.e., for governmental employment. Further, as it is practiced, the work of the Assessment Board is a sort of one time evaluation based on a minimum requirement.

(2) For a healthy and effective growth, what is required is a sort of continuous and objective assessment aiming at higher and still higher standards. Even though many agencies, particularly, statutory agencies are involved and any such attempt may not be looked upon with unmixed favour, the point to be remembered is that we should without further delay, strengthen our system, by identifying the weaknesses and strength of a particular sector/course/institutions so that there is adequate motivation and direction for further improvement. This comprehensive purpose of assessment, not limited for any objective of recruitment by official agencies only, will act as a spur when such evaluation and assessment is done periodically. This agency for

accreditation and evaluation of standards should be a national agency, with perhaps, regional and sectoral wings, as may be required. Professional organisations and persons of standing in the profession and representatives of accredited user agencies should be intimately involved in the work of an agency. A system of frequent and periodical evaluation with provision for a graded scale of attainment of individual courses/departments should be the objective. Such an agency might work under the auspices of the Ministry of Education but not as a part of it; it should be an autonomous organisation so that it would be free to draw upon expertise wherever available.

(3) Monitoring and Information System: Manpower planning—

The setting up of such an agency, of course, presupposes the availability and easy flow of the required information from the various organisations to this agency. A national (and regional) agency for such an information system should be built up without further delay. Any monitoring of man power requirements, availability and utilisation, naturally will be depending upon such an information system being readily available.

X SUGGESTED FURTHER STUDY

The suggestions might be considered along with any other that might be forthcoming through perhaps sub-groups which would have an indepth study of the connected problems. It is suggested that sub-groups might be in the following areas:

- i. Post-graduate education and Research.
- ii. Under-graduate education.
- iii. Technician education, and
- iv. Management Education.

ANNEXURE -- A

All India subject-wise summary of diploma courses in common polytechnics in Engineering/
Technology.

<i>Sl. No.</i>	<i>Subject</i>	<i>Sanctioned intake as in 1967</i>	<i>Present sanction- ed intake</i>	<i>Actual Admission</i>	<i>Outturn</i>
1	2	3	4	5	6
1	Civil	14695	12428	12568	5497
2	Mechanical	15862	12032	12369	4935
3	Electrical	12925	10855	11046	3776
4	Electronics/Tele-communication/Ind. Electronics/ Radio/T.V./Sound Equipment	410	1103	1178	574
5	Mining	260	350	352	84
6	Metallurgy	240	302	323	114
7	Automobile	552	956	922	490
8	Production Engineering Technology	20	208	183	62
9	Pharmacy	520	1878	1798	1265
10	Chemical Engineering/Operators	180	375	378	127
11	Architecture	30	60	61	22

1	2	3	4	5	6
12	Textile Technology/Chemical/Engineering	575	656	685	445
13	Ceramics Technology	36	115	117	24
14	Instrument Technology/Instrumentation Control	—	110	122	32
15	Refrigeration and Air Conditioning	—	200	168	47
16	Printing Technology	440	520	508	282
17	Leather/Footwear Technology	125	155	165	85
18	Paper and Pulp Technology	90	100	92	98
19	Commercial Practice /Secretarial Practice & Steno	95	527	511	94
20	Construction Technology	—	30	36	—
21	Tools Technology/Tools Engineering/Tools Design	—	125	117	48
22	Plastics Technology	—	60	70	—
23	Town and Country Planning	—	20	9	9
24	Public Health Engineering	—	30	30	—
25	Agricultural Engineering/Agro. Industrial Engineering/ Agro Mechanical	—	210	226	55
26	Electrical Machine & Appliances	—	30	30	3
27	Knitting Technology	—	30	33	8
28	Garment Technology/making	—	37	39	11

29	Ground Water Engineering	—	15	4	3
30	Mechanical and Electrical Engineering (combined)	—	400	208	119
31	Drilling Engineering	—	10	11	9
32	Mines Surveying	—	10	12	9
33	Petro-chemical Technology/Engineering	—	65	51	149
34	Material Handling Technology	—	20	—	2
35	Power Plant Engineering	—	20	—	1
36	Technical Sales Representation/Salesmanship	—	45	21	6
37	Man-Made Textile Technology/Man-Made Fibre	—	70	73	27
38	Man-Made Textile Chemistry	—	70	71	50
39	Paint Technology	20	20	25	15
40	Commercial Artists	—	100	103	101
41	Cinematography	—	30	32	12
42	Fisheries & Navigation	—	20	20	18
43	Applied Mechanics & Electronics	—	20	15	—
44	Machine Tool Operation & Maintenance	—	45	46	12
45	Welding & Sheet metal/Welding Technology	—	27	19	4
46	Costume Design & Dress Making	—	90	56	—
47	Wool Technology	—	30	28	—
48	Materials Management	—	20	23	—

1	2	3	4	5	6
49	Tube Well Engineering	—	30	30	—
50	Home Science	—	15	16	—
51	Structural Fabrication and Erection Engineering	45	35	20	—
52	Optometry and Repraction	—	20	10	—
53	Sugar Technology	—	20	20	8
54	Industrial Engineering	—	8	5	2
55	Medical Equipment	—	10	6	—
Total		47120	44769	44961	18704

All India subject -wise Summary – Girls Polytechnics – 1975

<i>Sl.</i>	<i>Subject</i>	<i>Present Sanc- tioned intake</i>	<i>Actual Admis- sion</i>	<i>Out-turn</i>
1	Civil Engineering	260	268	43
2	Radio Engineering/Electronics/Tele Communication	576	516	240
3	Interior Decoration & Display	60	45	15
4	Costume Design & Dress Making	405	375	180
5	Commercial Practice/Stenography & Sec. Practice	1042	1079	424
6	Commercial Art	66	43	24
7	Architectural Assistantship	234	247	54
8	Library Science	250	209	118
9	Medical Laboratory Technology	75	35	14
10	Beautification	20	17	—
11	Pharmacy	179	162	114
12	Home Science	30	50	—
13	Social Communication Media	40	30	22
14	Catering Technology	30	40	12
15	Industrial Technology	25	25	6
16	Cosmetology	10	4	4
17	Data Processing	10	3	3
18	Mechanical (Design & Drafting)	20	20	—
		3332	3168	1273

ANNEXURE—B

28

The Subject-wise distribution of the Sanctioned intake as in 1967, present sanctioned intake, Actual admissions and out-turn is given below:

<i>Sl. No.</i>	<i>Subject</i>	<i>Sanctioned intake as in 1967</i>	<i>Present sanctioned intake</i>	<i>Actual Admission</i>	<i>Out-turn</i>
1	2	3	4	5	6
1	Civil	6198	5258	5227	2986
2	Mechanical	6658	5387	5492	3794
3	Electrical	4684	4906	4866	2655
4	Electro/Tele Communication	744	1568	1506	942
5	Chemical	1569	1461	1466	1287
6	Metallurgy	943	748	684	455
7	Mining	205	180	199	21
8	a. Architecture (B. Arch.)	600	482	468	279
	b. Architecture (G.D. Arch.)		186	195	103
9	Automobile	30	36	33	29
10	Aeronautical	105	120	106	70

11	Agriculture	275	225	224	122
12	Pharmacy	364	693	660	480
13	Textile Technology/Chemical/Engineering	390	398	462	316
14	Production	90	154	151	73
15	Sugar Engineering/Technology	24	55	61	21
16	Petroleum Engineering/Chemical	20	25	25	12
17	Ceramics	42	37	23	16
18	Leather Technology	25	27	33	11
19	Instrumentation/Technology/Control	65	75	89	75
20	Instrumentation & Electronics		15	20	11
21	Plastics and Rubber Technology	23	43	43	34
22	Paints Technology	23	23	23	22
23	Pharmaceuticals and Fine Chemicals	18	18	18	19
24	Oil Technology	25	25	29	30
25	Oil, Fats and Waxes	16	16	16	15
26	Alcohol Technology & Industrial Ferment.	8	25	31	—
27	Food Technology	60	55	59	39
28	Bio-Chemical Engineering		15	15	9
29	Intermediates & Dyes	16	16	16	21
30	Applied Geology, Applied Geo-physics & Exploration Geo-Physics	40	55	41	9

1	2	3	4	5	6
31	Naval Architecture	10	22	41	17
32	Marine Engineering	—	73	63	8
33	Jute Technology	—	40	40	24
34	Mechanical Industrial	—	20	20	18
35	Man-Made Fibre	—	10	9	—
Total		25070	22492	22454	14073

ANNEXURE — C**List of Courses offered in P.G. degree level**

Sl. No. Name of the Courses

- 1 Civil Engineering
- 2 Mechanical Engineering
- 3 Electrical Engineering
- 4 Chemical Engineering
- 5 Food & Bio-Chemical Engineering
- 6 Pharmacy
- 7 Chemical Technology
- 8 Textile Engineering
- 9 Electronics & Communication Engineering
- 10 Metallurgical Engineering
- 11 Architecture
- 12 Mining Engineering
- 13 Silicate Technology
- 14 Applied Mechanics
- 15 Town Planning
- 16 Applied Geology
- 17 Space Engineering & Rocketry
- 18 Aeronautical Engineering
- 19 Operations Research
- 20 Exploration Geophysics
- 21 Regional Planning
- 22 Mineral Engineering
- 23 Industrial Management & Industrial Engg.
- 24 Agricultural Engineering

Courses offered in P.G. Diploma level

<i>Sl. No.</i>	<i>Name of the Courses</i>
1	Traffic Engineering
2	Refrigeration & Air Conditioning
3	Hydrology
4	Technology of Food & Drugs
5	Computer Science
6	Computer Control Engineering
7	Scientific Instrumentation
8	Instrumentation Technology
9	Highway Engineering
10	Irrigation & Hydraulics
11	Inland water navigation Engineering
12	Town Planning.

ANNEXURE — D**List of Courses offered in Indian Institutes of Technology****Under Graduate Level**

<i>Sl. No.</i>	<i>Name of the Courses</i>
1	Civil Engineering
2	Mechanical Engineering
3	Electrical Engineering
4	Chemical Engineering
5	Textile Technology
6	Metallurgy
7	Aeronautical Engineering
8	Mining Engineering
9	Agricultural Engineering
10	Naval Architecture
11	Architecture
12	Applied Geology
13	Exploration Geophysics
14	Electronics and communication

Post Graduate Level

Sl. No. Name of the Courses

- 1 Aeronautical Engineering
- 2 Agricultural Engineering
- 3 Chemical Engineering
- 4 Civil Engineering
- 5 Electrical Engineering
- 6 Electronics and Electrical Communication Engineering
- 7 Mechanical Engineering
- 8 Metallurgical Engineering
- 9 Mineral Engineering
- 10 Mining Engineering
- 11 Industrial Management and Industrial Engg.
- 12 Operations Research
- 13 City Planning
- 14 Regional Planning
- 15 Architecture
- 16 Applied Geology
- 17 Exploration Geophysics.

ANNEXURE — E**List of Courses offered in Regional Engineering Colleges****Under Graduate Level**

Sl. No. Name of the Courses

- 1 Civil Engineering
- 2 Mechanical Engineering
- 3 Electrical Engineering
- 4 Electronics and Communication
- 5 Metallurgy
- 6 Architecture
- 7 Chemical Engineering

Post Graduate Level

Sl. No. Name of the Courses

- 1 Civil Engineering
- 2 Electrical Engineering
- 3 Mechanical Engineering
- 4 Metallurgical Engineering
- 5 Public Health Engineering
- 6 Structural Engineering.

M.Tech. Industry-oriented Courses in Regional Engineering Colleges

Sl. No. Name of the Courses

- 1 Design & Production Engineering Machine Tools.
- 2 Electronics Instrumentation
- 3 Transportation Engineering
- 4 Chemical Plant Engineering
- 5 Advanced Physics
- 6 Advanced Engineering Mathematics
- 7 Hydraulics and Ground water Resources Engg.
- 8 Design & Production – Power Plant Machinery Hydro-Electric.
- 9 Design & Production – Power Plant Machinery-Thermal
- 10 Design & Production – Power Plant Machinery-Heavy Electrical Equipment.
- 11 Foundation Engineering (Applied to Vibratory System)
- 12 Engineering Materials
- 13 Design & Production Engineering Medium Duty Machines
- 14 Mechanical Shaping of Metals (Rolling, Forging and Heat Treatment)
- 15 Extractive Metallurgy and Foundry with emphasis on Alloy Steel Production
- 16 Production of Fertilisers.
- 17 Extractive Metallurgy
- 18 Foundry Technology
- 19 Public Health Engineering
- 20 Integrated Power System and Diploma courses in Metallurgy – Ferro Alloys Production.

Sl. No. Name of the Courses

- 21 *Marire Structure*
- 22 *Industrial Structures*
- 23 *Industrial Physics*
- 24 *Analysis and Design of Process Equipment*
- 25 *Production of Process Machines and Equipment*
- 26 *Design of Process Machines*
- 27 *Design & Production – High Pressure Boilers and Accessories*
- 28 *Design & Production – Heavy Machines with emphasis on mechanical equipment for steel plants.*
- 29 *Techrology of Metallurgical Furnaces*

ANNEXURE — F

ACTUAL INTAKE AND OUT-TURN FIGURES.

Degree Institutions

<i>Year</i>	<i>Actual Intake</i>	<i>Year</i>	<i>Actual Out-turn</i>	<i>% of Intake</i>
1966	23063	1971	17474	75.8
1967	23531	1972	15815	67.2
1968	17568	1973	15461	88.0
1969	16967	1974	13214	78.1
1970	17007	1975	13202	77.6

Diploma Institutions

<i>Year</i>	<i>Actual Intake</i>	<i>Year</i>	<i>Actual Out-turn</i>	<i>% of the out-turn</i>
1966	45923	1969	21476	46.7
1967	41917	1970	21921	52.3
1968	26669	1971	16019	60.1
1969	25604	1972	14746	57.6
1970	27056	1973	13129	48.5

ANNEXURE — G**I Courses in:**

1. Low Cost Housing
2. Food Preservation and Food Processing
3. Textile and Fibres with the emphasis on utilisation of all fibres and development of new fibres and design of efficient machinery for cottage industry.
4. Communication Technology System.

II Small and medium scale industry particularly with the emphasis on greater rural development growth will afford new courses on the following areas:

(A) Areas of Industrial Development:

<i>Sl. No.</i>	<i>Name of the Course</i>
1	Electronics
2	Agriculture based industry
3	Automobile
4	Building Industry
5	Railways
6	Fertilizers
7	Pharmaceutical
8	Power generation and distribution
9	Textiles
10	Refrigeration and air-conditioning
11	Highways
12	Ship building industry
13	Chemical industry
14	Agricultural Machinery
15	Machine building industry
16	Heavy Electrical equipment
17	Mining
18	Instrumentation
19	Petro-Chemicals
20	Plastics
21	Steel
22	Ceramics and glass.

(B) Areas of Rural Development

Sl. No. Name of the Courses

- 1 Minor Irrigation
- 2 Rural Water Supply and sanitation
- 3 Low cost housing
- 4 Agro-based industry
- 5 Consumer items – soap, oils, milk products
- 6 Food preservation
- 7 Handicrafts & garments
- 8 Marketing, distribution and sales
- 9 Servicing centres
- 10 Biogas technology
- 11 Rural electrification
- 12 Solar energy

(C) Areas in which changes in technology are expected during the next decades.

Sl. No. Name of the Courses

- 1 Packaging
- 2 Industrial fastners
- 3 Coating metals
- 4 Energy sources
- 5 Industrial electronics
- 6 Automation
- 7 Instrumentation
- 8 Shortage of farm products
- 9 Food processing and preservation
- 10 Prefabricated construction of low cost housing
- 11 Environmental engineering
- 12 Biomedical Engineering
- 13 Builders' hardware
- 14 Recycling technology

III Under graduate courses in the areas of:

Sl. No. Name of the Courses

- 1 Computer Science and Computer Technology
- 2 Textile Design
- 3 Engineering Design
- 4 Rubber Technology
- 5 Cybernetics
- 6 Aerospace Engineering
- 7 Air-conditioning and Refrigeration
- 8 Industrial Engineering and Production Engg.
- 9 Polymer Technology
- 10 Marine Engineering
- 11 Industrial Design
- 12 Operations Research
- 13 Optical Engineering
- 14 Fisheries
- 15 Environmental Sciences and Engineering
- 16 Data Processing
- 17 Energy Systems
- 18 Technology of Steel Making
- 19 Technology of Paper Making
- 20 Plant Design.

ANNEXURE — H

1. Number of teachers enrolled since the starting of Quality Improvement Programme upto March, 1977 is as undre:

i. M.Tech.	..	526
ii. Ph.D.	..	506
iii. Number of short term and refresher courses organised	..	1135
iv. Number of participants	..	23,122

APPENDIX II

**Minutes of the First Meeting of the Working
Group for Technical Education held at New
Delhi on 19-11-1977**

Minutes of the First Meeting of the Working Group for Technical Education held at New Delhi

On the 19th November, 1977.

The Working Group for Technical Education set up by the Union Education Minister to review the present status of technical education at all levels and suggest reorientation and improvements to the existing programmes and identify areas for development in the context of the nation's need during the next decade met at New Delhi at Vigyan Bhavan on the 19th November, 1977, under the Chairman of the Union Education Secretary, Shri P. Sabanayagam. The list of those who attended the meeting is at Annexure 'A'.

2. After welcoming the Members of the Group for the meeting, the Chairman, indicated to the Group the background of the formulation of the Working Group in the context of the next National Policy and said that a review of the present status was necessary before formulating the programmes for the future.

3. The Members, in general, welcomed the idea of the review which, it was expressed, was quite due and individually gave expression to the various aspects of technical education and training in the country as also the needs for the future. During the discussions, the following points emerged —

FACILITIES FOR TECHNICAL EDUCATION — While the facilities at present existing in the country at various levels were generally quite satisfactory for immediate national needs, it was necessary

to foresee the requirements for the next two to three decades and provide for opportunities/facilities for training in those specific areas. Keeping in mind that the professional career of an individual is over a span of nearly three decades, it is also necessary that the educational system should be geared to meet the challenges which the professional has to face during this span of his professional life. To this end, the training programmes should be arranged and wherever necessary facilities for re-training/continuing education should also be provided.

Emerging areas of national interest such as water supply, transport services, environmental management, ocean resources, management communication etc., should be given priority in organising technical education system. Programmes for Post-graduate work and research in these areas have to be organised to be able to cater to national needs. Under graduate curriculum also has to be re-formulated to provide courses in some of these areas at a number of places.

While the products of the under-graduate courses from some institute are easily comparable to any other advanced country, there is a definite need to improve the products of other institute. It is necessary to concentrate on quality improvement so that a minimum higher standard is maintained.

At the technician level, it is necessary to consider the more practical aspects of the requirements of the training both at the Polytechnic and the Industry so that the diploma holder is acceptable to the employer. It might be necessary to re-orient the programme of technician education not merely in terms of duration but also in terms of the content to give more practical content as also making it more practice oriented by making the courses industrial sector oriented rather than discipline oriented. Both at the technician and craftsman level, it might be necessary to think in terms of multi-trade training rather than training in a single craft or trade.

TRAINING OF TEACHERS — One of the most important aspects for improvement in the instructional standard is to have trained

and better teachers. More concerted measures have to be undertaken to upgrade and update the quality of teachers at different levels to cater to the specific requirements. It is also necessary to provide for appropriate field experience (industrial training) for the teachers to be able to make their teaching more effective and practical. The technique of case studies, as invoked in the case of management education, might also be tried in engineering and technical education.

INDUSTRY INSTITUTION COLLABORATION — Efforts at industry institution collaboration should be strengthened and more opportunities created for a two way flow. Definite steps have to be taken to promote industrial contribution to the educational effort. Sister-hood programme in institutions and industry as also among institutions themselves have to be fostered.

A system of accreditation of departments/courses has to be devised so that motivation for the weaker institutions/ departments to improve themselves can be there. Efforts to make forecasting of manpower requirements in the various sectors by a detailed analysis of the job requirements by the employers in the forceable further periodically should also be attempted. To provide for an effective feedback to enable improvement in the existing situation, a compact information system should also be devised. To facilitate inter-action between industry and institution and assistance of better institutions to those who are not so well off, it is necessary to take steps to improve the mobility of personnel from one system to another. All inhabitations coming in the way such as in the matter of administrative procedures, service benefits etc., had to be looked into. Not less important is the need for a common medium of instruction throughout the country in the area of technical education. For some time to come, it is necessary that the medium of instruction in the area of technical education should only be English. Even at the craftsman and technician level, occasionally it is disadvantageous to have a regional language instruction for specific purposes. Use of common international terminology would greatly facilitate not only the mobility of people but also improve the

standards. A deliberate effort has to be put in for decentralisation and involvement of institutions in intergrated rural development and community services. It might be necessary in this connection to re-orient the objectives of the system to achieve the desired result.

4. The Group decided that more in-depth studies should be made by Specialists in specific areas of interest and, therefore, authorised the Chairman to appoint sub-groups to report back to the Working Group --

- (i) To consider the present position of research and development in the area of Technical Education, its planning in relation to national needs;
- (ii) To consider diversification and re-designing of existing training and technical education (including Management Courses) and programmes in relations to emerging manpower requirements with accent on rural development and decentralisation;
- (iii) To consider the issue of Quality Improvement Programmes in the area of Technical Education including staff and key personnel, the training etc.;
- (iv) To consider the issue of Engineering and Technical Manpower assessment and planning -- medium and long-term perspectives; and
- (v) To consider the issue of industry institutional collaboration -- its modus operandi.

APPENDIX III

Report of the Special Committee on 'the issue of Engineering and Technical Manpower assessment and Planning-medium and long - term perspective'.

Report of Special Committee on Engineering and Technical Manpower Assessment and Planning of the Working Group on Technical Education (1977)

The Ministry of Education and Social Welfare has set up the Working Group on Technical Education to review critically the present system of technical education and to make recommendations to make it internally efficient and relevant as well as to bring its resources and expertise bear upon the problems of national development. At its first meeting held on 19-11-1977, the Group decided, *inter alia*, to appoint a special committee to study the medium and long-term aspects of engineering and technical manpower assessment and planning. The composition of the Committee is shown in Appendix I. The Committee held its meeting on 13-12-1977* and discussed in detail the several issues of engineering manpower assessment in the context of realistic planning of technical education programmes and facilities, including the need for, and details of, institutionalising a technical manpower information system. The various suggestions and recommendations of the Committee based on these discussions are outlined in the paragraphs which follow.

* *A paper prepared by Institute of Applied Manpower Research, entitled 'Educational Planning for Engineering Manpower—some issues for discussion' had been circulated for the meeting.*

I. SUMMARY OF FINDINGS AND RECOMMENDATIONS

2 (i) A tentative overall quantitative assessment of engineering and technical manpower made for the next ten years indicates that the annual admission capacity at present approved by the All India Council for Technical Education, viz., 3,000 for post-graduate level courses, 25,000 for first degree courses and 50,000 for diploma level courses, is more or less adequate to meet the likely requirements upto 1987. It should be possible for the existing institutions to increase the supply of additional manpower through optimum utilisation of existing facilities, reducing the rate of drop-outs and other forms of wastage and better internal efficiency especially in diploma level courses: similarly, the requirements in the different specialities could be met by appropriate shifts in the branch-wise admission of students within the total sanctioned capacity of the existing technical institutions. The network of technical institutions already established should be also able to provide for any expansion of facilities for technical education so much so, that there is no need for starting any new institutions at least for the next ten years. In addition, there is scope for, and possibility of, ensuring better utilisation of the present stock of engineering manpower by the employing sectors and agencies.

(ii) The Committee is of the view that a more realistic assessment of requirements should be based on the new perspectives, strategy and investment priorities which would be available when the Planning Commission publishes the new medium-term and perspective Plan document. An attempt should be made thereafter to review the above estimates of requirements of engineering manpower and to work out their details according to educational levels and branches of specialisation. The Committee further recommends that such a periodic review of manpower assessment should become a regular feature in the context of the rolling plan and be undertaken once in every year.

(iii) The Committee endorses the present system of technical education planning under the auspices of the All India Council for Technical Education which ensures a co-ordinated development of

facilities and proper maintenance of standards on an All-India level. For this purpose, there should be up-to-date and meaningful manpower information available to the All India Council for Technical Education not merely to help planning facilities in the conventional engineering disciplines but also to anticipate areas of growth in the field of science and technology and promote technical manpower development in those areas.

(iv) In addition to manpower assessment at the national level, and in fact in support thereof, it is necessary to initiate such assessment at the disaggregated level of States/Territories, as well. This is so partly because of the limited inter-State mobility of certain manpower groups for education and/or for employment and partly because of the varying composition of industrial and other segments of the employment markets in the individual States/Territories. It is only such State level manpower assessment related to specific industries located in States which can provide for proper identification of the type and magnitude of the manpower to be educated, trained and developed; this would also enable appropriate curriculum design and course planning at the level of the technical institutions.

(v) The usefulness of manpower assessment at the State and the National levels would depend upon the quality of primary manpower data on which these assessments are based and these have to be generated at the micro-level of units, such as the engineering departments of the Governments and the establishments in the public and private industry. Some of these units have already initiated enterprise-level manpower planning for recruitment, training and career development planning; but these efforts are neither extensive nor sufficiently future-oriented. The Committee recommends that as a long-term goal, unit-level manpower planning should be promoted and supported in all establishments in the organised sector. As an immediate measure, however, all establishments should be enabled to collect and compile data on their engineering manpower to help technical education planning; this could be done within the framework of a national technical manpower information system, which the Committee recommends to be established on a high priority basis.

(vi) A sound information system is a pre-requisite to rational planning, especially in the field of technical education and manpower training. Such a system is at present lacking: the necessary data are not even collected, much less updated, systematised and stored suitably for retrieval as and when necessary. Such a lacuna is perceived in respect of information regarding the educational out-turn as well; here the flow of data is not timely nor is it possible from the available data to undertake cohort studies relating, among others, to productivity of the educational programmes and absorption pattern of the educated in the employment market.

(vii) The main objective of the proposed manpower information system would be to enable estimation of short-term and long-term requirements of engineering and technical manpower, viz., graduates, diploma holders and skilled craftsmen, in the different branches of specialisation for purposes of current decisions on enrolment and a review of the matching of the job requirements with education and training mix being, and to be, provided. More specifically, it would cover the following:

(a) **at the level of a unit/establishment**, manpower information such as the number, qualifications, experience, age, income and activities vis-a-vis job specifications; economic parameters (like output, value added and investment) and technological characteristics (like technology of production and scale of operation).

(b) **at the level of a State/district**, manpower information such as the number, their occupational, educational and industrial composition, and age/income groups vis-a-vis the economic parameters (like composition of State income, Plan outlays).

(c) **at the national level**, information such as stock and characteristics of manpower, occupational, educational and industrial profiles of manpower groups vis-a-vis economics parameter (like national income, non-agricultural output and value added).

(d) **in terms of groups of engineering manpower**, information on their stock, pattern of employment according to industries, occupations and income levels, age-groups, educational levels, annual additions to, and withdrawals from the stock and changing trends.

(c) **in terms of assessment techniques**, information on inter-linkages and relationships between engineering manpower and varying economic, regional and technological parameters, mobility patterns, attrition rates and flow of additional manpower from known enrolment data.

(viii) In order to make the proposed information system operational, the Committee envisages effective co-ordination of efforts among the data generating and collecting agencies through a decentralised organisation structure, such as manpower cells in the engineering units, the major departments of the State Governments and the Central Ministries; a similar cell in the Bureau of Public Enterprises for co-ordination of information from all the undertakings thereunder; at least one nodal institution, such as a Regional Engineering College, in each State for co-ordination of efforts by all concerned agencies in government, private establishments, etc., at the State level. The existing interfaces should also be strengthened between agencies like the Institute of Applied Manpower Research, Directorate-General of Employment and Training, Council of Scientific and Industrial Research, Central Statistical Organisation, National Sample Surveys, Ministry of Education (Technical Education Bureau) and the Planning Commission.

(ix) The Committee recommends that the Government of India should sponsor the establishment of the proposed National Manpower Information system with a lead centre in the Institute of Applied Manpower Research for the storage, updating, retrieval and analysis of technical manpower information to assist technical education planning. The Institute of Applied Manpower Research should be suitably strengthened for this purpose with the provision of a mini-computer and other facilities; a detailed project in this regard could be formulated by that Institute. Simultaneous action is also required to be taken to develop corresponding manpower centre at the State level, preferably in a well established technical institution, as well as cells in the State Departments and Central Ministries.

(x) The manpower information system recommended by the Committee should initially start with processing of information

relating to the organised sector, disaggregated into industry, educational levels, and specialisations and States/Territories. It should also evolve methodological framework and relationships to be used in conjunction with the above data for assessing future requirements.

(xi) In regard to the unorganised sector, use should be made of sample surveys, sectoral studies and case profiles which should be undertaken by the different agencies like the Institute of Applied Manpower Research, DGE & T, Khadi and Village Industries Commission, Small Scale Industries Organisation, etc. The possibility of attaching a manpower information schedule along with the 5-yearly labour surveys of the National Sample Survey Organisation may also be explored.

(xii) In case of new emerging areas of science and technology and/or shortages in critical manpower groups, exploratory studies and opinion surveys should be undertaken by agencies like the IAMR, CSIR, Department of Science, etc.

II. GLOBAL QUANTITATIVE ASSESSMENT OF ENGINEERING MANPOWER, 1977-1987

3 It is well-known that a long lead time is required for the educational preparation of engineers and technicians. Their likely supply for the next five years is more or less pre-determined by the admission already made in the Fifth Plan. Any decision to be made or action to be taken at present would be based on an assessment of requirements for 1983 and beyond.

4 A number of global segmental and programmatic approaches are available for future manpower assessment; necessary historical data can also be disaggregated into details. But the basic problem in the use of these data has been the lack of precise information on the future plan perspectives and their employment implications. The Committee is therefore handicapped for want of an usable indication of the physical targets of development envisaged during the next 15 years or the likely pattern of investment in the different economic sectors. Nonetheless, an attempt has been made as a

working exercise to estimate a tentative order of magnitude of requirements upto 1987. This is based on the following assumptions:

(i) The estimate of stock of engineering graduates and diploma holders worked out by the Institute of Applied Manpower Research is taken as the base data.

(ii) An attrition rate of 2 per cent for degree holder and 1.1 per cent for diploma holders per year has been taken to account for death, retirement and migration.

(iii) The expected out-turn in the next 3 to 5 years would be on the basis of actual admissions made with a pass percentage applied as during the last five years, speciality-wise; the intake in the future years is assumed to remain the same as in 1975.

(iv) The only methodology which can be used in the light of available information on the future economic development perspective is the one based on a relationship between the rate of growth in national income and the employment of engineers. The regression relationship on these data as worked out by a Working Group on Engineering Manpower for the Fifth Plan has been used.*

(v) The difference between the stock of manpower and the number of those unemployed, estimated on the basis of employment exchanges data with correction factors based on follow-up studies by DGE&T etc., is assumed to constitute 'engineering manpower employment'.

(vi) The estimates of requirements relate to three rates of growth in national income, viz., 4.5 per cent, 5.5 per cent and 7 per cent at 1960-61 prices, representing a low, medium and high range of values.

(vii) An attempt has been made to apportion demand estimates between degree and diploma holders on an *ad hoc* ratio of 1 : 1.5.

* $Y = -273.650590 - 3.1221X$ where X is national income in Rs. (100 crores) and Y is total of engineering graduates and diploma holders in thousands.

5 The estimates of manpower assessment undertaken on these assumptions are given in statements in Appendices II, III and IV. These could be summarised as follows:

	<i>Engineering degree and Diploma holders (0000)</i>	
	1982	1987
(i) Estimated supply	727.2	870.1
(ii) Estimated requirements-low (4.5%)	642.6	875.0
Estimated requirements-medium (5.5%)	698.1	1004.8
Estimated requirements-higher (7.0%)	786.5	1224.3

It may be noted in this connection that the above estimates tend to overstate the requirements because of the factors inherent in the methodology regarding perfection of labour market conditions and behaviour, optimality of the present utilisation pattern, etc. In the case of supply there is a trend to underestimate especially because of the assumed pass percentage in diploma level courses, which is at present as low as less than 50; it is likely that the stress on quality improvement programmes in the Fifth Plan would result ultimately in better productivity and larger out-turn than assumed.

6 Notwithstanding the deficiencies and limitations, which are not unknown to the Committee, these estimates may be considered to provide a dimensional framework of the engineering manpower assessment vis-a-vis technical education planning at this stage. Accordingly, it is noted that the likely supply from the existing facilities would be able to meet the estimated requirements (medium estimate corresponding to a rate of growth of 5.5 per cent annually) by 1982 as well as by 1987 (low estimate corresponding to a rate of growth of 4.5 per cent annually). The conclusion which the Committee would like to draw from this is that there need be no immediate concern for any expansion of the overall capacity of the technical education system over and above that approved so far by the All India Council for Technical Education, viz., 3,000 for post-graduate

level courses, 25,000 for degree level courses and 50,000 for diploma level courses. Any additional requirements should be met by improvements in the internal efficiency and productivity of the system itself through optimum utilisation of existing facilities, reducing the rate of drop-out and other forms of wastage, etc. Similarly, the requirements in the different specialities could be met by appropriate shifts in the branchwise admission of students within the overall capacity. It is also to be noted that there is a wide network of technical institutions already established and this should provide for any expansion of facilities in the future so much so that there is no need to start any more new institutions at least for the next ten years.

7 The Committee is nevertheless of the view that the above estimates should not be taken as precise indication of the future manpower requirements not as any guideline for State-wise planning of technical education system on a long-term; estimates by their aggregate nature are not useful for that purpose. It is recommended that (a) these estimates should be reviewed in the light of the new perspectives, strategy and investment priorities which the Planning Commission is expected to outline in their new medium-term and perspective Plan document and (b) steps be taken for meaningful manpower assessment at disaggregated levels on the lines which are suggested in the subsequent paragraphs.

8 The Committee would like to endorse in passing the present system of planning of technical education under the auspices of the All India Council for Technical Education, which ensures a co-ordinated development and proper maintenance of standards on an All-India level. For this purpose, there should be an upto-date effective manpower information available to the All-India Council for Technical Education, not merely for planning facilities in the conventional branches of engineering but also to anticipate areas of growth in science and technology and promote technical manpower development in those areas.

III NEED FOR A MANPOWER INFORMATION SYSTEM

9 The present statistical system is broadly a decentralised one in which the responsibility for collection of statistics is divided

between the Central Ministries and the State Government Departments on a subject-wise basis. Consequently, in case of some common items such as manpower, there is no single source of information available among the official data collecting agencies. The individual agencies have also different terms of references, consequent to which the types of information collected on manpower is partial from a single source. Many a time the related information required for decision making like economic data, level of employment etc., is not collected by the same agency.

10 Superimposed on the existing limitations of data collection programmes are those arising out of the limitations of manual data processing. The volume of data collected by various government agencies has been increasing at a high rate but it is neither readily available nor is in a form usable by the decision makers or researchers in the fields of manpower planning. Un-coordinated data collection on related areas by different agencies has also resulted in data duplication and unanticipated data gaps. Differences in the definition of terms and terminologies, differences in standards and specification followed by different data collecting agencies, periodical changes in data collection plans etc., have made the task of comparing or collecting the data from different agencies almost impossible. Added to this is the difficulty in acquiring the primary data which are in some cases accessible only after the publication of the reports of the concerned organisation; as these publications are released after a time lag, the data when available become out-dated. Since the data volume is large, storing the data manually makes retrieval impossible for secondary analysis and for any further detailed study.

11 On account of these factors, the total information available at the moment for scientific and technical manpower planning is very limited. Moreover, technology has changed over time and no detailed records on the level of technology and trends of development are available at the moment. Evolving a coherent system of technical education for training engineers, technicians and other middle-level personnel needed by industry is, therefore, handicapped with the available information. Technological changes create

many new or more specialised occupations and older occupations required by simpler technologies become obsolete in certain areas. Also there are areas where the curriculum design for advanced levels of technology does not fit into present employment needs; this has given rise to highly qualified people being employed in occupations requiring lesser skills.

12 To the existing state of affairs, the change in strategy of, and emphasis in, development planning, e.g. accelerate rural transformation, integrated areas development etc., adds a new dimension. The decentralisation of planning to district level calls for detailed disaggregated information and the rolling plans require adjustments in the frequency of information flow. While the reorientation of the current data collection system to meet these new requirements would take time to be planned and effected, a manpower information system for the purposes of technical education planning needs to be introduced without delay in view of the long lead time referred to already.

13 Specifically, for the purposes of educational planning the following information will be required:

(i) Up-to-date data on enrolment and out-turn so as to provide complete information on stock, annual flow, migration and attrition of qualified technical personnel by industry, speciality, State and educational level.

(ii) data on employment in the organised and unorganised sectors of the economy, covering designation, job specification in terms of educational qualifications and experience, actual qualifications and experience, actual qualifications and experience of persons occupying the positions, age, year of joining, salary level, etc.

(iii) the general economic parameters relateable to engineering manpower planning such as value added, targets of production, investments etc., especially in engineering intensive sectors, the rates of absorption and retirement/resignations, etc., in employment sectors alongwith shortages and surpluses of engineering manpower. *Chart I* illustrates schematically the parameters involved in decision making for technical education planning (Appendix V).

IV OBJECTIVES OF THE MANPOWER INFORMATION SYSTEM

14 The establishment of manpower information system for reliable and continued educational planning will enable (a) estimation of short-term and long-term requirements of technical degree, diploma and certificate holders, with branches of specialisation, for purposes of decisions regarding enrolment and (b) to provide data for reviewing the matching of the job requirements with education and training being, and to be, provided. As in any other system, the education planning information system to be effective, should perform three basic functions, viz., storage of information, updating and dissemination of stored information, and retrieval of stored information in response to requests. The operations which must be performed by the system consist of collecting, screening, identifying, indexing, coding and storage of information, entry of requests as well as the transmission of required information to the enquirer. Standardisation of codes and tabulation procedures, evolving storage and retrieval methods for different data sets, design of the information system to meet the demands and activities relating to software development to assist educational planning would be broad areas of work to be performed by the system. These should be done in order to acquire, organise and manage data relating to technical manpower; acquire and develop effective computer programmes so as to operate data sets required for educational planning decisions; and to act as a liaison between official data producing agencies and decision makers.

15 More specifically, the manpower information system would cover the following:

(a) **at the level of a unit/establishment**, manpower information such as the number, qualifications, experience, age, income and activities vis-a-vis job specifications, economic parameters (like output, value added and investment) and technological characteristics (like technology of production and scale of operation).

(b) **at the level of a state/district**, manpower information such as the number, their occupation, educational and industrial com-

position, and age/income groups vis-a-vis the economic parameters (like composition of State income, Plan outlays).

(c) **at the national level**, information such as stock and characteristics of manpower, occupational, educational and industrial profiles of manpower groups vis-a-vis economic parameters (like national income, non-agricultural output, and value added).

(d) **in terms of groups of engineering manpower**, introduction on their stock, pattern of employment according to industries, occupations, and income levels, age-groups, educational levels, annual additions to, and withdrawals from, the stock and changing trends.

(e) **in terms of assessment techniques**, information on inter linkages and relationships between engineering manpower and varying economic, regional and technological parameters, mobility patterns, attrition rates and flow of additional manpower from known enrolment data.

V ORGANISATION OF THE MANPOWER INFORMATION SYSTEM

16 There can be no two arguments that the reliability of the manpower planning system depends not merely on micro-level planning and the degree of reliability of micro-level growth targets, but also on decentralised micro-level planning by the establishments concerned. If the establishment cannot plan for their targets at least three years in advance, then at the best discussions at the national, regional and establishment levels between the professional planning agencies with industry would be of a purely general nature. There is an economic and social cost attached to changes in educational system and the responsibility for planning the system must, therefore, be a shared one at manageable decentralised levels between the producers and users of trained manpower, especially in engineering and technology.

17 The Committee is strongly convinced that there is a need for continuous monitoring and up-dating of manpower information at all levels and that units/agencies at different levels should be engaged in these tasks. For example, at State level, engineering departments such as P.W.D., State Electricity Board, etc., could

undertake detailed work of manpower assessment concerning them; a manpower cell in each Ministry would take care of this function with regard to their functions; Bureau of Public Enterprises will do the same for all public sector enterprises; and organisations like CSIR will take care of all organisations coming under their control. In this process of delegation of the responsibility of manpower information monitoring, disaggregated information on manpower industry, specialisation, educational level, activities and area of functioning etc., can all be collected. For other establishments in the organised sector it should be possible to collect information on technical personnel, by adding a block or two in the questionnaires being canvassed by Annual Survey of Industries, for details of manpower and plans for expansion for the next two/three years. Such an approach will build up a system which will provide reliable factual data from the unit level for basing future projections as well as drawing up technical education programmes. However, the danger of over-estimation while aggregating decentralised estimates cannot be overruled. Hence, even for the organised sector the total of disaggregated estimates should be cross checked with the economic models based on growth rate etc.

18 For unorganised sector, sample surveys, sectoral studies and case profiles should be carried out as extensively as possible. Small scale Industries Organisations, Khadi and Village Industries Commission etc., should all be involved in such attempts of building up of data. The bench mark data through decennial census could be updated periodically through such studies. The possibility of attaching a manpower schedule to the 5-yearly labour surveys of the National Sample Surveys would also be explored. The existing manpower agencies like the IAMR, DGE&T, CSIR etc., would continue their research into the complexities of manpower relationships in the unorganised sector.

19 Areas of critical manpower shortages and emerging new areas because of the technological changes are avenues which do not have any base information for decision making. These have to be identified through opinion surveys and exploratory studies involving industries, DGE&T, DST, CSIR, IAMR etc.

20 On the manpower supply side, an educational information system existing at the moment is adequate except that the out-turn in a year is not available in terms of the enrolment cohorts. With faster data processing systems, which will have to be adopted in all areas of data collection, the information on the year of enrolment along with the year of passing can be made available; this will assist in studies, such as precise calculation of wastage rates and projection of future out-turn from known enrolment perspectives and *vice versa*.

21 For effective operation of the recommended system, these should be a decentralised organisation structure. The need for setting up appropriate cells in the State unit and Central Ministries has already been noted. The Committee suggests in this connection the concept of technical manpower data banks at the State level to be set up in a nodal Centre such as at a Regional Engineering College; this will maintain the stock, employment, unemployment information of the technical manpower within the State and co-ordinate efforts of all the agencies at that level. This will enable, to a considerable extent, the qualitative analysis of manpower information which at present is not possible, without conducting a field survey.

22 The Committee recommends that the co-ordinating lead centre for the proposed Manpower Information system be set up at the Institute of Applied Manpower Research. This Institute has, as one of its basic objectives, the functions of acting as a clearing house of manpower information. However, the Institute will have to be dependent on the several decentralised agencies for implementing the manpower information system. The Institute would need a mini-computer for processing of the data and other supporting resources for converting the data into machine readable form.

VI. PLAN OF ACTION

23 (i) The Government of India in the Ministry of Education should sponsor the establishment of the National Manpower Information system and a lead centre therefore at the IAMR on a high priority basis.

(ii) As the first stage of the establishment of the national manpower information system for technical education planning the detailed framework and organisational linkages should be worked out by the IAMR; in this, the role of the individual agencies such as the Bureau of Public Enterprises, Central Ministries, technical institutions, State Government Departments etc., and their functions, including the details of the data to be collected should be identified and specified.

(iii) The periodicity of collecting and communicating recent data and the form in which the data to be communicated should be clarified and the mechanism for this purpose settled.

(iv) The installation of a mini-computer in the IAMR and the development of the required system by that Institute should be taken up side by side with the collection of information: a time plan for the installation of the computer, collection of data and their processing should be laid down. The main agencies who will be making use of the engineering manpower information and the purposes for which the information will be used will have to be clearly spelt out and the necessary information format developed.

APPENDIX I**Special Committee on Engineering Manpower Assessment and Planning of the Working Group on Technical Education.****COMPOSITION***Chairman*

Prof. (Miss) Malathi Bolar,
Director,
Institute of Applied Manpower Research,
Indraprastha Estate,
New Delhi.

Members

Dr. Y. K. Alagh,
Advisor (Perspective Planning),
Planning Commission,
New Delhi.

Shri A.K. Basak,
Chief (Manpower Planning),
Planning Commission,
New Delhi.

Dr. G.R. Dalvi,
Executive Director,
National Productivity Council,
Lodi Road, New Delhi.

Dr. S. Ganapathy,
Professor,
Deptt. of Electrical Engineering,
Regional Engineering College,
Warangal (Andhra Pradesh).

Prof. M.A. Natarajan,
Deptt. of Training and Placement,
Technical Teachers' Training Institute,
Southern Region,
Adyar, Madras. (Tamil Nadu)

Dr. B.K. Nayar,
Scientist,
Division of Scientific & Technical Personnel,
C.S.I.R. Complex,
Pusa, New Delhi.

Shri A. Rahman,
Chief (Planning),
C.S.I.R.,
New Delhi.

Shri S.P. Taneja,
Director of Employment Exchanges,
D.G.E.& T., Shram Shakti Bhavan,
New Delhi.

Member—Secretary

Shri K.R. Sivaramakrishnan,
Director (Education),
Planning Commission,
New Delhi.

APPENDIX II

Stock of Degree and Diploma Holders

	<i>Degree Holders</i>			<i>Diploma Holders</i>		
	1977	1982	1987	1977	1982	1987
Civil	55212	63425	71403	107199	130140	151543
Mechanical	66736	81810	96345	107819	131116	153130
Electrical	52747	63781	74013	79489	100116	119604
Tele-communi- cation	7665	11602	15549	4258	7852	11309
Mining	2344	2556	2796	2804	3595	4369
Metallurgical	8275	10265	11797	1507	2139	2769
Chemical	15577	20323	24731	NAS	NAS	NAS
Architecture	4883	6740	8540	NAS	NAS	NAS
Others	23929	31736	39774	37386	59976	82475
Total	237368	292238	344948	340462	434934	525199

NAS – Not Available Separately.

(Sources: IAMR)

APPENDIX III

Projected Demand for Engineers in 1977, 1982, and 1987

<i>Assumed growth rates in National Income</i>	<i>Engineering degree and diploma holders</i>		
	1977 (in '000)	1982 (in '000)	1987 (in '000)
Low (4.5%)	456.2	642.6	875.0
Medium (5.5%)	463.4	698.1	1004.8
High (7%)	474.3	786.5	1224.3

NOTE: The linear relationship used in projections has been taken from the report of the Working Group on Engineering Manpower, 1972.

$$Y = -273.650590 + 3.1221x$$

Where x is national income in Rs. (abjas) and y is engineering graduates and diploma holders in employment (in thousands).

APPENDIX IV

Ratio between Stock of Technical Degree and Diploma Holders at the year end

<i>Occupation</i>	1955*			1960*		
	<i>Degree</i>	<i>Diploma</i>	<i>Ratio</i>	<i>Degree</i>	<i>Diploma</i>	<i>Ratio</i>
Civil	10900	21100	1.936	19500	37100	1.903
Mechanical	7200	8500	1.181	12500	14100	1.128
Electrical	6200	7900	1.274	10200	12500	1.226
Chemical	2700	400	0.148	4000	400	0.100
Metallurgical	1100	300	0.273	1900	400	0.210
Mining	500	600	1.200	900	1000	1.111
Tele-communi- cation	500	300	0.600	900	600	0.667
Total (including other branches)	34600	44600	1.289	58000	75100	1.295
<i>Occupation</i>	1974†			1978†		
	<i>Degree</i>	<i>Diploma</i>	<i>Ratio</i>	<i>Degree</i>	<i>Diploma</i>	<i>Ratio</i>
Civil	50725	95493	1.883	60213	113115	1.879
Mechanical	58774	96123	1.636	69633	121747	1.748
Electrical	47175	69908	1.482	58106	92142	1.586
Chemical	12801	1365	0.107	16341	2208	0.135
Metallurgical	7247	1200	0.166	9200	1300	0.196
Mining	2336	2566	1.098	2552	2917	1.143
Tele-Communi- cation	5659	2972	0.525	3702	4515	0.519
Total (including other branches)	209234	295915	1.414	257198	374523	1.456

* Source : IAMR Working Paper No. 11/1969—Employment Outlook for Engineers 1969-70.

† Source : Engineering Occupations in the Fifth Plan (IAMR Report No. 1/1974).

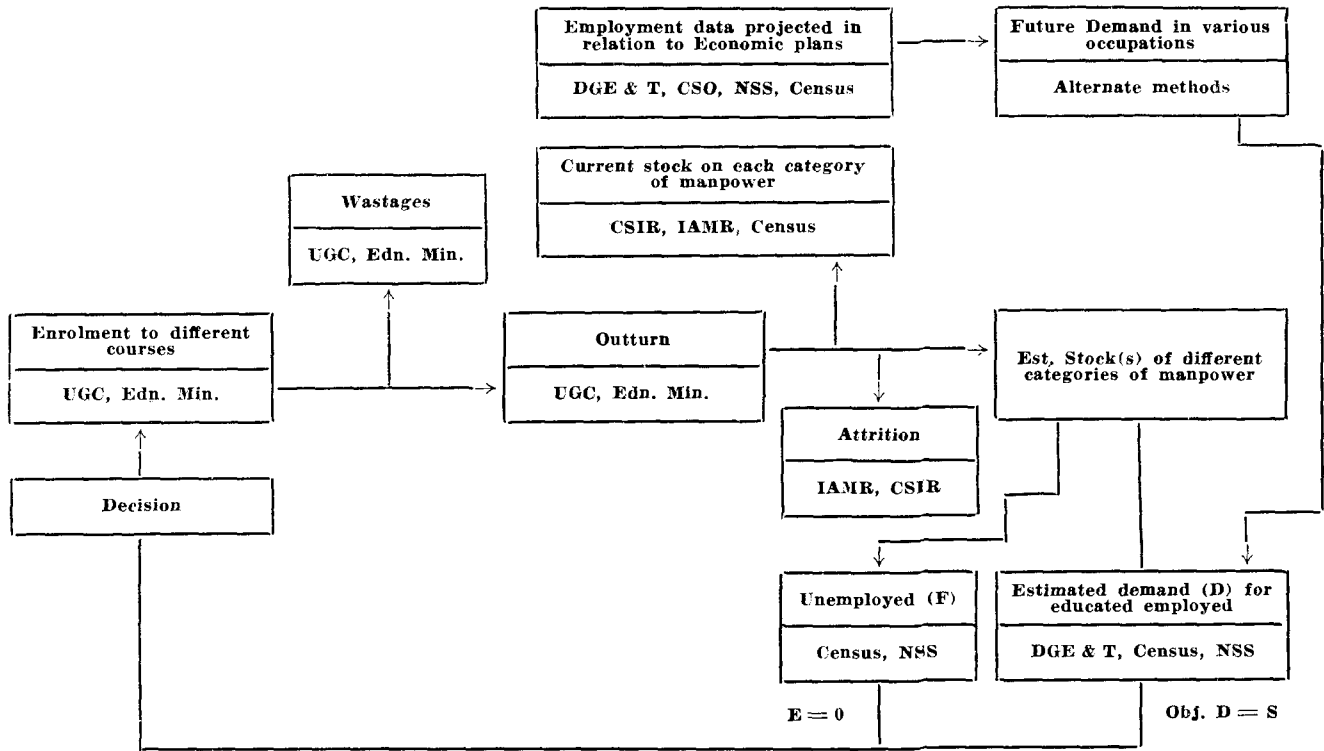


Chart I: Decisions on Enrolment

APPENDIX IV

Report of the Special Committee on 'the present position of research and development in the area of Technical Education, its planning in relation to national needs'.

Report of the Special Committee of the working group on Technical Education to consider the Position of Research and Development in the Area of Technical Education, its Planning in Relation to International Needs.

1 ADMISSION CAPACITY

1.1 Prior to independence, there were only half a dozen institutions offering facilities for post-graduate activities in the field of technical education. During the last three decades, particularly after the Second Five Year Plan period, the facilities for post-graduate work have been considerably expanded. Apart from the Indian Institute of Science, Bangalore, there are five Indian Institutes of Technology which have been established to specially cater for post-graduate and research work in the field of engineering and technology. In addition to these institutions, there are 21 university departments and 44 State Government and Government aided institutions as also Regional Engineering Colleges offering courses at post-graduate level and also catering for other post-graduate activities. The post-graduate programmes being run in the institutions are mostly the two years Master's Degree Programmes. Certain institutions also offer programmes leading to Doctoral degree and also are engaged in research and development activities. The total admission capacity at the Master's Degree programme in these institutions is of the order of about 3,000 which works out to about 15 per cent of the total intake capacity at the Under-graduate level.

1.2 Of the approximately 3,000 seats available nearly 40 per cent are in the Institutes of Technology which have the special responsibility of organising post-graduate and research activities. The admission capacity in all the institutions is not always fully utilised because of various reasons such as non-availability of type of courses in a desired field at a particular Centre; non-availability of adequate physical facilities and some times even the expertise at some Centres where these courses are run, the drop-outs during the course (again because of various reasons such as the candidates getting employment during the course or changing their interest of activity etc).

1.3 The total capacity available at the Master's Degree appears to be commensurate with the needs of the country till at least 1983 even when marginal increased activity in certain emerging areas is taken into account. Similarly a greater emphasis in certain of the existing areas might also demand a larger admission capacity in these specific areas. All these adjustments would easily be possible within the total intake capacity as indicated above since what is required is only to be more flexible with regard to the sectoral intake in the specific areas, with marginal adjustments, keeping in view that it is not necessary to continue the post-graduate courses being offered in those areas where very little demand or no demand at all is felt. An objective review for re-orientation of the existing facilities and consolidation is necessary to provide for diversification to meet the emerging situation. Specific requirements in the changing pattern of development can be put into quantitative terms only after a detailed manpower assessment. The need for training adequate number of personnel in both the emerging and existing areas is possible only then.

1.4 The capacity at the Doctoral level cannot be easily quantified, for the reasons that the offer/conduct of Doctoral programme is also the requirement for the Doctor's degree aspirants pre-suppose a certain expertise, and independent and original thinking, since these programmes are highly individually oriented. However, on a rough estimate it could be mentioned that about 10 per cent of the Master's Degree holders would go for the Doctoral programmes. The Doctoral students normally are required by academic institutions as faculty members as also for research and developmental

activities in industries and other organisations. With the increased activity at the post-graduate level in general, and commensurate with the needs of the country, where the post-graduates have to take on responsibility for research, development and design, it is expected that in the years to come a large number of Doctoral candidates will be deemed necessary.

2 THE STRUCTURE OF THE POST-GRADUATE PROGRAMMES

2.1 The post-graduate programmes being run in the institutes mostly are the two year's Master's degree programmes (generally the M.Tech.). In certain cases there are programmes leading to Doctorate degree. Most of the post-graduate programmes are broad-based. However, there are also certain facilities in some centres to have one years' post-graduate diploma programmes for special subjects, and tailored to the needs of industry/Government.

2.2 Out of the two years devoted to the post-graduate programme leading to M.Tech. degree, approximately 50 per cent of the time is devoted to course work and the rest to research/design/project work. As far as Doctoral programme is concerned it is based essentially on research through some institutions have recently included courses in partial fulfilment of the requirements for the doctorate degree to broaden their background. As far as post-graduate diploma courses are concerned, they are related to the particular needs of the industries, and consist of 80 per cent of course work and 20 per cent of project work.

3 FACILITIES FOR POST-GRADUATE ACTIVITIES

3.1 As mentioned earlier the higher institutions of technology were established specifically for giving a lead for post-graduate education and research. These institutions conduct Master's degree courses in a wide range of subjects and have facilities for research and doctoral work with the main emphasis on inter-disciplinary approach. To this end each Institute has developed good Depart-

ments of Physics, Chemistry, Mathematics and Social Sciences which interact with the Departments of Engineering and Technology. The list of courses offered at these Institutes is given at Annexure-I. As part of the National Plan of Science and Technology five Centres of Advanced Study and Research have been set up in these institutions in the fields of Energy Studies, Material Science, Cryogenic Engineering, Ocean Engineering and Resources Engineering. At the Indian Institute of Science, Bangalore, the oldest and a leading post-graduate and Research Centre in Science and Engineering, facilities also exist in special fields such as Aeronautical Engineering, High Voltage Engineering, Power Engineering, Bio-Chemistry, Physics and Mathematics. A major Centre in Automation and Control Systems and another in Electronics Design Technology are in the process of establishment. The Fifteen Regional Engineering Colleges which have been started as a joint enterprise between the Central and State Governments and the other State Colleges and University Departments also offer a wide range of post-graduate courses. A list of the courses offered is given at Annexure-II. Many of these State colleges (both Government and Non-Government) and University Departments have also made significant contributions in the field of Post-graduate Technical Education. The Regional Engineering Colleges, in addition to the other courses in the conventional areas, also offer industrially oriented courses to train specialist engineers for design, construction and production work. A list of these industrially oriented courses is given at Annexure-III. The experience with the industry oriented courses have been very encouraging. This is mainly due to the wide contacts established with industry, research institutions etc., by the colleges during the operation of the projects and also through active participation and interest evinced by the industry in evolving the academic programmes. During the students' industrial training, the laboratory and equipment of the industry have been used for routine as well as dissertation experiments. This strengthens and widens the laboratory base of the courses offered. Experienced and qualified engineers in industry and research institutions have taken active part in the academic and the industrial training of the students as also the faculty, giving benefit of their knowledge through lectures on special subjects. As a next logical step to the development of 'industry oriented' M.Tech.

courses 'problem oriented' research laboratories are also being set up in a few of the Regional Engineering Colleges. More extensive coverage of such 'problem-oriented' programmes in Regional College and also in other colleges will benefit the standard of these courses to a much more desirable extent.

3.3 The post-graduate programmes in the various institutions have met to a considerable extent the felt needs of the profession. Taking into account the special responsibilities which these students have to take on there appears to be a feeling that a greater emphasis on laboratory oriented programmes might help in the training of the students. Even among those where a feeling persists that more than adequate theoretical grounding has been given to the candidates the need for a more application oriented approach is felt. The post-graduate programmes is not merely to create academic competence but also to engender creative and innovative capabilities and sound judgement in problem identification and formulation, problem solving, application and transfer of technology and entrepreneurship. A good grounding to realistic project work and participation in R & D activities, case studies and opened problem solving, is vital. The teachers of the institutions also require frequent exposure to the professional situation to be able to bringing their best practical experience to the course work.

3.4 Post-graduate activity does not necessarily mean only the conduct of formal post-graduate courses at the Master's degree/ Doctoral degree level but also include other post-graduate programmes in the nature of research and developmental work. This activity, naturally centres around expertise and /or available facilities in the institutions and is at present limited, considering the number of institutions where post-graduate courses are being conducted. It is highly desirable that such centres of research and development are identified and properly supported to be able to contribute substantially to the system. The development of technical education system depends to a large extent on such activities since it helps in the improvement of the standards of the courses offered not only at the institutions concerned but also, by a multiplier effect at the work and curriculum of the other institutions.

3.5 A specific objective evaluation of the existing centres of post-graduate activities should be organised. This will help for continuance of the conduct of the programmes which are considered necessary. In addition there are many other areas of emerging interests where also our institutions have to engage themselves. Such involvement of the institutions (after appropriate evaluation of their capabilities) can be in either the existing centres of post-graduate activities or other so identified for the purpose. A list of illustrative areas/topics is given in Annexure IV. In not all these areas post-graduate courses are to be offered. However in many of these areas research projects could be supported.

4 ROLE OF TECHNICAL INSTITUTIONS, PARTICULARLY AT THE POSTGRADUATE LEVEL, IN RURAL AND COMMUNITY SERVICES

4.1 From what has been said above it will also be apparent that the effort in post-graduate institutions has been to cater to the felt needs of the community. During the last three decades, apparently because of the stress on industrial development, the post-graduate activities were more directed towards the needs in this area. Even so, the consequence of such activities has been adequately felt in various sectors of development including rural community services. Examples are those in the fields of rural and low cost housing including building materials, rural transport and communications, rural electrification, etc. In certain major industrial activities also, such as production of cement, sugar, paper and pulp, etc., the impact of post-graduate activities in the institutions has reached the community. Specific attempts in these sectors have also been taken up for consideration at special programmes in the Town Planning Institutions where regional and urban planning, traffic and transport planning, housing and community planning, etc., have been given attention. In fact, in opening up the vast hinterland in the country for development, the technical personnel from the institutions in the country have played a crucial role.

4.2 With the present thrust on greater emphasis on rural development and community services and the need for technical

education system to involve themselves more in these activities, it can be stated without any ambiguity that the infrastructure that has been built up in the institutions is basically of such quality that give, the orientation it would not be difficult at all for the system as such, to involve itself more effectively in this direction. There again, apart from the change in direction, the complexity of the task also has to be taken into account. The involvement of technical institutions in rural and community services more purposefully and effectively presupposes identification and development of local resources – materials, human, organisational and planning in an intergrated fashion to adopt to the technologies that are available already or are to be oriented towards this purpose. This requires appropriate survey, analysis and case study and system design which are part of advanced engineering and management methodology. Development of services in this area means exploitation of local resources, such as waste utilisation, re-cycling utilisation of mineral resources, local power and energy generation from various sources such as bio-gas, solar energy, wind energy, etc. The post-graduate institutions can contribute to a very great extent in the adoption of the necessary technology for rural and community purposes by integrating in their post-graduate training programme project activities suited to these needs. The illustrative list of topics/area of interest indicated above (Annexure IV) also takes into account the activities for such projects of specific interest to rural and community services.

4.3 Apart from direct contributions that this activity may make to rural development, a very valuable outcome will be the generation of understanding and a sense of commitment, awareness and participation among post-graduate students in the pressing problems of the community, besides resourcefulness and ability in application of knowledge to rural problems.

5 FINANCIAL SUPPORT FOR POSTGRADUATE COURSES/ACTIVITES

5.1 The facilities created at post-graduate level at the institutes of national importance which have been established specifically for

this purpose have been reasonably satisfactory. The faculty support that is provided, the facilities in laboratories and workshops, etc., in these institutions have taken into consideration the special requirements of various areas of work in each department/discipline. On the other hand, the support provided for post-graduate courses in the other institutions has been very minimal. In spite of these constraints, many of these institutions have acquitted themselves well, some of them even very creditably, it is very necessary, therefore, that an objective evaluation is carried out and necessary support extended where capability has been established.

5.2 In this context it should be emphasised that computer as a tool for advanced work in science and technology has to be accepted. Since computer facilities are not always readily available near-about approved post-graduate centres, it is recommended that each approved post-graduate centre should be provided with full computer facilities.

5.3 Centres of research and development identified at selected institutions should be appropriately supported with adequate contingency and research grants for their specific requirements, without linking with the conduct of formalised post-graduate courses at Master's and Doctorate levels as such.

6 NATIONAL EVALUATION AGENCY

An objective assessment of the existing programmes should be undertaken and further support should be considered only on the basis of proven performance. Even for starting of new courses in the existing institutions, identification of new centres, support for research activities and project work, etc., it is desirable that an evaluation of the institutions, both from the point of view of their professional competence and capability for advanced work, is done. This leads to the concept of a uniform yardstick for assessing the performance and the evaluation of standards of the departments. A suggested proforma for evaluation of the departments concerned by such an agency is indicated at Annexure V.

7 PLANNING, ORGANISATION AND FUNDING OF POST-GRADUATE ACTIVITIES

By its very nature, at the post-graduate and research level all efforts for consolidation and development have to be taken both from the academic and professional points of view. The national consideration rather than local or regional aspect should prevail. At present apart from sponsorship from various agencies, the funding and organisation of activities of post-graduate centres are under the auspices of different agencies such as institutions of national importance, University Grants Commission and the post-graduate centres approved on the basis of recommendations of the AICTE. To optimise the available resources as also to remove the imbalance and provide for appropriate impetus to all the centres in an objective manner, it is necessary that a unified national agency such as the Post-graduate Board of Technical Education undertakes responsibility of the organisation and funding of all these activities. Such a measure will also ensure selective, effective equitable support for future development. Diffusion of efforts as also of limited available resources would also be prevented by such a measure.

8 MANAGEMENT EDUCATION

8.1 It has been ascertained that Management Education for post-graduate students at their first entry is not considered essential as they are unlikely to share managerial responsibility. However, in certain areas of engineering and technology which are specifically management oriented appropriate courses, such as industrial engineering, entrepreneurship production management, etc., will have to be incorporated in the curriculum.

8.2 In addition to the normal M.B.A. programmes, there should be a provision for a number of functional courses in management to be offered in the various management institutions/departments. To create a cadre of teachers for management courses, efforts should also be made to provide for advanced courses in management by way of M.Phil., and Ph.D., programmes. Facilities for case studies, particularly in the context of Indian experience,

should be massively available both for the students and the staff of the management institutes. Areas of activity for the management courses either at the M.B.A. programme or later are suggested below:

Entrepreneurship
 Rural Development Management
 Agro-Industries Management
 Farm Management
 Public Utilities Management
 Hospital and Community Health Care Management
 Transportation Management
 Energy Management
 Entrepreneurship and Small Industries Management
 Industrial Relations
 Urban Systems Management
 Management of R and D
 Computer Systems
 Techno-Economic Evaluation

8.2 At present the Board of Studies in Management Education of the All India Council for Technical Education, deals with only matters concerning Management Education in University Departments and affiliated Colleges. For more effective contribution of Management Education to national needs its planning and organisation should be also common for all agencies engaged in the task of Management Education. The Indian Institutes of Management also should be brought under the purview of the Board of Management Education of the AICTE.

9 SUMMARY OF RECOMMENDATIONS

- i. The intake capacity for post-graduate courses in the country is generally adequate for the present i.e., till 1983. However, there is a need for re-orientation of some courses. There is need also for courses in certain emerging areas. All these programmes can be accommodated within the existing total intake capacity. (Paras 1.1, 1.2, 1.3).

- ii. The capability of the technical institutions, particularly at the post-graduate level, for their contribution to rural and community services has been established. However, greater and more effective involvement will be possible by re-orientation of research/project work. (Paras 4.1, 4.2).
- iii. A national agency for evaluation of post-graduate departments in Engineering and Technology should be established. (Para 6).
- iv. There should be a common agency for planning, organisation and funding for Institutions involved in post-graduate activities covering I.I.Ts., University Departments and affiliated and non-Government Colleges, etc. (Para 7).
- v. There should be a common agency for planning, organisation and funding of all institutions offering Management Education to cover Indian Institutes of Management and University Departments and affiliated Colleges of Management Education (Para 8.3).

List of Members of the Special Committee on Research and Development in Technical Education planning, in relation to National needs

Chairman

- 1 Dr. A. Ramachandran
Secretary,
Department of Science and Technology,
New Mehrauli Road, New Delhi 110 029.
- 2 Prof. A. K. De
Director
Indian Institute of Technology
Powai, Bombay 400 076.
- 3 Prof. O. P. Jain
Department of Civil Engineering
Roorkee University
Roorkee.

- 4 Dr. M. M. Sharma
Head of the Department of Chemical Technology,
University of Bombay, Bombay.
- 5 Prof. P. V. Indiresan
Dean, Department of Radar Studies,
Indian Institute of Technology
Hauz Khas, New Delhi 110 029.
- 6 Dr. R. Subbayan
Principial
P.S.G. College of Technology, Peelamedu Post,
Coimbatore 4.
- 7 Prof. T. R. Anantharaman
Head of the Department of Metallurgy
Banaras Hindu University,
Varanasi.
- 8 Dr. V. C. Kulandaiswamy
Director, Technical Education
Government of Tamil Nadu
Madras.
- 9 Dr. C. J. Dadachanji
Administrative Managing Director
National Organic Chemical Industries Ltd.,
Mafatlal Centre, Nariman Point,
Bombay 400 021.
- 10 Dr. M. R. Raman
Joint Director
Scientific Research Division
Planning Commission
New Delhi.
- 11 Prof. S. Chakravarti
Indian Institute of Management
Diamond Harbour Road
P.O. Joka viz Calcutta 700 027.

- 12 Dr. Kamta Prasad
Member (Economics), National Flood Commission,
Ministry of Agriculture and Irrigation,
Department of Irrigation
Vigyan Bhavan Annexe, New Delhi.
- 13 Dr. S. Paul
Director
Indian Institute of Management
Vastrapur, Ahmedabad 380 015.

Member-Secretary

- 14 Shri M. S. Srinivasan
Deputy Educational Adviser (T)
Ministry of Education & S.W.
New Delhi.

ANNEXURE I**List of Courses offered in Indian Institutes of Technology****POST-GRADUATE LEVEL**

<i>Sl. No.</i>	<i>Name of the Courses</i>
1	Aeronautical Engineering.
2	Agricultural Engineering
3	Chemical Engineering
4	Civil Engineering
5	Electrical Engineering
6	Electronics and Electrical Communication Engineering
7	Mechanical Engineering
8	Metallurgical Engineering
9	Mineral Engineering
10	Mining Engineering
11	Industrial Management and Industrial Engineering
12	Operations Research
13	City Planning
14	Regional Planning.
15	Architecture
16	Applied Geology
17	Exploration Geophysics.

ANNEXURE II**POST-GRADUATE COURSES OFFERED****List of Courses offered at Master's degree level**

Sl. No. Name of the Courses

- 1 Civil Engineering
- 2 Mechanical Engineering
- 3 Electrical Engineering
- 4 Chemical Engineering
- 5 Food & Bio-Chemical Engineering
- 6 Pharmacy
- 7 Chemical Technology
- 8 Textile Engineering
- 9 Electronics and Communication Engineering
- 10 Metallurgical Engineering
- 11 Architecture
- 12 Mining Engineering
- 13 Silicate Technology
- 14 Applied Mechanics
- 15 Town Planning
- 16 Applied Geology
- 17 Space Engineering & Rocketry
- 18 Aeronautical Engineering
- 19 Operations Research
- 20 Exploration Geophysics
- 21 Regional Planning
- 22 Mineral Engineering
- 23 Industrial Management & Industrial Engineering
- 24 Agricultural Engineering

List of Courses offered in P.G. Diploma level

Sl. No. Name of the Courses

- 1 Traffic Engineering
- 2 Refrigeration and Air Conditioning
- 3 Hydrology
- 4 Technology of Food & Drugs
- 5 Computer Science
- 6 Computer Control Engineering
- 7 Scientific Instrumentation
- 8 Instrumentation Technology
- 9 Highway Engineering
- 10 Irrigation and Hydraulics
- 11 Inland water Navigation Engineering
- 12 Town Planning.

ANNEXURE III

M. Tech. Industry-oriented Courses offered in Regional Engineering Colleges.

Sl. No. Name of the Courses

- 1 Design & Production Engineering Machine Tools
- 2 Electronics Instrumentation
- 3 Transportation Engineering
- 4 Chemical Plant Engineering
- 5 Advanced Physics
- 6 Advanced Engineering Mathematics
- 7 Hydraulics and Groundwater Resources Engineering
- 8 Design & Production – Power Plant Machinery – Hydro-Electric
- 9 Design & Production – Power Plant Machinery – Thermal
- 10 Design & Production – Power Plant Machinery – Heavy Electrical Equipment
- 11 Foundation Engineering (Applied to Vibratory System)
- 12 Engineering Materials
- 13 Design & Production Engineering Medium Duty Machines
- 14 Mechanical Shaping of Metals (Rolling, Forging and Heat Treatment)
- 15 Extractive Metallurgy and Foundry with emphasis on Alloy Steel Production
- 16 Production of Fertilisers
- 17 Extractive Metallurgy
- 18 Foundry Technology
- 19 Public Health Engineering
- 20 Integrated Power System and Diploma Course in Metallurgy Ferro Alloys Production

Sl. No. Name of the Courses

- 21 Marine Structure
- 22 Industrial Structures
- 23 Industrial Physics
- 24 Analysis and Design of Process Equipment
- 25 Production of Process Machines and Equipment
- 26 Design of Process Machines
- 27 Design & Production – High Pressure Boilers and Accessories
- 28 Design & Production – Heavy Machines with emphasis on mechanical equipment for steel plants
- 29 Technology of Metallurgical Furnaces.

ANNEXURE IV

Sufficient flexibility to the Institutions/Departments should be given for offering the projects at the Post-graduate levels. Inter-disciplinary/Multi-disciplinary programmes with broad specialisations allowing for relevant diversification might be encouraged. List of illustrative topics/areas is given below:

<i>Sl. No.</i>	<i>Name of the Courses</i>
1	Biomedical Engineering
2	Bio Engineering
3	Reliability Engineering
4	Hydro-metallurgy
5	Mineral process Engineering
6	Polymer Engineering
7	Process Engineering
8	Membrane Technology
9	Coal Processing
10	Environmental Science & Engineering
11	Switchgear Engineering
12	Microwave Engineering
13	Information and Communication Systems
14	Laser & Laser Systems
15	Instrumentation Engineering
16	Energy Systems
17	Opto-Electronics
18	Transportation Engineering
19	Construction Management
20	Resources Engineering
21	Recycling and Waste Utilisation
22	Acoustics Engineering
23	Ocean Engineering

Sl. No. Name of the Courses

- 24 Cryogenic Engineering
- 25 Tribology
- 26 Welding
- 27 Textile Engineering
- 28 Computer Technology
- 29 Process Techniques
- 30 Photogrametry
- 31 Photo Interpretation and Remote Sensing
- 32 Food Engineering
- 33 Water Management
- 34 Rural Communications, Rural Transport, Rural Housing
- 35 Impact of Technology on Environment
- 36 Entrepreneurship
- 37 Agricultural Engineering.

ANNEXURE V

Proforma for evaluation of the Department Concerned

- 1 Name of the Institution
- 2 Name of the Department
- 3 (a) *Physical facilities*
Sanctioned; Actually provided; Additionally provided by own initiative, Separately Funded and Managed Laboratories; Degree of Utilisation of Facilities.
- (b) *Faculty:*
Sanctioned; In position; Reasons for vacancies; Degree of Turnover. Members of faculty (separate list to be given with Name, Qualification Courses teaching, Project supervising, Research contributions, Publications, other achievements etc.). Faculty Development details.
- (c) Library facilities and utilisation.
- 4 *Utilisation of Funds:*
 - (a) Recurring Expenditure: Itemwise and Per Capita figures for Academic, Administrative, Laboratory, Project Work, General, Grant-in Aid.
 - (b) Non-recurring: Item-wise expenditure to be given.
 - (c) Methodology of utilisation of funds.
- 5 (a) *Courses:*
PG Degree requirements: (i) PG Diploma (ii) Master's Doctorate
Contents: Core/Basic; Specialisation; Project/Thesis; Seminar; Training.
- (b) *Students:*
Sanctioned intake and actual student strength in each course. Entry Qualifications, Admission Pattern; Reasons for unpopularity if any of particular Courses; out-turn; Results in examinations; Notable performances; Student Services provided; Job opportunities, Placement, Career Information and Feed back.

6 *Educational strategies/improvements in the 5 years period*

Contribution to curriculum development and Innovation.

Innovation in laboratory experiments.

New electives, topics introduced.

Notable aspects of instructional methods.

7 *Research Work*

(a) Project work:

i. Master's Thesis to Ph.D. Thesis (Field, Area, Title, Supervisor, Synopsis to be given)

ii. Ph.D. Thesis (do).

iii. Publications including Monographs & Books (review paper will be given separately)

Title Names of Authors Journal Year, Vol. no. & pages

iv. Notable Contribution by the Department.

8 *Sponsored R. & D. and Industrial consultancy*

(a) Project Title and financial support.

(b) Industrial consultancy based on the utilisation of Department facilities.

(c) Industrial consultancy based on individual expertise but without utilisation of any institutional facility. (The project titles & financial support figures to be given).

9 *Departments (self-assessment of capabilities for the existing programmes and potential for the proposed programmes).*

APPENDIX V

Report of the Special Committee on 'diversification and redesigning of existing training and technical education (including management education) in relation to emerging manpower requirement with accent on rural development and decentralisation concept'.

Recommendations of the Special Committee of the Working Group on Technical Education to consider diversification and redesigning of existing training and technical education (including management education) in relation to emerging manpower requirements with accent on rural development and decentralisation concept.

1 INTRODUCTION

The Special Committee to consider diversification and redesigning of existing technical education (including management education) programmes with accent on rural development and decentralisation concept met in the Ministry of Education and Social Welfare, New Delhi on 14th and 15th December, 1977.

The Committee discussed the progress and present status of technical education at all levels in the context of future needs of the country. In the development of technical education each Five Year Plan was characterised by major stress on certain aspects. Upto the end of the Third Plan, the main emphasis was on expansion, infrastructure development, promotion of post-graduate education and research. During the Fourth Plan there was selective expansion in post-graduate education and an attempt to consolidate other programmes. In the Fifth Plan, the efforts was mainly directed to consolidation, diversification, faculty development, industry-institution collaboration and curriculum development.

As a logical step in the direction of growth, it is now necessary to re-organise some of the activities and to identify programmes that

need to be supported and promoted in the context of future needs of the country. These programmes are:

- 1 Diversification and selective expansion
- 2 Rural development and extension services
- 3 Strengthening the system of technical education
- 4 Raising the image and status of technician education
- 5 Management education: Promotion including its introduction in technical education at diploma and degree levels
- 6 Academic re-organisation including
 - (a) introduction of internal evaluation, credit system and multiple entry,
 - (b) promotion of part-time education,
 - (c) review of course content and curriculum, and
 - (d) institution of a National Evaluation and Accreditation Agency.
- 7 Administrative re-organisation including
 - (a) integration of the whole spectrum of technical education
 - (b) giving autonomy to institutions,
 - (c) re-organisation of State Boards and State Directorates of Technical Education, and
 - (d) changing the funding pattern of technical education.

2 PROGRAMMES TO BE SUPPORTED AND PROMOTED

2.1 Diversification and selective expansion

The admission capacity for technical education available at present at all levels including those for management education appear to be adequate. However, further expansion could be admitted on selective basis and when the need is well-established. All programmes of diversification and expansion should be based on proper assessment of future manpower requirement. For this purpose a National Manpower Information System monitoring information on manpower requirements, availability, utilisation etc., should be established immediately.

With the ever-changing pattern of technology and development of various new scientific disciplines, diversification in several emerging areas will be necessary. This could mainly be achieved either by offering heavy electives or, if need be, specialised courses. In either case it should be ensured that adequate instructional support are given. Some emerging areas relevant to our future industrial and rural requirements are given in the Annexure.

2.2 Rural development and extension services

The technical education system by and large has met the objectives set so far, but in view of the greater emphasis now being laid on rural development, it is necessary that a re-orientation of the technical education system to reach a larger sector of the community in the country should be attempted. In this context those technical institutions situated in an environment suitable for this purpose have to be developed appropriately for this task.

Rural development with its present thrust is a new initiative. Technical institutions should initiate extension programmes in which the existing resources in terms of faculty and equipment could be employed to facilitate appropriate technology transfer, which in turn could generate employment in the rural sector. This initiative could be taken up immediately and be supported. In this attempts at rural development both the aspects of adoption and transfer of technology are involved. While in the case of transfer of technology to the rural areas, the polytechnics have to play the major role, assistance in adoption of technology should be available from engineering colleges and other institutions also. The intention is that hereafter the technician institutions should act as focal points for technology transfer. This, of course, does not preclude colleges and other institutions from playing a similar role.

The other aspect pertains to the development of knowledge and skills in the rural areas for developmental activities. Unfortunately, precise information about the extent of the skills and knowledge in rural areas is at present not available. It would be possible to arrive at precise conclusions only after extensive studies and research. In the meantime, it would only be appropriate to develop contacts

with the rural community and to collect data of need-based training programmes to be offered. Immediate efforts should be made to facilitate up-dating their traditional skills and crafts, modernising their tools and implements etc. In this matter of adoption and transfer of technology to the countryside all technical institutions in the country have to play their due role.

2.3 Strengthening the system of technical education

While the physical facilities for technical education available at present at all levels are considered adequate, there are areas which need consolidation with particular reference to improvement of quality and standards. There are a large number of institutions which need additional inputs to enable them to make the impact expected of them. These aspects are being considered by a separate Sub-group.

2.4 Raising the image and status of technical education

Immediate action should be taken to strengthen the technician education system and also to improve the social image and status of the technicians as recommended by Damodaran Committee in 1971. While we have considerable clarity with regard to the competence expected of and the role to be played by craftsmen from industrial training institutes and by technologists from engineering colleges, a similar position does not seem to exist with regard to technicians. The technician is a very important entity forming an inter-phase between the craftsman and the engineer. This role of the technician has to be clearly defined and understood.

Besides, a diploma-holder should be given all possibilities for continuing education in order that he is able to acquire the necessary competence to meet the requirements and challenges of the profession.

While discussing rural development, the part to be played by the polytechnics as a focal point for transfer of technology has been emphasised. Polytechnics are expected to interact with the environment and organise their programmes and activities to meet the needs of the community. In order to reflect the new role that is

expected of the polytechnics, it is desirable that selected polytechnics be designated as 'community colleges' rather than 'polytechnics'.

It is strongly recommended that selected polytechnics all over the country be developed into 'national institutions' for advanced training and for the award of higher diplomas. Special efforts should be put in to promote women's education in polytechnics by introducing need-based and socially relevant courses for women.

2.5 Management education: Promotion including its introduction in technical education at diploma and degree levels

While the three Indian Institutes of Management are doing fairly well in producing managerial manpower of the right quality at various levels, the 30 and odd University Departments of Management need strengthening on the basis of the recommendations made recently by the Review Committee on Management Education.

At present the pattern of courses in management at all management institutions is heavily oriented towards large-scale industries. Considering the great need for managerial manpower for small and medium size industries, it is suggested that at least a part of the present intake of the recognised management institutions should be diverted to this sector. Similarly, other sectors such as transport, power, health, education, agriculture etc., need trained managerial manpower for which sectoral specialised courses should be offered in these institutions.

It is possible and necessary to integrate relevant management education with professional courses such as engineering and technology both at degree and diploma levels. Efforts should also be made to introduce courses in Foremanship and Supervision in a large number of public and private sector undertakings.

There is great need for producing a large number of personnels with the requisite managerial and teaching skills who would satisfy the educational qualification requirements as laid down by the University Grants Commission for teaching positions in management institutions as well as in engineering and technological institutions where management elective courses are offered.

The focus of attention should shift from merely turning out large number of graduates to the question of developing potential managers of the required quality and practice orientation.

2.6 Academic re-organisation

2.6.1 *Introduction of internal evaluation, credit system: and multiple entry*

At present, all technical education programmes both at diploma and degree levels are so organised that every one has to enter at the same level, take the same number of subjects through a rigid pattern and complete the course at the end of a specified period. This system is extremely outdated and calls for immediate abandonment.

The adoption of credit system with the prescription of minimum and maximum numbers of credits that can be taken in a semester/academic year will bring about a great amount of flexibility in the system. This will enable multiple entry and depending upon the initial preparation of the candidate, he may be required to take and complete a certain number of credits before qualifying for the award of diploma/degree. This arrangement may need some additional inputs by way of staff and related expansion. Credit system will not only facilitate multiple entry and diversification, but also introduction of competency-based modular courses especially at the technician level in due course.

Internal evaluation is in the process of being implemented in many of our technical institutions. It is necessary to expedite and complete this process in all technical institutions as early as possible.

2.6.2 *Promotion of part-time education*

Massive efforts should be made to give education to those who cannot go for full-time regular courses by providing part-time and evening courses at all levels in the existing technical institutions. These facilities are offered at present only on a limited scale and within the structure of diploma/degree courses. There is need to enlarge these facilities by evolving a large number of schemes for full courses as well as for individual subject areas.

2.6.3 *Review of course content and curriculum*

It is necessary to have a good and close look at the course content now being offered at various levels. The standard of technical education will very much depend upon the pace the courses keep with the changing practices in science and technology. A continuous review of the curriculum is, therefore, called for. The Curriculum Development Centres at present functioning in various institutions should be asked to look into this aspect.

It is strongly felt that research in technical education is most essential and that research degree courses in technical education should be introduced in selected centres.

2.6.4 *Institution of a National Evaluation and Accreditation Agency*

Institution of a National Evaluation and Accreditation is an immediate necessity. Evaluation of the various courses has to be done on a continuing basis at the national level. Criteria for evaluation have to be devised and a common yard stick which can be applied by evaluating committees should be prescribed with a reasonable degree of uniformity.

As no such machinery is available at present, it is strongly recommended that the All India Council of Technical Education (AICTE) should be re-organised with statutory powers on the lines of the Indian Medical Council and assigned this task. The AICTE should play the role of guiding, offering data, publishing reports, providing criteria for evaluation, bringing into existence committees and agencies which will continuously do 'serious thinking' on the problems that confront technical education and provide solutions.

2.7 **Administrative re-organisation**

2.7.1 *Integration of the whole spectrum of technical education*

In education there should be no blind alley. A candidate who happens to take training as a craftsman in an ITI must be able to go for the diploma and from diploma to the degree programme

if he has the aptitude and the ability to do so. The task of educating and training technical manpower can be effectively done only if the whole spectrum of manpower from craftsmen to technologists is viewed together and the programmes are closely co-ordinated under one agency. Steps needed to bring about this integrated approach must be taken .

The ratio between the graduates, technicians and craftsmen in some of the more industrialised economics is of the order of 1:3:5, facilities for education being also provided for in that order. In India the facilities provided at graduate, technician and craftsman levels are in the ratio of 1:2:6, but in the actual output, the ratio comes to about 1:1:6. This is not at all a healthy trend. Ways and means should be found out to improve the ratio between engineers, technicians and craftsmen through a co-ordinated approach.

2.7.2 Giving autonomy to institutions

The need for relating technical education to the social needs has been stressed time and again. If this is to be done, it is necessary that the institutions are in a position to react to the needs of the regions in which they are situated, be alive and alert to the changing requirements and organise programmes accordingly. This is possible only if the Principals and the faculty members have the freedom to design courses and undertake projects and implement them. To enable such a situation to develop and grow, institutions need autonomy, not only academically but also administratively and financially. To begin with administrative and financial autonomy should be given by bringing all technical institutions including Government institutions under suitably constituted Governing Councils. Academic autonomy could be given on a selective basis. This step would release tremendous energies now available and remaining dormant in our institutions.

2.7.3. Reorganisation of State Boards and State Directorates of Technical Education

It is long since the AICTE recommended that the State Board of Technical Education be made a statutory body. This perhaps is the most important step towards re-organisation and reform of

polytechnic education. The Board must be headed by an eminent educationist or industrialist with full knowledge of the present and future demands on technical education. This Board for Technical Education should be what an university is for degree education, with the difference that while there may be many universities in a state, there will be only one Board for each state.

The State is the implementing agency for educational programmes, and for the technical education it is the Directorate of Technical Education. The Directorate must be reorganised as a matter of urgency. It must have organs dealing with manpower assessment, planning, quality improvement, performance evaluation etc. In short, the Directorate of Technical Education should not be thought of as a mere administrative body; its image as an academic and professional body of the state must be substantially improved.

2.7.4 Changing the funding pattern of technical education

Among the fields of professional education only engineering seems to be with the general education in the states. The State Department of Education does not have a separate wing for technical education. Consequently expenditure on technical education is treated as part of social service.

The expenditure on education is already close to 25 % of the state budget, and in a state like Kerala, it is over 40 %. If technical education is to fight for funds from education allotment, it will continue to suffer. Expenditure on technical education is not social service, it is an investment. Therefore, the Plan provision for technical education must be related to the developmental outlay of the user departments. A link between the user department's outlay and technical education budget must be established, if technical education is not to suffer in future.

It is observed that the State Governments are not in a position to spend on technical education even as much as is agreed to during the plan discussions, since the plan allocation for technical education is not always fully available. This has seriously affected the implementation of many of the approved schemes of technical education.

To enable a system of ear-marking the funds allotted to be spent on technical education, it is suggested that the pre-Fourth Plan funding arrangement, namely making available directly to the institution, the Central Government's matching share of expenditure on approved schemes be restored.

3. SUMMARY OF RECOMMENDATIONS

3.1 The admission capacity for technical education available at present at all levels including those for management education appear to be adequate. However, further expansion could be admitted on selective basis and when the need is well-established.

All programmes of diversification and expansion should be based on proper assessment of future manpower requirements. For this purpose a National Manpower Information System monitoring information on manpower requirements, availability, utilisation etc., should be established immediately.(2.1)

3.2 Technical institutions should re-orient themselves to rural development and extension services. All existing facilities and resources should be utilised for the adoption and transfer of appropriate technology to the rural sector.(2.2)

3.3 A large number of institutions still need consolidation. The additional inputs required for the purpose should be made available to them.(2.3)

3.4 Immediate action should be taken to strengthen the technician education system and also to improve the social image and status of technicians. Since polytechnics have a special role to play in the transfer of technology to the countryside, it is desirable that selected polytechnics be designated as 'Community Colleges' rather than 'polytechnics'.

Selected polytechnics all over the country should be developed into 'National Institutions' for advanced training and for the award of higher diplomas.

Special efforts should be put into promote women's education in polytechnics by introducing need-based and socially relevant courses for women.(2.4)

3.5 Sectors such as transport, power, education, health, agriculture, small-scale industries etc. need trained managerial manpower for which sectoral specialised courses should be offered in management institutions.

It is possible and necessary to integrate relevant management education with professional courses such as engineering and technology both at degree and diploma levels.

In management education, the focus of attention should shift from merely turning out large number of graduates to the question of developing potential managers of the required quality and practice orientation.(2.5)

3.6 Credit system and internal evaluation should be introduced in all technical institutions as early as possible.(2.6.1)

3.7 Massive efforts should be made to introduce schemes of part-time and continuing education at all levels.(2.6.2)

3.8 The course content and curriculum of all courses should be reviewed regularly to keep pace with the changing practices in science and technology.(2.6.3)

3.9 The All India Council of Technical Education (AICTE) should be re-organised with statutory powers and given, among others, the tasks of a National Evaluation and Accreditation Agency. (2.6.4)

3.10 The task of training technical manpower from craftsmen at ITI level to technologists at post-graduate level should be brought under one agency.(2.7.1)

3.11 Technical institutions should be given academic, administrative and financial autonomy. For this purpose they should first be brought under suitably constituted Governing Councils. (2.7.2)

3.12 The State Boards of Technical Education and the State Directorates of Technical Education should be urgently re-organised: the former with statutory powers and the latter to have the image of an academic and professional body. (2.7.3)

3.13 Expenditure on technical education is not social service: it is an investment. Therefore, the Plan provision for technical education must be related to the developmental outlay of the user departments.

To enable a system of earmarking the funds allotted to be spent on technical education, it is suggested that the pre-Fourth Plan funding arrangement, namely making available directly to the institutions the Central Government's matching share of expenditure on approved schemes, be restored. (2.7.4)

ANNEXURE

Some of the Emerging Areas in Engineering and Technology :

Sl. No. Name of the Courses

1. Rural and Cottage Industries.
2. Agrobased Industries.
3. Fertiliser technology.
4. Rural Communication.
5. Minor irrigation and water management.
6. Rural water supply and sanitation.
7. Low-cost housing.
8. Energy sources: wind and solar energy.
9. Food technology: handling, processing and preservation.
10. Packaging technology.
11. Agricultural and farm management.
12. Waste management and re-cycling technology.
13. Environmental science and technology.
14. Rubber technology.
15. Airconditioning and refrigeration.
16. Ceramics and glass technology.
17. Maintenance and repair engineering.
18. Fisheries technology.
19. Entrepreneurship and small industries management.
20. Urban systems management.
21. Industrial and production engineering.
22. Ship building industry.
23. Petro-chemicals.
24. Mining engineering.
25. Steel technology.
26. Paper technology.

Sl. No. Name of the Courses

27. Industrial electronics.
28. Instrumentation technology.
29. Bio-medical engineering.
30. Computer systems.
31. Marine engineering.
32. Ocean engineering.
33. Oceanography
34. Data processing.
35. Aerospace engineering.
36. Resources engineering.
37. Transportation engineering.
38. Satellite communication.
39. Remote sensing technology.
40. Micro-wave engineering.

List of Members

Special Committee of the Working Group for Technical Education to consider diversification and redesigning of existing training and technical education including management courses and programmes in relation to emerging manpower requirements with accent on rural development and decentralisation.

- 1 Prof. P. J. Madan, *Chairman*
Vice-Chancellor,
M.S. University of Baroda,
Baroda.
- 2 Dr. C. S. Jha,
Director,
Indian Institute of Technology,
Kharagpur.
- 3 Shri Y. Saran,
Principal,
Technical Teachers' Training Institute,
Western Region,
Shyamala Hills,
Bhopal-2.
- 4 Prof. Shankar Lal,
Department of Mechanical Engineering,
Roorkee University,
Roorkee.
- 5 Prof. Y. V. N. Rao,
Principal,
S. V. Regional College of Engineering & Technology
Surat-395 007 (Gujarat).
- 6 Prof. R. N. Kapur,
Principal,
Allahabad Polytechnic,
Allahabad.

- 7 Prof. G. S. Laddha,
Director,
A. C. College of Technology,
Guindy, Madras-25.
- 8 Shri H. N. Bhaya,
Director,
Indian Institute of Management,
Diamond Harbour Road, P. O. Joka,
Via-Calcutta-700 027.
- 9 Dr. H. C. Pandey,
Director,
Science and Technology Department,
Government of Bihar,
Boring Canal Road,
Patna-1 (Bihar).
- 10 Prof. Srinivasa Iyer,
Principal,
Sri Ramakrishna Mission
Vidyalaya Polytechnic,
Coimbatore.
- 11 Prof. N. S. Ramaswamy,
Director,
Indian Institute of Management,
33, Lang Ford Road,
Bangalore-560 027.
- 12 Shri Satyendra Tripathi,
Science Correspondent,
Indian Express,
Bahadur Shah Zafar Marg,
New Delhi-110 002.
- 13 Shri M. S. Padmanabhan,
Technical Director,
Tata Marlin & Gerin Ltd.,
2nd Pokhran Road,
Thana-400 606 (Maharashtra).

- 14 Rear Adml. Krishna Dev,
Vice-Chairman and Managing Director,
The Shipping Corporation of India Ltd.,
Shipping House,
229/232, Madame Cama Road,
Bombay-400 021.
- 15 Shri S. K. Bose,
Joint Secretary,
Ministry of Energy,
Department of Coal,
Shastri Bhavan, 'A' Wing,
New Delhi-110 001.
- 16 Shri Harish Mahindra,
Chairman and Managing Director,
Mahendra UGINE Steel Co. Ltd.,
Bombay-400 021.
- 17 Shri B. N. Guha Biswas,
Director of Training,
Directorate General of Employment and Training,
Shramshakti Bhavan, Rafi Marg,
New Delhi.
- 18 Shri S. C. Mishra,
Member (Mechanical) & Ex-Officio
Secretary to the Government of India,
Railway Board,
Rail Bhavan,
New Delhi-110 001.
- 19 Dr. V. S. R. Murthy,
Director,
Jannalal Bajaj Institute of Management Studies,
Bombay University,
Bombay.

- 20 Dr. S. N. Saraf,
Chief (Education),
Planning Commission,
Yojna Bhavan,
New Delhi.
- 21 Dr. Pitchai,
Prof. of Public Health Engineering,
College of Engineering,
Guindy, Madras-26.
- 22 Dr. K. Gopalan,
Deputy Educational Officer (T) & Member-Secretary,
Ministry of Education and Social Welfare,
Shastri Bhavan, New Delhi-110 001.

APPENDIX VI

Report of the Special Committee on 'Quality Improvement programme in Technical Education including training of staff and key-personnel'.

Recommendations of the Special Committee of Working Group for Technical Education set up to Consider the Issue of Quality Improvement in Technical Education Including Training of Staff and Key-Personnel

1. INTRODUCTION

Quality improvement essentially means improvement of the product coming out of educational institutions, i.e. improvement in the quality of the graduating students. To analyse this problem the various processes which occur in the whole system of technical education have to be examined. The performance of the constituents of the system has to be assessed and their short-comings diagnosed. It is only then that remedial measures can be identified which would improve the functioning of the constituents and thus of the whole system. And this has to be done keeping in view a clearly defined national policy on technical education.

The quality of education is reflected in a mixture of its three basic elements: the teacher, the student and the curriculum. Interactions between these elements constitute the instructional processes of the system. Other processes which effect the quality of education are the managerial processes with which the administration is closely concerned. The committee had discussed these in detail and its recommendation are given in the following sections.

2. INSTRUCTIONAL PROCESSES

One of the most important aspects of quality improvement in education is improving the instructional processes in all its aspects. This involves various features such as recruitment, development and evaluation of the faculty; selection of students, identifying their needs, evaluating their performance and giving them adequate support services. The continuous revision and updating of the curriculum to meet the requirements of the ever-expanding store of knowledge is yet another important aspect of the instructional process.

2.1 Faculty

In discussing educational processes it is sometimes said that 'the student is more important than the teacher, and the teacher is more important than the curriculum'. This may be true generally, but in the context of quality improvement it is the teacher who is at the focal point. Improvement and development of the faculty, therefore, will have to receive top priority if a real and meaningful improvement in quality is to be achieved.

2.1.1 *Recruitment (i) Qualifications* : Faculty recruitment should be based on precise job descriptions. The minimum qualifications necessary for recruitment of the various categories of teaching staff should be carefully drawn up. In doing this it should be borne in mind that both teaching and research abilities are required of a teacher; and for senior teaching positions, particularly in colleges, it must be ensured that the persons recruited possess these abilities.

It was noted that the minimum qualifications for recruitment have been laid down by UGC/AICTE. These are considered to be generally adequate. The only lacuna in these is the inadequate emphasis placed on industrial experience. The Committee recommends that in addition to the minimum academic qualifications already laid down, for all fresh recruitments at least one year's industrial experience should be considered essential for junior categories of teaching staff (i.e. Lecturers and below) and at least two

years for all senior categories (i.e. Asstt. Professors and above). All educational institutions should be urged to accept these additions to the list of essential qualifications.

(ii) *Selection Procedures*: Regarding selection procedures, it was realised that several procedures are possible, each with its own advantages and disadvantages. While other methods of selection could be tried out in selected places, it was felt that the present method of screening, short-listing followed by a personal interview appears to be satisfactory and may be continued. However, whatever be the method of selection employed, the Committee recommends that all recruitment should be strictly on merit, by open competition, on an All-India basis.

(iii) *Contract Employment*: One of the incentives for good performance and hard work at the Lecturer's and Assistant Professor's level is the fact that these categories of staff can aspire for promotions to the next higher category. However, at the level of the Professor or the Head of an Institution such incentives no longer exist. Persons at this level have to be self-motivated; but, unfortunately, not all persons at this level fall into this category. In order to ensure that the quality of work done by persons at higher levels continues to be good, the Committee recommends that all appointments to the post of Professors and Heads of Institutions should be on the basis of renewable contracts, for five years at a time. This would provide check points in the careers of such persons and ensure sustained high quality of output.

2.1.2 *Faculty Development*: Once a teacher is recruited, his planned development is the key-note to the building up of a dynamic faculty. This cannot be done on an ad-hoc basis. The Committee recommends that planned, carefully organised faculty development programmes be considered as being absolutely essential to the improvement of quality and should be started in all educational institutions. Although this is primarily a managerial responsibility of the administration (i.e. of the Heads of Departments and Heads of Institutions), this important aspect is discussed here because considerable responsibility devolves on the faculty itself to respond to these programmes.

(i) *Programmes for Higher Degrees*: The need for teachers to acquire higher qualifications is justified from the point of view of both the beneficial impact this has on the teaching process and also the fulfilment of personal aspirations of the teachers.

(a) *College Teachers*: In the case of College teachers a Master's degree has now been prescribed as the minimum qualification required for initial recruitment at the Lecturer's level. Besides, it was noted that most existing faculty members at the College level already have the Master's degrees. The Committee, therefore, recommends that the provision for Master's degree training in the QIP should be rapidly phased out and in its place provision should be made for training an additional number of Ph.Ds.

It is estimated that there are nearly 12,000 teachers at the College level. A large number of these teachers have yet to acquire the Doctor's degree. In view of this the Committee recommends that provision should be made under QIP to train at least 250 teachers per year for the Ph.D. degree.

(b) *Polytechnic Teachers*: For Polytechnic teachers, a Bachelor's degree has now been prescribed as the minimum qualification required for initial recruitment. It would be desirable, therefore, to ensure that the existing faculty also satisfy this norm. But it was noted that of the 10,000 or so Polytechnic teachers in the country a very large number are only Diploma holders. The Committee, therefore, recommends that selected Engineering Colleges should be requested to organise three-year courses to enable Diploma holders to get Bachelors degrees. Institutions which agree to do so should be given full financial support.

The acquiring of higher degrees by Polytechnic teachers would also have an important feed-back on the quality of the whole system of Polytechnic education. Since the existing Master's degree courses available in the country are not considered appropriate for Polytechnic teachers, the Committee recommends that one-year Post-graduate Diploma Courses for Polytechnic teachers should be strated in selected institutions. These should be primarily industry-oriented courses; a few could also be in the fields of technical

education and its management. They could be organised under the present QIP for Polytechnic teachers by providing an adequate number of fellowships for this purpose.

(ii) *Short-term Courses*: In view of the rapid changes in technology the risks of teacher obsolescence are very high. It is essential, therefore, that every serving teacher should be provided with opportunities to renew and update his knowledge periodically. This may be achieved by deputing teachers to short-term courses organised in all parts of the country on a regular basis. At present such courses are being organised through agencies like ISTE and the various QIP Centres. There is a need for better coordination of the efforts of the various agencies conducting these short-term courses. It would be better if a single agency were made responsible for the organisation of these courses and their continuous monitoring to ensure that the resource utilization is optimum. The Committee recommends that a National Advisory Committee, consisting of representatives of Central and State Governments, QIP Coordinators and ISTE nominees should be set up for this purpose.

(iii) *Training in Education Technology*: It is not enough for a teacher to know what he is required to teach; he should also be able to teach it well. A teacher must be well trained in all aspects of education technology; his pedagogical skills must be well developed. This is important for both College and Polytechnic teachers. The four TTTIs are already conducting courses on many aspects of education technology. The Committee recommends that these efforts of the TTTIs be strengthened and expanded. Provision should also be made to organise short-term courses for the pedagogical development of teachers. While all teachers should be encouraged to attend atleast one such course during their careers, fresh entrants to the profession should be required to undergo some form of formal training in education technology soon after joining.

(iv) *Industrial Training*: There is a wide-spread feeling in academic circles that the present industrial training programmes are not satisfactory. This is primarily because teachers who go for

such training are not permitted to do any meaningful work in the industry; they are treated more as remote observers to what goes on in the organisation than as participants. For the industrial training to be more beneficial, the teacher trainees must be more actively engaged in the work of the industry so that they can have a first-hand impression of the problems and procedures that persons in industry have to tackle. Such training programmes must, therefore, be carefully planned on an individual basis so that the best advantage accrues to both the teacher and the industry.

The present provisions of the industrial training programmes permit a teacher to go to industry only for short periods. This is not adequate. The Committee recommends that industrial residencies of 12 months duration should be created with a provision for adequate additional payment to the teacher during the whole period of residency.

2.1.3 *Staff Appraisal*: Teacher evaluation is a very sensitive issue. The main reason for this is the fear that the results of the evaluation will be used to the disadvantage of the teachers by the administration. This fear can only be removed by proper motivation.

(i) *Staff Appraisal Schemes*: At present staff appraisal is done primarily for administrative purposes. The confidential reports prepared hardly represent profiles of the strengths and weaknesses of teachers. A scientific staff appraisal scheme should be established which is based on a methodology acceptable to the faculty. The results of such an appraisal are necessary for identifying the needs of staff development.

The Committee feels that the successful implementation of scientific staff appraisal schemes is necessary for quality improvement. This work of appraisal should preferably not be done by a single individual; it is best done by a committee consisting of internal and/or external experts as may be considered necessary by the institution concerned.

(ii) *Personal Promotion Schemes*: There is a lot of discontentment among the existing bright young faculty members who have had to stay in the same category for long periods of time because

there are no opportunities for promotion due to lack of vacancies at the higher levels. This problem is likely to become more acute in the future as more young teachers get employed at the highest levels. The Committee recommends that for such bright young faculty members personal promotion scheme should be initiated by which they could be promoted, even though no vacancies exist at the higher levels. Such promotions would be on a personal basis. Financial provision should be made such that approximately 20% of the faculty members of each lower cadre could be considered for promotion to the next higher cadre. This would provide motivation for sustained good work.

2.2 Curriculum

The curriculum should be one of the most important concerns of academic administration. In the context of improvement in the quality of education the importance of curriculum growth and development can hardly be over-emphasized. It is a continuous process and in many countries it is standard practice for educational institutions to have standing Curriculum Committees who look after this work.

2.2.1 Curriculum Development: Curriculum development work is being done in our country in selected educational institutions: the QIP Centres for degree-level curricula and the TTTIs for diploma-level curricula. It was noted that although considerable work has been done with respect to diploma-level curriculum development, the progress made in the case of degree-level work is not the same. The main reason for this appears to be the fact that curriculum development is being interpreted differently by the different QIP centres working on it. The Committee recommends that continued support be given to the Curriculum Development Centres operating at the various institutions. Steps should also be taken for the co-ordination of the work being done at the various centres and for the dissemination of the information generated at these Centres to all the institutions of the country.

2.2.2 Laboratory Work: Although laboratory work has a crucial and specific role to play in both degree-level and diploma-level engineering education, so far not much work has been done

for the improvement of laboratory instruction. There is also need for a change in the philosophy: from the simple 'verification of theory' view point to the more difficult to achieve 'learning by doing' attitude. Project work must also be included as a part of laboratory experience. The Committee recommends that Curriculum Development Centres should be encouraged to take up the work of setting guide lines for improving laboratory work on a priority basis.

Yet another point regarding laboratory work which attracted the attention of the Committee is the obsolescence of equipment in the laboratories. Most of institutions have purchased their laboratories equipment in the early '60s and a large part of this equipment needs replacement during the period of the next Five-Year Plan. The Committee recommends that the whole question of replacement of obsolete equipment should be examined in detail by the institutions and annual grants should be made available to them in a phased manner to modernize their laboratories.

2.3 Students

All quality improvement work is centred around the attainments and accomplishments of students. Due attention should therefore be paid to all aspects of the students, from admission to graduation.

2.3.1 *Selection of Students*: Institutions must be encouraged to admit students of merit with aptitude for studies in engineering. Since there is a wide variance in the standards of the various examination bodies, admitting students on the basis of marks (or grades) obtained at the qualifying examination does not appear to be fair. Besides, this method provides no clue regarding the aptitude of the students for engineering studies. The Committee recommends that admission to both degree Colleges and diploma Polytechnics should be on the basis of very carefully designed common entrance tests. These examinations could be conducted state-wise, common for all the institutions of the State.

2.3.2 *Remedial Courses*: In spite of the best methods of selection the student body always has a small percentage of weak students

who need special attention. This problem is particularly acute in the case of most of those students who are admitted under reserved quotas of some kind of another. The Committee recommends that every educational institute should take special measures to ensure that such weak students are given remedial courses to help them overcome their handicaps.

2.4 Supporting Services

Of all the supporting services necessary in an educational institution, there have been singled out as requiring special attention: the technical supporting staff, the library facilities and special learning resources.

2.4.1 Technical Supporting Staff: The non-teaching supporting staff includes both technical and administrative staff. Of these, it is the technical supporting staff which has a more direct bearing on the quality of education. Such staff, apart from assisting in laboratory experimentation and workshop practice, are also the ones who are primarily responsible for the maintenance of laboratory apparatus, measuring instruments and workshop equipment. No attempt at quality improvement would, therefore, be complete without giving due attention to this category of staff.

(i) *Norms:* The present practice for providing technical supporting staff is to specify that the cost of hiring such staff should be a certain percentage of the most of hiring the teaching staff. Such artificial norms are no longer adequate. The Committee recommends that technical supporting staff should be provided on need-based norms.

(ii) *Training and Development:* At present there is no provision for the training and development of technical supporting staff. With change in the instructional and developmental processes and the utilization of more sophisticated and delicate instruments and equipment, the need to train and develop this category of staff is being felt acutely. The Committee recommends that schemes for the training of technical supporting staff, on the same lines as the QIP schemes for teachers, should be started soon.

2.4.2 *Library Facilities: (i) Organisational Efficiency:* The library is the heart of any educational institution. It provides the materials necessary to support and supplement the teaching-learning programmes. While the size, scope and character of a library are important, its proper organisation is of even greater importance. With the vast amount of published literature available today and the newer methods of information retrieval it is of utmost importance that librarians and the library staff be well qualified and libraries well organised. There is considerable scope for improvement in this. The Committee recommends that educational institutions be urged to improve the efficiency of their library services. If need be, the scale of pay of the librarian could be upgraded, with a corresponding raise in the minimum qualifications required, so that better and more efficient library services would result.

(ii) *Other Services:* Other services which have an important bearing on the quality of education are audiovisual aids and reprographic aids. To start with, these services could be organized in the library. The Committee recommends that adequate support should be given to institutions to organise Audio-Visual Services and Reprographic Services as a part of their library facilities.

2.4.3 *Learning Resource Centres:* Although Learning Resource Centres are new to this country, they are being experimented upon in other countries as a means of improving the teaching-learning process, especially when a very large number of students is involved. Such Centres assist in course development, production of instructional materials, design of new instructional facilities, instructional research etc., and serve all the academic departments of an institution. The Committee recommends that such Learning Resource Centres be started in one or two selected institutions on an experimental basis.

3. MANAGERIAL PROCESSES

Management of the educational system has a direct bearing on the improvement of its quality. The scope of management here includes planning, resource allocation, monitoring and institution building processes. In terms of the institution it could include staff

development, resource utilisation, institutional climate and many other details which are essential pre-conditions for the improvement of quality.

3.1 Training in Educational Management

The time has come when educational administrators must be given scientific training in management of educational institutions. The Committee recommends that to start with this training be given by organising short-term courses under the QIP schemes and all Heads of Departments and Heads of Institutions be required to attend at least one such course.

3.2 Staff College

Technical education in the country has now entered a new phase of development. In the first phase the facilities were expanded and a large number of institutions were established. During the second phase the major emphasis was on the improvement of quality through teacher training and curriculum development activity. There is strong evidence that teacher competence is on the increase and many of them could now perform at more demanding levels. There is now a need to enter a third phase of activity without which the existing efforts may not be optimised. This third phase pertains to professionalism in the areas of administration, planning, decision making and organisational development. Without initiative in this direction the increasing teacher competence may lead to frustration.

A Staff College for training managers of technical education could provide a solution to many of these problems. The main aims of such a College would be to:

(i) enable key administrative staff for institutions to acquire skills (and recognised qualifications) in educational management.

(ii) assist government agencies to plan and bring about policy changes in technical education and to monitor and evaluate the effect of these policy changes.

(iii) help institutions and other technical education agencies in the promotion and diffusion of new ideas so that the processes of technical education becomes more effective.

There are many alternatives possible. The proposed Staff College could be an independent institution or it could be established in any Institute of Management or in one of the TTIs. Yet another aspect of the proposal is whether there should be two separate staff Colleges, one for engineering and the other for technician education or should there be a single Staff College for both streams of technical education? All these alternatives have merits and demerits.

The Committee recommends that the question of setting up Staff College(s) should be examined by an Expert Committee which could also be asked to draw up a Project Report on the proposal.

3.3 Statutory Powers for AICTE

The AICTE has played a very important role during the first two decades after independence, in maintaining uniformity of standards in the technical education system in the country. During this period the recommendations of this body were taken seriously by the State Governments and were invariably implemented. Recent trends, however, indicate that many important recommendations which have a direct bearing on the improvement of quality have not been implemented; they have either been overlooked or neglected. These recommendations include the norms for consumable laboratory materials used by students, staff structure, the salary scales of staff, etc.

If quality improvement is to be ensured then some body like the AICTE has to continuously keep watch on the basic issues pertaining to technical education. It should have enough authority to ensure that measures suggested by it are implemented. The present mode of functioning of the AICTE has probably outlined its utility. The Committee recommends that the functioning of the AICTE should be reviewed and it should be equipped with statutory powers, on the pattern of UGC, as recommended by the Kothari Commission.

4. SUMMARY OF RECOMMENDATIONS

4.1 (a) A National Advisory Committee consisting of representatives of Central and State Governments, QIP Coordinators

and ISTE nominee should be set up to organize short-term courses under QIP

(b) Industrial residencies of 12 months duration should be created with a provision for adequate additional payments to the teachers during the whole period of residency.

(c) Carefully organised faculty development programmes be considered as being absolutely essential to the Improvement of Quality and should be started in all Engineering/Technical Institutions.

(d) At least 250 teachers may be trained for Ph.D. under this programme per year. M.Tech. fellowships should be gradually converted into Ph.D. fellowships as the revised recruitment qualification for lecturers post is M.Tech.

(e) For polytechnic teachers condensed degree courses leading to B.E. degree may be started in selected Engineering Colleges.

(f) Industrial residencies of 12 months duration should be created with a provision for adequate additional payments to the teachers during the whole period of residency. (2.1.2)

4.2 (a) All recruitments should be strictly on merit by open competition on all India basis.

(b) All appointments to senior teaching posts should be on contract basis for five years renewable on expiry of the term. Due weightage should be given to Industrial training.

(c) To encourage bright young faculty members personal promotion schemes should be introduced by which they could be promoted even through no vacancies exist at the higher levels. Provision should be made for promotion of 20% of faculty members of each lower cadre for promotion to next higher post. (2.1.1)

4.3 Scientific staff appraisal schemes are necessary for Quality Improvement. The appraisal should be done by a Committee consisting of Internal and External experts. (2.1.3)

4.4 The whole system of replacement of obsolete equipment should be examined in detail by the institutions and annual grants

should be made available to them in a phased manner to modernize their laboratories. (2.2.2)

4.5 Admission to degree and diploma courses should be on the basis of Statewise common admission test. (2.3.1)

4.6 Every educational institution should take special measures to ensure that weak students are given remedial courses to help them overcome their handicaps. (2.3.2)

4.7 Schemes for training of Technical supporting staff should also be started soon. (2.4.1)

4.8 Facilities for scientific training in educational management should be provided by organising short-term courses under Quality Improvement Programmes for all Heads of Departments and Heads of Institutions. (3.1)

4.9 The desirability of setting up an Administrative Staff College for training of key personnel should be examined by an Expert Committee. (3.2)

4.10 For effective control on standard of technical education the AICTE should be given statutory powers on the pattern of the UGC as recommended by the Kothari Commission. (3.3)

List of members to the Special Committee of the Working Group for Technical Education, to consider the issue of Quality Improvement Programme in technical education including training of staff and key-personnel.

- 1 Dr. Shankar Lal, *Chairman*
Professor of Mechanical Engineering,
Roorkee University,
Roorkee.
- 2 Shri B. K. M. Nair,
Deputy General Manager,
Bharat Heavy Electricals Ltd.,
Hyderabad.
- 3 Prof. L. S. Srinath,
Department of Mechanical Engineering,
Indian Institute of Science,
Bangalore-560 012.
- 4 Shri T. K. Vaidyanathan,
Principal,
Technical Teachers' Training Institute,
Sector-26,
Chandigarh.
- 5 Prof. K. S. Hegde,
Director,
Madras Institute of Technology,
Madras.
- 6 Prof. Indiresan,
Dean of Radar Studies,
Indian Institute of Technology,
Delhi.
- 7 Shri Y. Saran,
Principal,
Technical Teachers' Training Institute,
Shymala Hills,
Bhopal-2.

- 8 Shri A. K. Mehta,
R & D Manager,
Kelvinators Ltd.,
Faridabad,
Haryana.
- 9 Shri S. B. Kumta,
Director of Technical Education,
Government of Gujarat,
Government Polytechnic Building,
Hostel Block,
Ahmedabad-15.
- 10 Shri S. K. Handa,
Deputy Educational Adviser (T),
Ministry of Education and Social Welfare,
Southern Regional Office,
Shastri Bhavan,
No.35, Haddows Road,
Nungambakkam, Madras-6.
- 11 Shri S. R. Chopra,
Senior Research Officer,
Education Division,
Planning Commission,
Yojana Bhavan,
New Delhi-1.
- 12 Shri Y. Singh, *Member-Secretary*
Assitant Educational Adviser (T),
Ministry of Education and Social Welfare,
Shastri Bhavan,
New Delhi.

APPENDIX VII

**Report of the Special Committee on 'Industry
Institution Inter-Action and Collaboration—
The Modus Operandi'.**

Report of the Special Committee on Industry Institution Inter-Action and Collaboration—The Modus Operandi

A Graduate/Technician who comes out from the Institution with a conferment in Engineering/Technology has adequate capability to take up the task in an industry or organization. However, the diversification and magnitude of tasks involved vary from industry to industry or organization. The Graduate/Technician has, thus, to be oriented to a particular industry or organization and wherever capability is in-built, he can be taken through a well organized Graduate/Technician training programmes. Thus, the limitations of providing requisite practical experience in the Institutional (Theoretical) situation and on the other hand the limitations of the theoretical background in coping up with the practical situation, have to be appropriately resolved by complementary approach.

2 Since total simulation of the industrial situation in the education system is not possible and also in view of the changing requirements of the industrial situations (because of its continuous development, etc.), an active inter-action between the technical education system and the professional experience is required. The Working Group makes the following recommendations for inter-action between the institution and the industries.

'Adjunct Professorships' in Institutions and 'Residency' for Faculty Members in Industry.

3 The expertise and capability of executives, managers and technical personnel from industry, research institutions and professional bodies should be utilised for supplementing and complementing the capabilities of the institutions by creation of 'adjunct professorship' and *vis-a-vis* educational institutions should arrange to send their faculty to industry/research institutions for acquainting themselves with the problems and working of the industry by creation of 'residency' for faculty members in industry. Such association would facilitate the professors to expose the students to an industrial situation. The residency position would enable the faculty members to study the problems of research and development and consultancy opportunities. Many of such problems could be translated into research projects to be undertaken by the students.

4 While the period of such deputation for the Adjunct Professorship in the institutions and the Residencies in the industry/research organizations should be flexible and appropriate, leave benefits should be extended for the purpose. Other basic facilities also have to be extended to these personnel to motivate them to accept these assignments. Some of these are: basic salaries and allowances should be paid by the parent organization; contingent expenditure at the place of the assignment such as transport, incidentals, housing, etc., should be provided by the host organisation. To facilitate the institutions being in a position to depute their faculty for such assignments in the industry allowance to the extent of 20% of additional provision of budget should be made. However, both for the adjunct professors coming to the Institutions from the Industry and for the position of residencies from the institutions coming to the industry, an appropriate compensation (up to a monthly ceiling of Rs. 2,000) should be provided by the Central Government to meet the 'out of pocket' expenses.

ADOPTION OF POLYTECHNICS

5 The Committee noted that All India Council for Technical Education at its meeting held in 1976 recommended that the industry

(which includes all the establishments engaged in production), specially Public Sector industry, may be requested to *adopt one Polytechnic* so that the polytechnic should have academic autonomy under the management of the industry with an appropriate Managing Committee. The Committee also noted that the cost of running the Institute at the present level of operation and the normal increase in expenditure will continue to be the responsibility of the State Government. However, for any future expansion or further development and improvement, the industry would take the entire responsibility. The Committee noted with regret that so far such an extremely worthwhile recommendation of the Council has not been implemented in any State. The Committee felt that this question be pursued with vigour.

Consultancy Services

6 The Committee recommends setting up of 'consultancy centres' for organizing consultancy activities. In the terms and conditions of services rendered by the Centres there should be certain flexibility taking care of the following:—

(i) All consultancy activities should be on institutional basis, including those of identified individuals or a group of individuals or for short tenures.

(ii) The revenue accruing from the activities of these Consultancy Centres should not be included while calculating the financial grant of the institution but should be credited to a separate 'development' fund to be utilized for specific development purposes at the discretion of the institution.

Industrial Experience for Teachers

7 Involvement of industry in giving facilities for faculty members of the institutions for gaining industrial experience is essential. The industry should give their attention for this specific aspect.

The Committee notes that the industrial experience for teachers during vacation is being examined separately by another Sub-Group on 'Quality Improvement'.

Continuing Education Programme for Industrial Personnel

8 Staff from industry and other organizations need continuing education programmes to expose them with advancing 'know-how' and technology. Institutions should arrange for 'tenure' refresh courses either short-term or long-term to the personnel from industry. Such programmes should be organised in consultation with industry to take care of their specific needs and areas. Further, such programmes may be repeated at pre-determined intervals to suit their needs. Such programmes should, as far as possible, be self-financing.

Sandwich Programmes

9 These programmes organized by Technical Institutions in collaboration with the Industry have been highly successful. The product from these courses have been better received by industry and such courses should be organized in more number of institutions. Industry should definitely provide appropriate senior technical personnel from their organizations to supervise the students under such Sandwich programmes. Provision for increased number of appropriate faculty positions in institutions should be provided to take care of the responsibilities of these programmes.

Vacational Training

10 It is observed that only a few institutions in the country have been able to organize well programmed and supervised Vocational training for the students. The Committee strongly feels that a well structured training programme in consultation with the industry should be organized by greater number of institutions to make it more meaningful and effective. The Committee further recommends that such vocational training programmes should carry appropriate credits.

Apprenticeship Training

11 Under the Apprenticeship Act, students passing out of the institutions, both degree and diploma level, are provided with

training with a maximum period of one year in designated industries. While, as for the Act, the industry is obliged to provide training places, it is felt that the training could be effective only if proper supervision is also ensured. The Boards of Apprenticeship Training, as at present organized, are not adequately staffed to undertake this work of supervision. It is very necessary to make this programme effective and successful. The Board of Apprenticeship Training should be adequately strengthened. Involvement of institutions in this work of supervision is also helpful and a programme of such involvement should be worked out.

Industrial Liaison Boards

12 It is noted that in many States there are already industrial Liaison Boards to pursue the work of liaison between the industry and the technical institutions. These Boards could help materially by over-seeing the implementation of the programmes enumerated above, for inter-action between institution and industry so that effective liaison could, in course of time, be achieved.

Industrial Contribution for Technical Education

13 Under Section 80 (G) of the Income Tax Act, an amount equal to 50 % of the aggregate of the sum paid by an assessee as donation to a University established by law, or any other educational institution recognized by the Government, or an institution financed wholly or in part by the Government or a local authority, shall be deducted in computing the total income of an assessee, whereas, Section 35(1) (ii) provides that any sum paid to a Scientific Research Association which has as its objects the undertaking of scientific research or to a University College or other institutions be deducted for purposes of income tax. The Committee strongly recommends that under the Section of Income Tax Act, an identical provision be made that expenditure on technical education, including Management education at all levels, be similarly deductible for the purpose of income tax assessment.

14 SUMMARY OF THE RECOMMENDATION:

14.1 In order to have effective inter-action and collaboration between industry and institutions, the committee recommended the provision of '*Adjunct Professorship*' in the institution or personnel from industry and of '*Recidency*' for institutional faculty in industry.

14.2 Endorsing the A.I.C.T.E.'s recommendations of its 1976 meeting, the Committee recommended the '*Adoption*' of a Polytechnic by the Public Sector/Private Sector industry in the area, so that the Polytechnic may have academic autonomy, under the management of industry.

14.3 Consultancy Centres should be set up in suitable educational institutions with suitable working guidelines.

14.4 Continuing education programmes for industrial personnel should be arranged in educational institutions.

14.5 Sandwich programmes in collaboration with the industry should be organised in more number of locations.

14.6 The training imparted by industry under the Apprenticeship Training Programme should be properly supervised. The Regional Boards of Apprenticeship Training should be adequately staffed and strengthened for the purpose.

14.7 The industrial liaison boards set up in the States should help in over-seeing the implementation of the training programme mentioned above.

14.8 Expenditure on Technical Education, including management education at all levels, incurred by the industry should be fully deductible for the purpose of income tax assessment.

LIST OF MEMBERS

- 1 Shri Nanu B. Amin *Chairman*
Chairman, Jyoti Limited,
P.O. Chemical Industries Area,
Baroda 390 003.
- 2 Shri S. Santhanam
Chairman,
AMCO Batteries Ltd.,
Bangalore.
- 3 Prof. S. M. Dasgupta,
Director,
National Institute for Training of Industrial Engineering,
Vihar Lake, P.O. NITE,
Bombay 400 087.
- 4 Dr. R. G. Narayanamurthy,
Director,
Indian Institute of Technology,
Madras.
- 5 Prof. R. C. Narayanan,
Principal,
Delhi College of Engineering,
Kashmiri Gate, Delhi.
- 6 Prof. Dr. M. Sen,
Principal,
Regional Engineering College,
Kurukshetra, Haryana.
- 7 Prof. P. S. Mani Sundram,
Principal,
Regional Engineering College,
Tiruchirapalli, Tamil Nadu.
- 8 Shri M. R. Naidu,
Executive Director,
Bharat Heavy Electricals Ltd.,
Heavy Power Equipment Plant,
Ramachandra Puram, Hyderabad 500 032.

- 9 Shri I. P. Anand,
Deputy Chairman,
Thapar Brothers, Thapar House,
124, Janpath, New Delhi 110 001.
- 10 Prof. H. C. Patel,
Principal, & Secretary
Shri Bhagubhai Mafatlal Polytechnic,
Irla Juhu Road, Vile Parle (West),
Bombay 400 056.
- 11 Prof. G. R. Damodaran,
Dean of Post Graduate Studies & Director,
P.S.G. Industrial Institute,
Coimbatore 641 004.
- 12 Dr. P. L. Aggarwal, Rep. by Shri H. Goswami,
General Manager, AGS(TA),
Hindustan Steel Ltd., Rourkela Steel Plant,
Rourkela, Orissa. Rourkela, Orissa.
- 13 Shri Suresh Mehta,
Chairman,
Star Textile Engineering Works, Ltd.
Dhanraj Mahal, Shivaj Marg,
Bombay 400 039.
- 14 Shri S. S. Rangnekar,
21, Raveline Street,
Searle (India) Ltd., Bombay 400 001.
- 15 Shri K. R. Sivaramakrishnan,
Director (Technical Education),
Planning Commission,
Yojua Bhavan, New Delhi.
- 16 Prof. P. J. Madan,
Vice-Chancellor,
M.S. University, Baroda.
- 17 Shri S. Sadasivam, *Member-Secretary*
Deputy Educational Adviser (Tech).,
Ministry of Education & S.W.,
(Department of Education) New Delhi.

APPENDIX VIII

Recommendations of the All India Council for Technical Education on the Report of the Working Group

Recommendations of the All India Council for Technical Education on the Report of the Working Group

The Council noted that the Ministry of Education had appointed a Working Group to review the present status of technical education including management education at all levels, to identify areas for development in the context of the nation's need during the coming decade, and to suggest re-orientation and improvement to the existing programmes.

The Council further noted that the Ministry of Education would prepare the Sixth Plan proposals on the basis of the recommendations of the Council on the report of the Working Group.

The Council thereafter examined various recommendations made by the Working Group and resolved as under:

1. Within the approved annual intake capacity each institution should increase the supply of technical manpower by improving the efficiency and effectiveness of educational processes. Shifts in the intake capacities between disciplines may be effected to cater to the emerging manpower needs.

2. All new courses should be based on well established and well defined manpower needs.

3. A reliable information system is a pre-requisite to planning, especially in the field of technical education and training. A national manpower information system should be established with a lead centre in the Institute of Applied Manpower Research for the storage, updating, retrieval and analysis of manpower infor-

mation to assist technical education planning. The Institute of Applied Manpower Research should be suitably strengthened for this purpose with provision of requisite facilities.

4. Credit system with provision for multi-point entry in part-time and full-time programmes should be introduced.

5. Industrial and rural development problems be identified and a greater emphasis on research programmes to tackle such problems be given in keeping with the national needs. Technical education institutions having the potential and capability to undertake problem-oriented and application-oriented programmes be selected and properly supported to facilitate substantial contribution to rural and community development.

6. Institutions be encouraged to set up Consultancy Centres to promote consultancy activities.

7. Relevant Management Education be integrated with professional courses at degree and diploma levels.

8. Courses in management education be restructured to provide for managerial manpower for small and medium sized industry as also for sectoral needs such as transport, power, health, education and agriculture, co-operation and co-operative banks.

9. Selected Polytechnics act as focal points to promote transfer of technology to the rural community. Such Polytechnics should be designated as 'Community Polytechnics' and adequate support provided.

10. Selected Polytechnics should be given central assistance to conduct advanced technician programmes.

11. Support be provided to strengthen the work of Curriculum Development and Research related to problems of technical education.

12. In addition to minimum academic qualifications laid down by AICTE, one year's industrial experience for lecturers and two years for senior staff is considered desirable. All recruitment

should be strictly on merit, by open competition and on all India basis, subject to reservation because of constitutional requirements.

13. To ensure high quality performance, appropriate measures be taken for providing the necessary facilities. In this context the feasibility of making appointments to senior teaching posts (i.e., Professors and Heads of Institutions) on contract basis for five years, renewable after assessment be considered.

14. Personal promotion schemes should be established to enable promotion of deserving young faculty stagnating at a particular level. Such promotion be restricted to 20% of the sanctioned strength.

15. An appropriate staff appraisal scheme based on a methodology acceptable to the faculty should be introduced. This would also enable identification of the needs of staff development.

16. Facilities for Masters' degree training under the Quality Improvement Programme be progressively reduced. Considering the number of teachers involved, provision for Doctoral Programme under QIP be increased to enable 250 teachers every year to enrol for Doctoral Programmes.

17. Provision be made to organise short-term courses for Polytechnic and Collegiate teachers in educational technology.

18. Selected Engineering Colleges should organise under Quality Improvement Programmes three-year courses to enable Polytechnic teachers with diploma qualification to get Bachelor's degree.

19. Polytechnic teachers should be sponsored under the Quality Improvement Programme for industry oriented post-graduate diploma/degree courses organised for the purpose.

20. In order to ensure purposeful and meaningful interaction and collaboration between industry and institutions, "Fellowship" in the institution for willing and capable personnel from the industry be instituted. Similarly 'Residency' for institutional faculty be provided in the industry on the lines of QIP. Additional budgetary

provision on staff to the tune of 20% should be made to finance these schemes.

21. Admission to both degree and diploma courses be on the basis of carefully designed entrance tests. These tests should be conducted State-wise common to all institutions.

22. In order to reduce drop outs and other forms of wastage, it is necessary that special efforts in the form of remedial courses be carried out in the initial stages to help weaker students.

23. Flexible programmes of continuing education through part-time/full-time courses be introduced at all levels for serving personnel.

24. Representation be given to students in bodies concerned with framing the curricula.

25. Schemes for training of technical supporting staff be started under "Quality Improvement Programme".

26. To ensure better and more effective library services, qualified and trained library staff be provided.

27. Adequate support be given to institutions to organise Audio-Visual and Reprographic services.

28. On an experimental basis, Learning Resource Centres be established in a few selected institutions.

29. The replacement of laboratory equipment which have become obsolete due to technological and curricular changes be examined. Laboratories be modernised with relevant, and versatile equipment with more instructional potential.

30. The tasks of planning and organising Technical Education from the level of craftsmen to that of technologists be brought under a single National Agency both at the Centre and States to ensure balanced development through an integrated approach.

31. It is essential to optimise the utilisation of available resources and provide impetus to all the Centres engaged in Post-graduate Programmes and Research. The Planning, organisation

and prescription of norms for post-graduate and research programmes conducted at Universities, Indian Institutes of Technology, Indian Institutes of Management and affiliated Colleges should be coordinated by the Board of Post-graduate Engineering Education and Research of the AICTE.

32. The organisation of short-term courses under QIP be coordinated.

33. The Regional Boards of Apprenticeship training be adequately staffed and strengthened with a view to ensure purposeful planning and supervision of Apprenticeship Training Programmes.

34. The Directorates should have organs dealing with Manpower Assessment, planning, coordination, controlling, monitoring and evaluation of technical educational programmes. Reorganisation of Directorates to enable them to perform these professional functions effectively be undertaken as a matter of urgency.

35. Administrative autonomy and powers of financial control be given to all technical institutions including Government institutions by bringing them under suitably constituted governing councils. Academic autonomy be given to institution soon a selective basis.

36. The concept of 'Adoption of Polytechnics' by industry already recommended by the All India Council for Technical Education be pursued.

37. Short-term courses under Quality Improvement Programme in educational management be organised for training Heads of institutions and Heads of Departments.

38. Setting up a Staff College for Technical Educators be examined by an Expert Committee.

39. Maintenance of uniform standards in technical institutions in the country is the constitutional responsibility of the Central Government. It is therefore, necessary to coordinate and strengthen existing evaluation agencies.

40. To ensure effective implementation of policies and programmes of the Council, measures other than making it statutory, may be considered for the present.

41. The Plan allocations for Technical Education should be commensurate with the developmental outlay of the other user departments, since technical education is developmental investment.

42. To provide the necessary incentive to industry expenditure by industry on technical education including Management Education be deductible for purposes of Income Tax Assessment.

43. The system of making available the Central Government's share for approved schemes directly to the institutions should be restored.