Report of the

SPECIAL COMMITTEE

REORGANISATION AND DEVELOPMENT

POLYTECHNIC EDUCATION IN INDIA

1970-71

MINISTRY OF EDUCATION AND SOCIAL WELFARE
GOVERNMENT OF INDIA ● NEW DELHI

C O N T E N T S

PART - I

CHAPTER - I

1.0   **INTRODUCTION**

1.1   Background

1.11   In recent years, there has been serious criticism of the system of polytechnic education by educationists, representatives of industry, professional bodies and employers. The common points of criticism are as follows :

   (a)   The diploma courses in our polytechnics are mostly theoretical with very little practical bias.

   (b)   The diploma courses are a poor imitation of the degree courses and as such do not really serve the purpose of training middle level technical personnel.

   (c)   The diploma courses, as conducted at present, are in the broad fields of civil engineering, mechanical engineering, electrical engineering, metallurgy, etc. No attempt has been made towards specialisation in any one particular branch of a subject field in which specialist technicians are required.

1.12   These and several other factors have been causing

concern to persons responsible for the development of

technical education.   Their anxieties have found expression,

on several occasions, in the meetings of the All India Council

for Technical Education, the Institution of Engineers (India),

the All India Manufacturers' Organisation, the Indian

Engineering Association, the Indian Society for Technical

Education and other organisations.

1.13   The second conference of the State Directors of

Technical Education held on the 14th and 15th June 1969

at Delhi has also stressed the need for the reorganisation

of polytechnic education.

1.14   It was in this context that the initiative for

focussing attention on the reorganisation of the system of

Polytechnic Education came from Prof. V.K.R.V. Rao,

Union Minister for Education and Youth Services. Presiding

over the 20th meeting of the All India Council for Technical

Education held on the 23rd September 1969, Prof. Rao expressed

concern over the state of polytechnic education and suggested

that the present stage of consolidation of technical education

is opportune for reorganising the polytechnic courses. He

also outlined the following general guidelines for

consideration :

(a)   A system of polytechnic education that articulates the joint and cooperative effort of technical institutes and industry should be developed. The primary need is for a purposeful system of industrial apprenticeship that industry accepts as its responsibility. The technical institutes, on the other hand, should consider apprenticeship as an integral part of the total process of polytechnic education.

(b)   Polytechnics and industry which are located near each other should co-operate in organising and conducting sandwich courses for training the correct type of technicians that industry requires. Sandwich courses should become ultimately a general pattern for all polytechnics which are located close to industry.

(c)   It is only through better faculty development and through better selection procedures for admission of students that the prevalent ineffectiveness of the teaching and learning in the polytechnics can be corrected.

(d)   Polytechnics, in close cooperation with
       industry, should carry out an analysis of the
       functions, fields of activity and typical job
       positions available, identify various technician
       specialities amd reorganise their curricula to
       suit them. In doing so, the polytechnics should
       bear in mind the pattern of employment in major
       sectors of engineering activity, the need for
       the mobility of technicians - both vertical and
       horizontal, and the immediate and future employment
       opportunities available to them. Each polytechnic
       should, in consultation with the employing
       authorities comcerned, ensure that there is
       an adequate demand for the specialist technicians
       to be trained. Training in each speciality
       should be a judicious combination of theory
       and practical experience in the field.

(e)   The curriculum should aim to give a broad-based
       education in the major fields of engineering. Training
       in a particular speciality should be built on this
       broad base. This is necessary to ensure that, if the
       diploma holder cannot get a suitable job in his
       speciality, hie would not become unemployable as a
       technician in another relevant field; his
       horizontal mobility should not become difficult.

1.15   Prof. V.K.R.V. Rao suggested that a high-power Committee consisting of experts in technical education and industry should examine the emtire system of polytechnic education.   The Committee should not only examine the present inadequacies in the system and suggest measures for improvement, but also prepare a blue-print to reorganise all aspects of polytechnic education during the next ten years.   He also suggested that experts from Briitain, Germany, USSR, USA and other countries, where similar problems have been dealt with effectively, should be invited to advise and assist the Committee.

1.2   Setting up of the Committee

1.21   On the advice of the All India Council for Technical Education, the Government of India constituted the Special Committee for Reorganisation and Development of Polytechnic Education under the Chairmanship of Prof. G.R. Damodaran.

1.22   The composition of the Special Committee is as follows :

Prof. G.R. Damodaram   Chairman
PSG College of Technology
Coimbatore.4.

Prof. SK Das   Member
Principal
Technical Teachers' Training
              Institute
7, Mourbhanj Road
Calcutta.23.

Dr. S.M. Dasgupta Director Govindram Seksaria Institute of Technology and Science Indore.3.	Member
Shri K.C. Lall Principal YMCA Institute of Engineering, (Faridabad) Zakir Nagar, Mathura Road Faridabad.	Member
Shri A.L. Narayan Principal Government Polytechnic Hyderabad.	Member

Dr. Pranlal Patel
Messrs. Malleable Iron and
      Steel Castings Co. Pvt. Ltd.
      and President, All India
      Manufacturers' Organisation
Tulsi Pipe Road
Lower Parel
Bombay.13.
	Member

Shri Y. Saran Principal S.V. Polytechnic Bhopal. (at present, Principal of TTTI, Bhopal)	Member
Prof. B. Sengupto Lat-Bagan P.O. Shahganj Dist. Hooghly.	Member
Shri S.G. Somani Hon. General Secretary All India Manufacturers' Organisation Bombay.	Member
Shri Biman Sen Dy. Educational Adviser (T) Ministry of Education & Youth Services New Delhi.	Member-Secretary
Shri D.V. Narasimham Dy. Educational Adviser (T) Ministry of Education & Youth Services New Delhi.	Member-Secretary

1.23   The Committee coopted the following members :

Shri K.R. Sivaramakrishnan
Institute of Applied Manpower
        Research
Indraprastha Estate
New Delhi.

Col. S.G. Pendse
Director of Training and Central
        Apprenticeship Adviser
Directorate General of Employment
        and Training
Shram Shakti Bhawan
Rafi Marg
New Delhi.

Shri M.V.V. Raman
Director (Industrial Engineering)
National Productivity Council
38, Golf Links
New Delhi.

Prof. H.C. Guha
(Representative of Institution of
Engineers (India)
77-A, Ibrahimpur Road
Jadavpur
Calcutta.32.

1.24   The following foreign experts were associated with

the work of the Committee :

Prof. Ross Henninger	...	USA
Mr. E. Houghton	...	Britain
Prof. W.D. Kurz	...	West Germany
Dean Minoru Shimosaka	...	Japan

1.25   The terms of reference of the Committee were

as follows :

(a)   To examine the whole system of polytechnic

education vis-a-vis the needs of industry for

middle level technicians and to prepare a

ten year plan for its reorganisation and

development;

(b)   To recommend measures for improving the

practical content of diploma courses through

co-operation between polytechnics and industry

with particular reference to sandwich courses,

apprenticeship training and diversification

of subject fields;

and

(c)   To report on all other aspects of polytechnic

education.

1.3   Sittings of the Committee

1.31   The first meeting of the Committee was held at

New Delhi on 4th April 1970.   It was inaugurated by

Prof. V.K.R.V. Rao, Union Minister for Education and Youth

Services, who broadly indicated the guide-lines for the work

of the Committee. (Prof. Rao's address is given in Appendix No.1).

1.32   After a general discussion on the terms of reference the Committee decided to adopt the following strategy of action :

(a)   To undertake a sample survey of industry in order to find out the types of technicians required.   This survey should cover a cross-section of industry embracing the heavy, medium and small scale industries.

(b)   To make a thorough analysis of the present system of polytechnic education in order to find out the lacunae and deficiencies vis-a-vis job requirements.

(c)   To examine how far diversification at the technician level is possible keeping in view the need for mobility of technicians - both horizontal and vertical.

(d)   To examine the fields in-which sandwich courses could be successfully started with indications of the structure of the courses, duration etc.

(e)   To examine how best the practical training be made industry-oriented and the type of training which the students should get and its corelation with the teaching.

(f)   To examine the aspects of faculty development,
        the types of training and retraining programmes
        for teachers and the type of industrial training
        required to keep them uptodate.

(g)   To analyse the present evaluation system in
        order to modify and make it purposeful.

(h)   To consider ways and means of achieving the
        maximum involvement of industry in the training
        of technician-students and teachers.

1.33   The Committee, at its first meeting, set up two
sub-committees to make preliminary studies.

(a)   The sub-committee to examine all aspects of
        the present Polytechnic Education and to
        formulate future educational programmes,
        was constituted as follows :

        Prof. B. Sengupto (Convenor)

        Shri A.L. Narayan

        Shri S .K. Das

        Shri Y. Saran

        Shri N. Gnanasambandham

        Prof. S.M. Dasgupta

(b)   The sub-committee to prepare a questionnaire and conduct a sample survey of industry was consstituted as follows :

Dr. Pranlal Patel (Convenor)

Shri K.R. Sivaramakrishnan

Shri S.G. Somani

Shri Y. Saran

Shri K.C. Lall

At the seccond meeting held at Bangalore, the Committee authorisced the Chairman to conduct an independent, brief and quick survvey of the utilisation of technician manpower in industrry.

1.34   Subsequenttly the Committee met at Bombay, Calcutta and New Delhi beforre its concluding session at New Delhi on the 26th, 27th aind 28th February 1971.

1.35   During thev course of the meetings held in various regions, the Committtee met the Directors of Technical Education of variouis States, representatives of the Institution of Engineeers (India), the All India Manufacturers' Organisation, the Imdian Engineering Association, Chamber of Commerce and otherr organisations in order to ascertain their views.

1.310   During the course of its work, the Committee also appointed the following Working Groups :

(a)   Working Group to prepare the draft frame-work of a TEN YEAR PLAN.

Prof. G.R. Damodaran (Convenor)

Shri K.R. Sivaramakrishnan

Dr. Prem Bhatt

Shri P. Sivalingam

Shri Biman Sen

(b)   Working Group to examine the ways of organising PRACTICAL TRAINING, securing the co-operation of industry and starting of sandwich and diversified courses.

Prof. G.R. Damodaran (Convenor)

Shri S.G. Somani

Prof. B. Sengupto

Shri M.S.S. Varadan

Shri T.R. Doss

Prof. A.P. Jambulingam

Shri D.V. Narasimham

1.4   Draft report

1.41   The Draft Report prepared by the Drafting Committee was considered at the last sitting of the Committee held at New Delhi between the 26th and 28th February 1971 and adopted after modifications.

CHAPTER - II

2.0 A REVIEW OF THE DEVELOPMENT OF POLYTECHNIC EDUCATION

2.01   Although the history of technician education in our country can be traced back to over 150 years, unfortunately very little growth or development took place prior to Independence. The growth of technical education depends on the socio-economic and industrial conditions of the country and its development is controlled by the needs and requirements of the economy. Therefore, it is not surprising that technical education, particularly technician education, did not make much progress prior to Independence.

2.02   In 1947, the country was faced with the great challenge of rapidly industrializing the predominantly agricultural economy. In order to do so, the country had to build up its technical education system within a short period. Perhaps one of our most remarkable achievements since Independence has been the phenomenal growth of technical education. In 1947, there were about 53 institutions conducting technician courses (diploma courses) with a total admission capacity of about 3,700 students per year; the total out-turn from these institutions was of the order of 1500 per year. The number of institutions offering technician courses (diploma courses) was progressively raised to 284 by 1966. The total annual intake capacity was increased to about 49000 and the annual out-turn to

2.12   A State-wise list of polytechnics with their annual admission capacity, out-turn for 1969, subject fields and locations is furnished in Appendix No.4.

2.2   Existing organisational pattern

2.21   With the phenomenal expansion of all sectors of education since Independence, the administration of education has become complex. During the post-independence period several new dimensions have been added to the functions and responsibilities of Government in policy-making, coordination and fulfilment of national targets in education. In this process technical education has received special emphasis.

2.22   The All India Council for Technical Education was constituted in November, 1945 to advise the Government of India on all aspects of technical education. It consists of representatives of the Union and State Governments, Parliament, associations in the fields of business, industry, labour and education, and professional bodies. Though the Council is an advisory body, experience shows that its recommendations have, by and large, been accepted in the past by the Union and State Governments. The four Regional Committees of the Council, each covering a group of States, have their offices at Kanpur, Madras, Bombay and Calcutta and assist the A.I.C.T.E.

2.23   The All India Council for Technical Education has set up eight Boards of Technical Studies in different branches of engineering, technology, management etc. to advise the Council on such matters as the preparation of model courses of studies, and the specification and regulation of standards in the respective subject fields.

2.24   Technical education is normally administered by the Education Departments of State Governments. In some cases, however, it is being administered by other departments such as Department of Industries or Public Works Department etc. On the recommendation of the All India Council for Technical Education, each State has set up a State Board of Technical Education. Most of the State Governments have also established separate Directorates for the effective administration of technical education.

2.25   The activities of the polytechnics in each State are coordinated through the concerned State Board of Technical Education within the overall national policies formulated by the All India Council for Technical Education. The Directorate of Technical Education is responsible for the administration and inspection of the polytechnics and provides secretariat assistance to the State Board of Technical Education which conducts the examinations and awards the diplomas.

2.26   At present, about 70% of the polytechnics are run by State Governments and the rest by private agencies

2.27   Perhaps one of the weakest links in the development of technical education at present is the system of evaluation, inspection and feed back. Neither at the national nor at the State levels, is there an adequate machinery for the systematic evaluation of the work and progress of different institutions. In the absence of such a machinery there has been very little feed back of information which is very necessary to make the technical education system more sensitive to the needs.

2.3   Employment and collaboration with industry

2.31   The Survey of Industries which has been carried out on behalf of the Committee reveals that only 36% of the positions at the middle level in industry are occupied by diploma holders, 48% being held by persons who have risen from the craftsmen level and about 16% by engineering graduates. It is clear that although there is unemployment amoung the diploma holders, there is at the same time a tendency in industry to assign a significant proportion of technician positions to persons without formal qualifications but with job experience at the craftsman level. The Survey further reveals that the products of polytechnics do not and cannot straightaway fit into job situations in industry, because the education and training which are now being imparted at the polytechnics are not sufficiently industry-or practice-oriented.

2.32   The main reason for such an anomalous situation is perhaps the lack of collaboration between industry and the polytechnics. There is a tendency for the polytechnics to

2.4   Need for qualitative improvement

2.41   An analysis of the current unemployment among

engineering graduates and diploma holders was recently made

by the Institute of Applied Manpower Research. It revealed

that out of the 56,700 persons estimated to be unemployed

by the end of 1968, as many as over 46,000 were diploma

holders. According to the data available from the Employment

Exchanges, for every engineering graduate registered as

unemployed, there are 5 unemployed diploma holders even

though the annual out-turn of graduates and diploma holders

is in the proportion of, approximately, 1:2.

2.42   One of the factors leading to this increasing

unemployment among diploma holders is reported to be the

deficiencies of the present polytechnic courses vis-a-vis

the requirements of industry. The shortcomings of these

courses as revealed by the Committee's Survey of Industries

are described in Chapter IV. The Committee would like to

stress in this context the need to accord a much higher

priority in technician education development to the quali-

tative improvement of courses and consolidation of existing

institutions rather than to quantitative expansion.

2.43   It is also relevant here to refer to an assessment,

by the Institute of Applied Manpower Research, of the demand

for engineers during the Fifth Plan period. Assuming that the

economy will grow at an annual rate of 5.5 percent during the

Fourth Plan and 6 percent during the Fifth Plan, as postu-
lated by the Planning Commission, the overall demand for
engineering graduates and diploma holders in 1978-79 is
expected to be met with the current levels of admissions
in technical institutions. It will also be possible to
meet any additional demands of a marginal nature within
the overall sanctioned intake capacity in the existing
institutions.

2.44   The Committee is therefore of the view that, at
least for the next five years, there would be no need to
consider the establishment of new polytechnics. As for the
intake capacity of existing polytechnics, the position may
be reviewed after three years and any changes necessary may
be made so as to meet the actual needs. The resources
available in the current Five Year Plans of the States and
the Ministry of Education and Youth Services should be
devoted to programmes aiming at qualitative improvement of
technician education on the lines suggested in this Report.

2.45   At the same time, efforts should be made to prepare
realistic estimates of the demand for technicians for the
Sixth and subsequent plans, region-wise and by specialities
and types of technician functions in industry, commerce,
services and public utilities, so that appropriate programmes
of educational development could be formulated and included
in the Fifth Five Year Plan.

TABLE 2.1

Statewise distribution of Polytechnics (excluding Girls' Polytechnics as in the year 1969-'70

S.No.	State	Institutions Conducting 3-year courses	Institutions conducting 2-year courses	Institutions conducting sandwich courses
1	Andhra Pradesh	18	1	1
2	Assam	6	-	-
3	Bihar	14	-	-
4	Chandigarh	1	-	-
5	Delhi	3	-	-
6	Goa	1	-	-
7	Gujarat	17	-	-
8	Haryana	6	-	1
9	Himachal Pradesh	2	-	-
10	Jammu & Kashmir	2	-	-
11	Kerala	16	-	-
12	Madhya Pradesh	22	-	-
13	Maharashtra	24	2	-
14	Manipur	1	-	-
15	Mysore	27	-	-
16	Orissa	6	-	1
17	Pondicherry	1	-	
18	Punjab	10	-	1
19	Rajasthan	6	-	-
20	Tamil Nadu	27	-	3
21	Tripura	1	-	-
22	Uttar Pradesh	33	3	-
23	West Bengal	23	2	2
	Total:	267	8	9

Total   284

NOTE: Government Polytechnic, Hyderabad (A.P.) also offers the two year diploma course.

TABLE 2.2.
Subject-wise distribution of capacity togehter with total
intake and out-turn for the year
1969-70
(excluding Girls' Polytechnics)

S.No.	Subject area	Maximum intake capacity as in 1966	Admission 1969-70	Out-turn 1969-70
1	Civil	15,190	6,402	4,812
2	Mechanical	16,339	9,194	8,905
3	Electrical	13,395	7,460	6,035
4	Electronics/Telecom/ Radio Engg.	350	290	223
5	Mining	400	154	95
6.	Metallurgy	240	166	86
7	Automobile	497	414	243
8	Textile	493	413	280
9	Leather Technology	95	112	59
10	Paper and Pulp Technology	50	40	54
11	Printing Technology	385	409	207
12	Textile Chemistry	95	55	49
13	Chemical Operator Chemical Engg.	180	220	147
14	Pharmacy & Dressers course	400	478	219
15	Ceramics	64	34	24
16	Sound	61	68	23
17	Refrigeration	40	59	35
18	Production Engg.	190	6	9*
19	Industrial Engg.	-	6	5*
20	Architectural Assistantship	60	68	11
21	Town Planning	20	20	18**
22	Industrial Electronics	-	10***	
	Total	48,544	26,078	21,539

* 1 1/2 years post-diploma course at the PSG Polytechnic, Coimbatore.
** 1 year post-diploma course at the Central Polytechnic, Madras
*** Allahabad Polytechnic, 1969.

TABLE 2.3

State-wise distribution of Girls' Polytechnics as in the year 1969-70

S.No.	State	Institutions conducting 3-year course	Institutions conducting 2-year course	Remarks
1	Andhra Pradesh	3	-	Also offers 2-year courses in Commercial Practice and Pharmacy
2	Assam	1	-	Also offers 2-yr. course in Secretarial Practice
3.	Bihar	-	-	-
4	Chandigarh	1	-	Also offers 2-year courses in Commercial Practice, Pharmacy & Library Science
5	Delhi	1	-	Also offers 2-year courses in Secretarial Practice, Library Science & Laborat0ry Technology
6	Goa	-	-	-
7	Gujarat	2	-	Also offers 2-year course in Secretarial Practice
8	Haryana	-	1	-
9	Himachal Pradesh	-	-	-
10	Jammu and Kashmir	-	-	-
11	Kerala	3	-	Also offers 2-year course in Commercial Practice

Table 2.3 contd...

12	Madhya Pradesh	1	-	Also offers 2-year courses in Secretarial Practice and Laboratory Technology
13	Maharashtra	-	-	-
14	Manipur	-	-	-
15	Mysore	1	-	Also offers 2-year course in commercial Practice and Library Science
16	Orissa	-	-	-
17	Pondicherry	-	-	-
18	Punjab	-	-	-
19	Rajasthan	2	-	Also offers 2-year course in Library Science
20	Tamil Nadu	3	-	Also offers 2-Year course in Commercial Practice
21	Tripura	-	-	-
22	Uttar Pradesh	2	-	Also offers 2-year course in Secretarial Practice
23	West Bengal	1	-	-
		21	1	

Total : 22

TABLE 2.1

Subject-wise distribution of capacity together with total
intake and out-turn for the year 1969-70
(Girls Polytechnics)

S.No.	Subject Area	Sanctioned Intake (1969-70)	Admission (1969-70)	Out-turn 1969-70
1.	Electronics	420	329	141
2.	Secretarial Practice	300	304	123
3.	Interior Decoration and Display	55	36	15
4.	Library Science	145	135	86
5.	Medical Laboratory Technology	40	29	18
6.	Commercial Arts	25	29	18
7.	Architectural Assistantship	180	96	84
8.	Commercial Practice and Stenography	300	424	116
9.	Pharmacy	150	162	12
10.	Costume Design	245	163	77
11.	Civil/Draughtsmanship	300	202	67
12.	Catering	30	44	---
		2,190	1,953	757

C H A P T E R - III

3.0   CONCEPT OF TECHNICIAN AND HIS EDUCATION

3.1   Definition

3.11   In the technical manpower spectrum, while professional engineers and craftsmen are easily recognisable, it is more difficult to recognise technicians as a class by themselves, although they occupy a large part of the spectrum. This is so because of the difficulty in drawing clear-cut lines separating certain highly skilled craftsmen and process workers from technicians and the difficulty in distinguishing the well-qualified technicians from some technologists with a similar level of responsibility. As a result, technicians as a class can be identified only by removing professional engineers and craftsmen from the spectrum. There is, however no doubt that the duties and functions performed by technicians are recognisable.

3.12   The I.L.O. defines a "technician" as a worker who prepares working plans and other technical drawings from suggested sketches or notes for engineering, manufacturing or other purposes; performs technical tasks usually under the direction and supervision of professionally qualified specialists in engineering.

3.13   At the 12th session of the General Conference of the UNESCO held in 1962 the member States adopted the following definition:

> " The term "technician" applies to persons working in occupations requiring a knowledge of technology and related sciences between that of a skilled worker and that of an engineer or technologist; occupations at technicians level may call for inspection and maintenance, detailed development plans, supervision of production work, detail construction. Collaboration with the engineer is an essential part of the work of the technician".

3.14   The Huddersfield Conference on the Education and Training of Technicians held in 1966 identified technicians as being those people employed in the broad spectrum of occupations lying between the craftsmen on the one hand and the professional (or technologist) on the other.

3.15   It may, however, be stated that a technician working in fields such as sales, servicing, routine maintenance, estimating etc. may need very little guidance or advice from a professional. In such cases he will mostly be working independently except for a nominal professional supervision as a matter of administrative hierarchy. In some situations the technician may be called upon to supervise the work of craftsmen, operators or junior technicians.

So far as the supervision of craftsmen is concerned there is a tendency in industry to leave such supervision to persons promoted from the ranks of skilled craftsmen if the work does not require complex technical knowledge. It has, however, been generally accepted that a technician's job is not an extension of that of a craftsman or an operator. Technicians and professionals are complementary to each other.

3.2 Functions

3.21 The occupation of a technician may broadly involve one or more of the following functions:

   i. Erecting and commissioning of engineering structures, equipment etc.

  ii. Engineering drawing and detailing

 iii. Maintenance and repair of engineering plant and machinery

  iv. Assisting engineers in design and development

   v. Assisting engineers and scientists in research and development activity

  vi. Inspection, testing

 vii. Estimating

viii. Sales and after-Sales Service

  ix. Servicing

   x. Contracting

  xi. Production and Control

 xii. Work Study

3.22   The above functions are related to the engineering

industries. While the use of the term technician in business,

commerce and other fields is relatively new, there are clearly

several occupations which are comparable to those of technicians

in the engineering fields. Such occupations include personal

secretaries, accountants, auditors, data processing personnel

and certain other junior executives.

3.3   Definition and interpretation adopted by the Committee

3.31.   After a careful consideration of the duties and

functions of technicians, the Committee has adopted the

following broad definition and interpretation of the term

"technician":

> "A technical employee, whatever his designation,
>
> who occupies a middle level position between the
>
> craftsmen and the technologist; whose work requires
>
> the application of technical knowledge higher than
>
> that of a skilled worker but below that of a
>
> technologist; whose work moreover requires a
>
> proficiency in skills higher than that of a
>
> technologist but lower than that of a skilled worker."

The Committee uses the terms "technical" and

"technology" in the broadest sense without confining them

to denote only the specific disciplines of engineering.

3.32   The following diagram illustrates the two major

dimensions which may be used to distinguish skilled workers,

technicians, technologists and scientists. For the purpose of

this report, the Committee has restricted the areas of

technicians to the extent to which technical personnel can be

trained effectively through full-time or part-time courses etc.

to occupy middle level positions in the technical manpower

spectrum as indicated in the schemetic diagram given below:
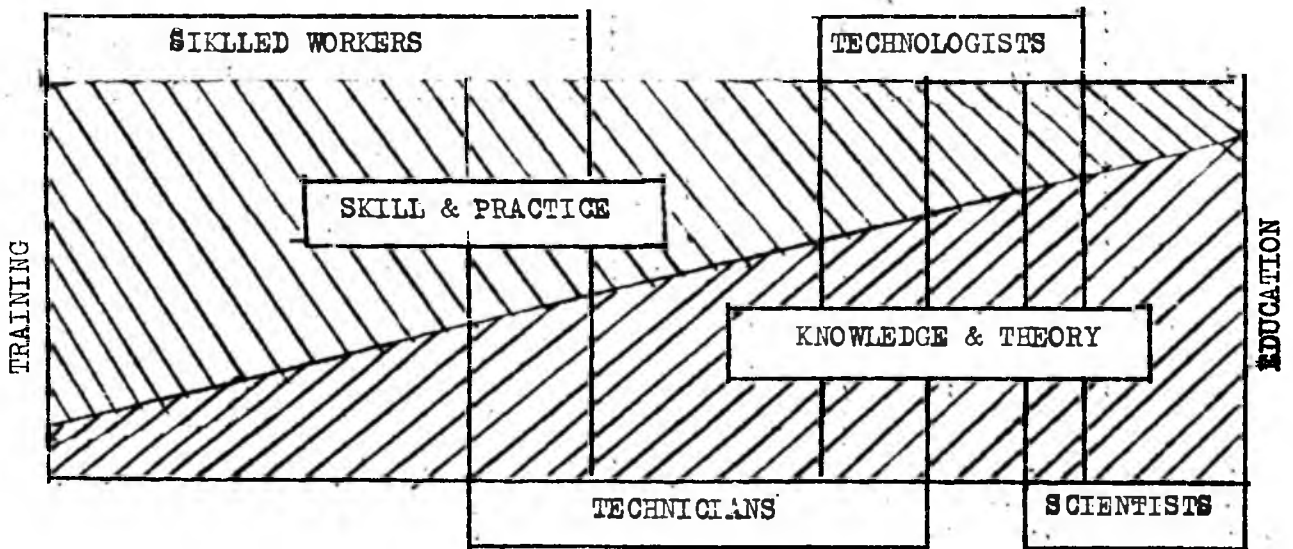
Skill in techniques based on the knowledge of principles, sufficient to judge the most appropriate technique to adopt or to adapt where necessary.

Thorough knowledge of basic principles as found, for example, in the sciences and their application and/or adaptation in novel or out-of-the common situations.

3.4   Education and Training

3.41   The main objective of the technician education
programmes of polytechnics is to give the technician student
a sound broad-based knowledge of a chosen field. The education
needs to be supplemented with actual practical experience in
industry or business and commerce. It is therefore necessary
that the programmes of technician education and training should
be properly drawn up in an integrated manner with the cooperation
of industry. Whereas educational programmes should take care of
the present and future needs, training programmes should condition
the technician to meet the immediate needs.

3.42   Technician jobs involved a level of scientific and technical
knowledge higher than that needed by an operator or craftsman,
but lower than that of a technologist, engineer or scientist.
A technician's education and training should enable him to
exercise technical judgement; this judgement is based on an
intelligent application of the general principles underlying
the technician's work as compared with the realiance upon
accumulated skill and experience which is characteristic of
the craftsman. Whereas the term 'craftsman' applies to a
fairly easily defined and generally recognized degree of
skill, the term 'technician' applies to a broad band of abilities
ranging from jobs which are only slightly more technical than
those of craftsmen, right up to others where high-grade
technicians are rubbing shoulders with technologists and
scientists.

3.43   The special characteristics of technicians' work determine the nature of their education and training. First and foremost, technicians need to have a mastery of those techniques which are directly relevant to their immediate employment. Proficiency in these techniques requires an understanding of the sciences and mathematics on which they are based. This understanding need not be so profound as that of the professional scientist, but should be sufficiently firm to permit its further extension as new applications of the relevant sciences and technology are introduced and also as the technician himself encounters situations which present new requirements for specialisation.

3.44   Most technicians also find themselves concerned technically with the work of others at craft or operative level. They must, therefore, be aware of its nature and problems. This awareness is preferably acquired through the medium of a broad basic training and planned experience which is specifically designed to give direct acquaintance with the work in question.

3.45   Technicians in all fields should also be able to communicate with their colleagues at senior and junior levels, for example, in making reports, issuing and conveying instructions and so on. Therefore, they need fluency in the use of the written and spoken word and this can best be built on the basis of a sound general education.

3.46   The relative extent of the technician's requirement for manual skills as opposed to technical knowledge will depend very largely on the field in which he is employed; in design, for example, it will be minimal, in servicing it may be high.

3.47   During their careers technicians will be required to guide and supervise the work of skilled work people and craftsmen. In due course they may also be expected to rise to positions of responsibility in industry, commerce and society. Some technicians may set up their own industrial or business concerns. Technician education should not lose sight of these aspects of the future life of technicians. Through their courses, educational approach and extra-curricular activities, polytechnics should attempt to develop the right type of motivation, the correct attitude towards dignity of labour, a practical way of thinking and a sense of discipline, team work and social responsibility. The confidence and competence needed for self-employment should also be developed.

3.48   Our country is facing the problem of adapting
itself to an ever-increasing rate of technological change
and scientific progress: if the technician is to play his
proper part in the solution of this problem, he must be
adaptable and needs to have an appreciation of the social
and economic environment beyond the narrow confines of his
immediate discipline. This need for flexibility and a wider
outlook calls for broad-based courses which include liberal
or humanistic studies and the provision of adequate
co-curricular, extra curricular and recreational facilities.

3.49   Entry into a technician occupation requires not only
an understanding of the scientific principles behind particular
technician functions but also a mastery of the techniques and
the skills, procedures and processes which are a part of
these techniques. Application of these techniques implies a
careful selection of the tools, equipment and skills and
their judicious use to production objectives. Polytechnics
can offer only a part of the training needed to impart these
competencies because of the limitations of their workshop
facilities. They may include in their programme the
training in basic manual and machine skills.

The rest of the above practical competencies can only be acquired by industrial or field training. Training to achieve an acceptable level of practical competency is thus an integral part of the education of technicians and the success of technician education programmes will depend on the degree to which the integration of polytechnic courses with relevant field/industrial training is achieved and consequently on the degree to which collaboration between polytechnics on the one hand and industry and commerce on the other is established. The Committee recognises the supreme importance of associating industry and commerce - the employers - with the planning and implementation of technician education and training programmes. From the initial forecasts of technician manpower requirements through the analysis of job content to the preparation of course syllabuses, and the final assessment of the completence of the technicians, there is an urgent need to ensure the closest possible cooperation of employers. The problems of providing proper education and training for technicians are the concern of a partnership between government, employers and the educational system: each has its responsibilities and each must collaborate with the others in a combined effort if the right solutions are to be found and applied.
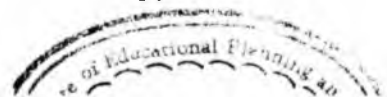
C H A P T E R - IV

4.0   SURVEY OF INDUSTRY

4.01   To consider the nature and direction of the reorganisation of polytechnic education to meet the real needs of industry for middle level technicians, it is necessary, among other things, to ascertain the job positions available in industry for diploma holders, the qualities and skills expected of them, the pattern of in-service development and promotion prospects and the need and nature of re-training and updating courses. Moreover, a study of the views and suggestions of Industry on the present diploma courses, and an assessment of the in-plant facilities which could be made available by industry, would be useful in planning for the education and training of technicians on proper lines.

4.02   The Chairman of the Committee therefore undertook a detailed survey of selected industrial establishments covering a representative sample of the engineering and process industries and the public utilities and services. The Report of the Survey is given in Appendix No. 5. A pilot study was also made by the Technical Teacher Training Institute, Calcutta, aiming at an analysis of technician jobs in two selected engineering establishments. In this chapter, a brief resume is given of the findings of these studies with special reference to the qualitative needs of technician education and training.

4.1   Pattern of employment

4.11   Technician positions in industry are occupied by engineering graduates, diploma holders and 'engineering practicals'* i.e. those who do not have formal technical education qualifications but perform the functions on the basis of their job experience. According to the Survey, the proportion of these groups is as shown in Table 4.1.

TABLE 4.1

Technician positions by educational
qualifications

Industry group	Proportion (in percentage)			
	Engg. Graduates	Diploma Holders	Engineering Practicals	Total
1	2	3	4	5
Mechanical Engg. Industry	11	41	48	100
Electrical Engg Industry	16	38	46	100
Metallurgical (including Mining) Industry	9	37	54	100
Processing Industry	23	24	53	100
Others	26	29	45	100
Overall proportion	16	36	48	100

*In the Report of the Survey of Industries, the phrase
 "persons with job experience only" is used in place
 of the term "engineering practicals".

4.12   There are wide variations in the pattern of

utilisation of diploma holders as technicians within these

industry groups, the proportion ranging from 24 percent

in the processing industry to over 60 percent in the

automobile, ship-building, machine tool, and paper industries.

4.13   A sizeable proportion of skilled craftsmen get

promoted to technician positions after they gain experience

on the shop floor. Sufficient attention has not been given

to this group of technicians in the present system of

polytechnic education. Polytechnics have the necessary

facilities to offer a variety of short-term and part-time

educational courses to supplement the technical skills of

these craftsmen, especially to equip them for their role in

planning, supervising and managing men and materials.

4.14   In terms of functions, technicians are distributed into

the three fields of (a) design and production, (b) laboratory

testing and analysis, and (c) sales, stores and costing, as

shown in Table 4.2.

TABLE 1.2

Functional distribution of Technicians

| Industry group | Proportion (in percentage) | | | |
	Design & Production	Laboratory testing & analysis	Sales, Stores etc.	Total
1	2	3	4	5
Mechanical Engineering Industry	74	19	7	100
Electrical Engineering Industry	65	19	16	100
Metallurgical (including Mining) Industry	NA	N.A.	NA	N.A.
Processing Industry	68	24	8	100
Others	N.A.	N.A.	N.A.	N.A.
Total	69	20	11	100

N.A.: Not available.

The concentration of technicians in the design and production field, especially in the engineering industry, is noteworthy. It is also observed that in the process industries, such as petrochemicals and electronics, a substantial number of technicians, about 30 percent, are engaged in process control and laboratory work. In industries like electrical machinery manufacture and textile machinery manufacture, there is a growing demand for technicians for sales and services.

4.2   Requirement of technical knowledge and skills

4.21   Irrespective of the nature of processes or organisa-
tions, the main qualities expected of diploma holders for
filling up technician positions in industry are: (a) knowledge
of basic technology in the chosen field, (b) knowledge of
engineering practice in industry, (c) ability to apply
technical knowledge to practical situations, and (d) personnel
qualities and leadership ability. Industries also stress
the importance of communication skills for their technicians.

4.22   In relation to the qualities identified above, the
present diploma courses need reconsideration particularly
in the matter of practical orientation. 96 percent of the
respondents to the Survey stated that the present diploma
holders do not possess the skills necessary for performing
technician duties. It was also noted that the technical
knowledge of diploma holders in particular specialities
is not of sufficient depth.

4.23   Industry is generally in favour of specialised
instruction and training in a number of diversified fields
in place of the present generalised courses in broad
fields; a suitably broad-based study is however felt
to be necessary before any specialised study is undertaken.

4.3 Organisation of technician education

4.?1 An attempt was made through the Survey to ascertain the views of Industry on the possibility of organising diploma courses on a sandwich pattern. Sixty six percent of the respondents favoured sandwich courses with specialisation. The Engineering Industry in general supports sandwich courses wherever such courses are feasible; this includes eightyone percent of the respondents from the heavy engineering industry, seventy seven percent from the electrical industry and seventy percent from the electronics industry.

4.32 In regard to process industries, a majority of the respondents were in favour of specialisation without sandwiching; they, however, stressed the need for training the industry after the institutional programme.

4.33 It was also stated by most of the respondents that specialisation should be considered according to the needs of different industries. A view was expressed on behalf of some units in the petro-chemical industry and in the electronics industry that sponsorship of students by industry to technician courses would be very desirable.

4.34 A close coordination between industry and education is considered essential in the process of technician education and training. This will be necessary, among other things,

for the periodic revision of curricula and development of

new courses wherever necessary, for providing facilities to

teachers of polytechnics to gain industrial experience, for

sponsoring candidates to sandwich courses and for conducting

such courses. Most of the respondents to the Survey

expressed their willingness to cooperate with polytechnics

in all these areas.

4.4 Training of diploma students in industry

4.41 Consistent with the view that training in industry is

an essential component of the education of technicians, many

industries have offered facilities for organising such

training, subject to certain conditions of financial and

organisational commitments. In this context, it is

emphasised by Industry that such training should be properly

planned and effectively supervised.

4.5 Training of polytechnic teachers in industry

4.51 Respondents from industry emphasise that the teachers

in polytechnics should be uptodate in their knowledge of

the practices in industry in order to make polytechnic

education application-oriented and relevant to the needs

of industry. Nearly 80 percent of the respondents are

willing to offer the necessary facilities for the industrial

training of teachers subject to certain conditions. These

conditions mainly concern (a) the cost to be incurred for

the training and (b) the safeguards necessary to maintain

technical secrets relating to their products, processes and

4.52 Various suggestions have been made about the duration
of the industrial training of teachers. The durations
proposed vary from one month to 5 years at a time, the longer
duration being generally meant for new entrants to the
teaching profession. In the opinion of Industry, such
training should be made an essential qualification for
recruitment as teachers. There should also be provision
for further training of shorter duration from time to
time during the tenure of work of teachers.

4.6   Retraining

4.61 The Survey reveals an increasing appreciation by
Industry of the need for refresher courses and retraining
programmes for technicians working in industry. The factors
supporting this need are: (a) technological developments
and continuing changes in processes and products; (b)
occupational mobility of technicians; (c) the need to
update knowledge for improved performance; (d) the specia-
lised requirements of certain industries; and (e) continuing
improvements in management techniques.

4.62 Several industries have suggested special short-term
courses for technicians in industrial and production
engineering and in the modern concepts and techniques in
their subject fields. Some of the subjects indicated in
this connection are: (a) operations research; (b) instrumen-
tation; (c) tool design and engineering; (d) production

planning; (e) standardization; (f) materials planning
and control; (g) quality control; and (h) cost control.

4.63 Some of the above subjects, like quality control
and production control, are in the nature of basic require-
ments for any technician course and should be included in
the pre-employment education offered in polytechnics.
Wherever Industry identifies specific areas of retraining,
polytechnics should devise suitable short-term courses
jointly with the industry concerned and conduct such
courses either in polytechnics and/or in industry.

4.7   Job analysis

4.71 The sample job analysis made by the Technical Teacher
Training Institute, Calcutta, primarily as a pilot study,
broadly supports the findings of the Survey particularly
on the need (a) to specialise by means of diversified
technician courses, (b) to develop supervisory and managerial
skills, (c) to improve the technician's ability to plan,
organise and control shop-floor activities, (d) to develop
the ability to communicate effectively with engineers and
craftsmen, (e) to ensure a sound knowledge of engineering
principles and sciences along with skill in the application
of such knowledge to practical problems, and (f) to consider
the process of technician education as a cooperative effort
of polytechnics and industry.

CHAPTER - V

5.0 REORGANISATION OF POLYTECHNIC EDUCATION

5.01   The duties and functions of technicians and the corresponding educational and training requirements have been outlined in chapter III.   The deficiencies of the present system of technician education and training and the desirable improvements pointed out by industry have been summarised in Chapter IV.   This chapter examines the reorganisation of the educational programme and the organisational set-up in the light of the several views and suggestions presented to the Committee.

5.1   Need and nature of the reorganisation of courses

5.11   Need for Diversification of diploma courses

a)   Industry has drawn attention to the inadequacy of the technical knowledge of present diploma holders.   Particularly their lack of depth of knowledge in different technician specialities has come under criticism.

b)   This criticism is but quite natural if one looks at the bewildering variety of specialised technological techniques, operations, procedures, and equipments which characterise the present-day industrial activities.   New methods, materials and processes are emerging rapidly.   Side by side, new techniques of production management, as in production control and industrial engineering, are developing.   Commerce and business are also making an increasing use of scientific and specialised methods in organisation, sales and management.

Correspondingly, there has been considerable development in technician functions and specialities. Underlying these specialities there is such a great deal of specialised theory and practice that a general course in a major branch of engineering can only superficially cover all these specialities. It may, therefore, appear desirable to favour a narrow specialisation of the courses to facilitate a study of each speciality in depth. However, there are weighty reasons against such narrow specialisation, the important among them being:

   i. In the Indian context, narrow specialisation will severely restrict the employment opportunities and mobility of technicians.

   ii Narrow specialisation may restrict future occupational advancement for want of higher level positions in many of the specialised fields.

   iii. In the absence of broad-based technical knowledge, the scope for further study and adaptability to technological changes will be limited.

c)   Bearing these considerations in mind, the Committee feels that, at present, narrow specialisation is undesirable at the first diploma level. The diploma courses should, wherever necessary, be diversified to provide for a range of broad specialisations within the major branches of study. These broad specialisations should, moreoever, be built on the broad based study of the basic principles of engineering, technology or other fields and the applied and basic sciences and mathematics common to the entire branch.

5.12   Need for Sandwich courses

a)   Other deficiencies in diploma holders repeatedly pointed out are that they lack skills, practical job knowledge and the ability to apply and are ingorant of the actual requirements of industry.

b)   But the industries agree, nearly unanimously, that however, efficiently the systems of technician education and training may be organised, the diploma holders are not likely to exactly fit into the needs of the actual work done in industry without some kind of orientation and shop floor/field training. This is so because the practices and techniques, tools and equipment, and procedures vary in nature from unit to unit in the same kind of industry and from industry to industry and are also liable to changes from time to time. The organisational arrangements too are not of a standard pattern.

Multiplying this diversity b the broad array of techncian functions

from design, drafting and development to maintenance and supervision

one could see the dimensions of the problem of training the student

to adequate technician job-competency. Most industries realise

this and are prepared to organise orientation and induction programme

and on-the-job training to new recruits. Even so they expect the

diploma holder to have a good practical knowledge and skill

concerning industrial techniques, procedures, tools, materials etc

so as to enable him to judiciously select and apply these in any

particular situation.

c)   The capability of purely institutional education and training

to impart such a competency is somewhat limited by the available

equipment and facilities. In the institutional set-up the industrial

atmosphere too is lacking. The practical work in the polytechnics,

if well-organised, can give the training in basic manipulative and

machine skills necessary to develop skill acquisition and appreciation,

Facility in the judicious combination of skills and tools and the

integrated application of knowledge and techniques to actual field

operations can, to a large extent, be acquired only through properly

planned and guided training in industry. Moreoever, in the

institutional practical work, the student lacks the inherent urgency

and interest which characterise the work being done as a part of a

production, maintenance or business job. Planned practical work

in a production shop or in a drawing office, where the activities

are not merely exercises but stages of work which will end in

saleable products, makes a difference in the intensity of motivation,

d)   For these reasons, the Committee recommends that efforts

should be made by all concerned to provide practical training in

industry for all **diploma** students.   The several aspects of

industrial training are discussed in chapter IX.

e)   One of the best ways of linking industrial training with

institutional education is through the organisation of **sandwich**

courses.   The training resources of institutions and industry are

combined to conduct these courses, with the result theory

and practice are closely correlated.   The student's motivation

is enhanced as work is coordinated with studies and he develops

greater skill in human relations and a greater sense of responsibility.

The transition from academic pursuits to the world of work becomes

easier.   Therefore, there can be no doubt that sandwich courses,

if they are properly planned, organised and conducted, would

be the best way of producing capable technicians.   The Committee

favours their progressive introduction in appropriate technician

specialilities wherever possible.   However, the effective

organisation of sandwich courses depends on several

considerations both academic and practical.   These considerations

are examined in a later section.

f)　　　While the incorporation of industrial training as an important component of technician education is essential, it is equally necessary that adequate attention be paid to strengthening the practical content of the courses and giving them an industrial orientation.

g)　　　The practical content as prescribed in our present courses seems impressive, often occupying 60 to 70% of the total time. In practice, however, the teaching and learning of technological practice have largely been ineffective. Important among the several reasons for this deficiency are: (a) a lack of clear understanding of the real meaning of practical work in the context of technician education (b) a theoretical teaching approach devoid of appeal to real situations (c) the lack of equipment and facilities (including adequate consumables) for simulating industrial situations, work and activities and (d) the lack of practical experience, on the part of the teachers, in the work they are trying to teach.

h)　　　This calls for the adoption of new teaching approaches and the reorientation of institutional practical work to foster ability in application. The practical work must simulate industrial or commercial conditions as closely as possible. Industrial experience for faculty and measures for industrial training of teachers also become vital. These aspects will be discussed further in later sections.

5.13   Need for part-time and other courses

a)   Reference has already been made in chapter IV to the need expressed by industry for organising a variety of short term and part-time educational courses for technicians and craftsmen working in industry in order that they may qualify themselves to work with greater competence. The Committee recognises the importance of such courses as the most effective method for the education of persons to fill the technician positions falling nearer the craftsmen.

b)   Industry has also stressed the need for organising special refresher and retraining courses in several areas for their technicians. The Committee recommends that while the major concern of polytechnics should be the running of regular diploma courses, they should also organise part-time, short-term and other special refresher and retraining courses, depending on the needs and situations.

c)   Apart from these courses, polytechnics should organise advanced diploma courses. The Committee feels that the provision of such opportunities to enable technicians to qualify themselves better will not only serve the interests of industry, but, more importantly, improve the promotional prospects of technicians and enhance their status.

d)   In this context the Committee feels it necessary to refer to the greater social recognition given to degrees and the wide-spread demand by technicians for the creation of opportunities to qualify for degrees. The technician education system must make due provision to meet this need. Therefore, the Committee recommends that certain selected polytechnics of acceptable standard having the necessary facilities, faculty and resources must be authorised to offer part-time degree courses. The State Council of Technical Awards - the machinery for the control of standards of technician education recommended in the later part of this chapter - may award these degrees. Such courses could moreover give scope for polytechnic teachers also to attain better status and opportunities.

5.14   Need for flexibility in course planning

If the suggestions made so far about course reorganisation are to be effective, the courses must reflect the needs of regional, local and individual industrial and commercial units as closely as possible. Therefore, it is obvious that the courses and curricula of different polytechnics would not always be uniform. Moreover, the local conditions with regard to industrial training vary greatly and therefore, there can be no single uniform training arrangement.

In view of these considerations, it becomes essential that, within the broad framework of certain general guidelines as regards the standards, objectives and scope of technician courses, there should be a great deal of flexibility in course planning to permit local variations in their structure, contents, and organisation. This necessity for flexibility gains further emphasis if it is agreed that technician education should continually adapt and modify itself to suit future needs and changes.

5.2 Courses

5.21 Course patterns

a) In line with the foregoing considerations the Committee recommends that polytechnics should organise a variety of courses as given below depending on the needs and situations. In organising the different courses, it is essential that coordination should be established in centres where more than one polytechnic exists so that duplication of efforts may be avoided.

b) Full time diploma courses

i, General courses: General courses are of the kind as exist at present in the fields of engineering and in commercial practice.

ii. Diversified courses: Diversified courses have been defined earlier as those in which study-in-depth or specialisation in any of a range of broad sub-fields is built on a study of the fundamentals of the entire branch. Diversified courses should be organised in such institutions where the need for them has been fully established. These

courses may be introduced in the initial stages by means of elective subjects within the broad-based diploma courses.

In introducing diversified courses, due regard should be paid to the pattern of employment in the major fields of engineering, commerce and business. In the field of civil engineering, for example, the major employers like the PWD and Government departments feel that there is no need for extensive diversification. However, other employers like the contracting firms, practising architects and consulting engineers have expressed the view that there is need and scope for some diversified courses in the civil engineering field.

In mechanical engineering and electrical engineering, where manufacturing industry is the major employer, there is a large demand for specialist technicians. There employment pattern in respect of technician level personnel in commerce and business also admits of some diversification in the related diploma courses. Introduction of diversified courses therefore implies a careful analysis, from time to time, of the activity of employing organisations and the job positions available therein and a precise description of the functions of technicians. For this purpose the Committee recommends the setting up of special cells in the Directorates or Departments in charge of technical education. Their functions would include the estimation of future technician demand, speciality-wise, on the basis of analyses of occupations.

In India, the technician is frequently required to deal with tasks related to, but not necessarily part of, his functions. Therefore, in planning the diversified courses, we should look beyond the boundary of such occupational analyses. Courses must be planned to suit the needs of techncian occupations in a cluster of closely related specialisations. A list of some of the fields in which diversified courses can be organised is given in Annexure 5.1 to this chapter.

c)   Sandwich courses

In sandwich courses institutional education and industrial training alternate over the duration of the course. The sandwich periods may vary according to the nature of the speciality and the training arrangement that is best suited in any particular case. Experience suggests that 3 to 6 month sandwich periods are generally suitable.

The quantum of industrial training needed varies with different technican specialities; consequently, courses in certain specialities lend themselves better to the sandwich pattern. Sandwich courses should therefore be organised in such specialities where a proper balance and correlation could be achieved between the institutional education and the industrial training.

In organising sandwich courses, adequate arrangements should be made for proper instruction, guidance, supervision, assessment and evaluation during the industrial training periods. It is preferable to make the last period of a sandwich course an institutional period so that the final examination naturally falls at the completion of the entire course. It may, however, happen in some cases that the last period is an industrial period. In such cases the final examination should be held after the completion of the last period of industrial training. This is necessary in order to properly control and ensure the effectiveness o the last period of industrial training from the point of view of the course objectives.

The other conditions to be fulfilled in organising sandwich courses have been set out by Mr. Henninger and Mr. Houghton, the foreign consultants to the Committee, as follows:

1. There must be a relatively high and extensive concentration of suitable industries.

2. There must be substantial active support and participation by appropriate industries arranged well in advance, and definitely committed.

3. The participating industries must be committed in advance to furnish proper instruction programmes, and to provide a system and competent personnel for the necessary supervision, instruction and progressive evaluation of each trainee.

4. The institution shall be committed in advance to furnish a competent and interested faculty member to serve full time in the plant for each group of at most 20 students to act as coordinator, counsellor and instructor and incidentally to learn for himself about industrial problems and practices.

5. Satisfactory allowances must be committed in advance by the institution on behalf of both faculty members and students to assure a reasonble time-table and work load properly in keeping with effective learning processes and normal social amenities.

Considering all the above aspects, the Committee recommends that efforts be made to secure the active and effective partnership of industry towards the progressive organisation of sandwich courses at selected centres and in certain specialised fields duly preceded by very careful study of all relevant factors. A list of suggested fields and locations for the introduction of sandwich courses in given in Annexure 5.2 to this chapter.

d)   Advanced diploma courses

These courses are for diploma holders who have been
in service for at least one year. These courses, by and large,
will be in fields of specialisation. The fields should be selected
after a careful consideration of the industrial needs in any particular
area. Some suggested fields in which advanced diploma courses
may be offered are given in Annexure 5.3 to this chapter.

e)   **Part-time diploma courses**

a. General and diversified evening courses

b. Day-release courses

c. Block-release courses

Part-time diploma courses should be organised for
craftsmen and technicians who have been in service for at least
2 years. The courses should be so framed as to prepare them for
the craft-based technician functions. In framing the curricula due
regard should be given to the educational attainments, skills and
industrial experience already possessed by these technician
students. Courses should be started at the initiative and with
the cooperation of industry in subject fields which will benefit
a large number of skilled persons.

f)   Short-term and special courses

To meet the special needs of industry for retraining

their technicians, short-term and special courses should be

organised in suitable fields.   Some suggestions in this regard

have been made by various industries in response to the

Committee's Survey of Industries.

5.22   Types of Courses

a)   Engineering/Technology

Diploma courses may be offered in diversified areas

of the major branches of Civil, Mechanical, Electrical and

Chemical Engineering, Metallurgy, Textile Engineering etc.,

in addition to, or in place of, the general courses in these

branches.   A list of possible areas for offering diversified

courses in suggested in Annexure 5.1 to this chapter.   The

Committee emphasises in particular the need for organising courses

in Electronics, Control Engineering, Metallurgical Engineering,

Plastics Technology and Polymer Science and Technology, which

are becoming increasingly important in present-day industry.

b)   Commerce-Business

Polytechnics should offer courses in commerce and

business in so far as these are closely related to industry.

A note on commerce and business education tracing its develop-

ment and suggested line of reorganisation, with indications

of the necessary courses, is given in Annexure 5.4 to this chapter.

c)   Courses in Girls' Polytechnics

A variety of courses suitable to the temperament and special aptitudes of girls should be organised in Girls' polytechnics. These may be offered in the following fields: Catering and Food Technology, Agricultural and Horticultural Extension Services, Pharmacy, Para-Medical Technicians, Medical Laboratory Technicians and X-Ray Technicians, Home Science and Home Economics, Architecture, Applied Arts, Interior Decoration, Radio and Television, Secretarial Practice, Business Administration, Commercial Practice etc. Other courses in the fields of Engineering and Commerce may also be offered if felt desirable. The Committee recommends in particular that diploma courses in Home Science and Home Economics options should be introduced in all Girls' Polytechnics.

d)   In respect of polytechnics situated in non-industrial urban areas, a careful study may be made of the types of courses required for these regions and, in the light of such study, suitable courses may be organised. However, these institutions may concentrate on offering generalised courses. Efforts should be made to set up industrial estates in the vicinity of such institutions to stimulate their growth.

e)   Polytechnics in rural areas may offer courses in
agricultural engineering and courses applicable to agro-industries.
In such areas the possibility of setting up industrial training
instituttes in the proximity of existing polytechnics may be
considered with a view to augment the training facilities for students.

5.23   Duration of courses

The Committee realises that the duration of courses may
vary depending on the nature, pattern, and type of courses.   The
Committee examined this matter very carefully and is of the view
that, in general, the duration of a full-time diploma course should
not be less than 3 years.

b)   However, for such courses as in the field of commerce and
business a shorter duration can be considered if a careful study
reveals that the required standards could be achieved within such
shorter duration.

c)   For sandwich courses while the duration should be greater
than for the regular courses, they should not be of so long a
duration as to make them unpopular.   However, sandwich courses
have the advantage of effectively preparing the student to fit
straightaway into the first technician job.   Also, the periods of
vacations in samdwich courses are shorter and thereby the time
available for education and training is increased.   After carefully
examining these factors, the Committee is convinced that duration
of 3 1/2 years should be sufficient in most cases.

d)   The following are the normal durations recommended:

Full-time institutional
diploma courses   :   3 years

Full-time sandwich courses
at first diploma level   :   3-1/2 years

Advanced diploma courses   :   1 year

Part-time evening courses
at first-diploma level   :   Not exceeding four years*

(*Actual duration will be governed by the
 subject unit requirements).

Short-term and special courses:

The duration will depend upon the subject contents.

5.3   Admission qualification

5.31   There are at present three different schemes of

polytechnic education based on the minimum admission requirements,

viz. the 3-year diploma course after matriculation or a secondary

school certificate, the 2-year technician course after Higher

Secondary Education and the 4-year sandwich course for chemical

operators after general education upto the age of 14 years.   All

these schemes have been approved by the All India Council for

Technical Education and are under implementation in the poly-

technics.   The main pattern, however, is the 3-year diploma

course which accounts for about 94 per cent of the total

sanctioned admission capacity in polytechnics (excluding the

Girls' Polytechnics).

5.32   Even with reference to the 3-year diploma course,
the admission pattern varies from State to State, depending upon
the structure and stages of secondary education in the concerned
State. In Madhya Pradesh and Delhi, there is a 11-year school
education leading to the Higher Secondary Certificate, a pass
in which is the qualification for admission to a polytechnic. In
another group of States, comprising Andhra Pradesh, Bihar, Gujarat,
Maharashtra, Orissa, Tamil Nadu, Goa and Pondicherry, the
Secondary School Leaving Certificate is awarded after 11 years of
school education but it is not of the same level as the Higher
Secondary Certificate which is attained only after an additional
year of education. Students are however eligible for admission
to polytechnics in these States at the end of the 11 years of school
education. Another case is that of Assam where the school
education including a pre-primary stage extends to 12 years but
terminates at the same level as at the end of 11 years in the
above group of States. The States of Jammu and Kashmir, Kerala,
Mysore, Punjab, Haryana, Rajasthan, Uttar Pradesh, West Bengal,
Himachal Pradesh and Tripura provide yet another variation with a
public examination held at the end of 10 years of school education,
marking a definite stage. This is followed by an additional year
or two, either as a part of the school system or of the university,
aiming at the level of Higher Secondary or Pre-University stage.
The polytechnics in these States take on those students who
successfully complete the Class X examination.

These various patterns of admissions and the consequent development of polytechnic education in the States have led to a great deal of difficulty on the part of industry to determine the standards expected of a diploma holder today. Another feature that was brought to the Committee's notice in this regard is that about 75 per cent of the students who apply for admission to polytechnics in some States have in fact completed Higher Secondary education or the Pre-University Course even though the minimum admission qualification prescribed is only Matriculation or its equivalent. For these students, most of the first year of the diploma course is a repetition of academic work in Science and Mathematics which they have already studied before joining the polytechnics.

5.33   In contrast, a situation in one of the States was referred to in which the first year of the diploma course is so designed that it would be equated to a Pre-University Course; the students could thus siphon off at the end of that year to join either a 3-year degree course in arts, commerce or science or a 5-year integrated degree course in engineering and technology. This sets at naught the concept of an integrated 3-year diploma course and seeks to imply that the diploma course should be completed in two years after the Higher-Secondary or Pre-University course.

5.34   The Committee has also observed the wide disparity among
States in the standards set for the several stages of education; in
one case, the course content of the Pre-University Course was
reported to be much less than that prescribed by the Central Board
of Secondary Education for the Higher Secondary.

5.35   After examining all these aspects, the Committee concludes
that the basic approach to the laying down of minimum admission
qualification should be, on the one hand, to keep the integrated
nature of technician education and training intact and, on the
other, to consider the general level of knowledge and maturity
required to meet the demands of industry or to take the maximum
advantage of the courses offered in polytechnics.

5.36   It has already been observed that industry needs persons
who can plan, organise and supervise the work of skilled workers
as well as those who can assist professional engineers or
technologists in design, development and planning activities
by taking over some of their simpler activities and performing
them under their general guidance. Such types of technicians
require a sound knowledge of the fundamentals of engineering
or technology and a good level of science and general education.
It has also been noted that the technologies involved in
technician functions are always in a stage of transition.
Unless a sound educational foundation is provided, problems
of adaptation to changing technology will arise during the
working life of technicians.

5.37   Keeping these trends and requirements in view, the

Committee recommends that the minimum admission qualification

for technician courses should be laid down as a pass in Higher

Secondary Examination or its equivalent. In cases where students

are to be admitted after matriculation, technician courses should

be preceded by a preparatory course of one year after the matriculation

examination or its equivalent. The details of this course, which

will be in the nature of a 'transfer' or a 'bridging' course, will be

worked out by the concerned State Government through the proposed

State Council of Technical Awards.

5.4   Curriculum

5.41   Principles

The following considerations are important in designing the

technician curriculum:

1. The technician curriculum should comprise an integrated

group of subjects of study arranged in proper sequence and

leading to the general objectives of technician education and

to the specific objectives of the technician specialities. While

the curriculum should be designed primarily for the preparation of

technicians, it should provide enough academic foundation for

students aspiring to futher their knowledge through self-study

or through extension courses leading to higher qualifications.

2. The curriculum should be built upon the level of attainment required at entry.

3. The curriculum should generally be the outcome of the joint and cooperative efforts of polytechnics and industry. Consultations with other engineering colleges and polytechnics could also be very valuable in this respect.

4. The curriculum should be flexible enough to permit addition or deletion of subjects and alternation in their levels and contents depending upon the pre-entry preparation, the varying needs of industry and the direction of technological change.

5. The syllabi should not only specify the topics but should also indicate the depth of their treatment.

6. When changes are to be effected in the curriculum, it is desirable to take into account the views and suggestions of students as well.

7. Provision must be made in the curriculum for self-study and independent work and for library work and consultations with faculty.

5.42 Course contents

a)   The objectives of technician education have already been discussed and it has been noted that any technician course should be broad-based and generally comprise (i) basic and applied sciences and mathematics, (ii) technical subjects and (iii) general studies.

    i.   Basic and applied sciences and mathematics should enable the student to understand and learn the technical subjects that follow, but also lay the foundation for adaptability to changes and further studies.

    ii.   Technical subjects both basic and specialised, should be included in appropriate proportion consistent with the requirements of the course. Technical subjects aim to impart the knowledge of technological principles and mastery of the techniques and skills and should comprise both theory and practical work.

    iii.   General studies including language study should aim at developing communication skills, broad outlook and personal attitudes and qualities.

b)   In determining the breadth and depth of the scientific

and technical subjects, it should be kept in mind that the

technician need not pursue his fundamental studies to the same

depth, nor does he need to study the applied and technological

subjects in the same breadth, as the engineer or technologist.

But within the particular range of specialised study, he should

be much better equipped with practical skills and detailed

knowledge of techniques.

c)   In technician courses, greater stress should be placed

on developing practical competency and skills. Practical work

should therefore form a substantial part of technician courses,

particularly the full time regular courses. The elements comprising

practical work may differ from field to field. In the field of

engineering, for example, practical work will consist of work in the

science laboratories and technical laboratories, design and drawing,

and field work or workshop practice. Whatever the field, the basic

requirement regarding the contents of practical work is that it should

reflect similar work in industry, commerce or other field as far

as possible within the limitations of institutional facilities.

d)   General studies should include the following:

   i. Study of language as an effective tool of

       communication.

ii. Study in appropriate depth of topics from

the following subjects as and where relevant:

Industrial organisation, Factory laws, Labour

laws, Human relations, Materials management,

Industrial hygiene, Industrial safety, Concepts

of systems engineering, Production control,

Quality control, Cost control, Standardization,

Principles of economics etc.

e) The Committee feels it necessary to stress that besides

imparting specialised knowledge and practical orientation to the

world of work, technician courses should be designed to foster

the development of personal qualities such as integrity, a sense of

social responsibility, liberal values, a commitment to progress, and

adaptability to change. Moreover, the education should help

students to acquire an understanding of the social context in

which they live and the processes of social change. To the

extend possible therefore, general studies should also include

subjects oriented towards developing an appreciation of the social

and economic implications of science and technology and

industrial and commercial activity.

f) The educational programme should also include project

work, seminars and co-curricular activities aiming to develop

in the student the confidence and competence needed for self-

employment.

g)   The proportions of general studies, basic sciences,

applied sciences, basic technical subjects and specialised

technical studies, and the ratio between theory and practical

work will vary from course to course within certain limits and

should be carefully determined in relation to the general

objectives of technician education and the specific requirements

of the particular speciality. The following pattern is suggested

as a very broad indication of the relative percentage of contents

in a diversified course :

	Percentage content
General studies	
(including languages, management subjects etc)	10%
Sciences	
Mathematics, Basic Sciences, and Applied) Sciences (including laboratories))	15% to 20%
Technical Studies	
Principles (theory)	
Basic) Speciality (electives))	20% to 30%
Practice	
Design/Drawing) Tech. Lab/Workshop) Project and Field work)	40% to 50%

h)   Some curriculum outlines are given in Appendix No. 6 and

these may serve as illustrations of the way in which curricula

may be planned for full-time, part-time, diversified and

sandwich courses. It should be emphasised that the

curricula given are examples only and should not be interpreted

5.43   Sequence of study

The basic sciences, applied sciences, languages, humanistic studies and the basic technical studies should generally be covered in the first two years. The electives should preferably be reserved for the final year. Some topics of the general studies (for e.g. industrial administration, economics, psychology, industrial hygiene, factory laws, and man-management) require a certain degree of maturity and should therefore be carried over to the final year.

5.44   Orientation of the educational programme

a)   In framing the educational programme and related activities, and more importantly in interpreting them in the actual teaching and course work, it must be recognised that technician education should stress not only the acquisition of functional knowledge and skills, but also the development of the attitudes and abilities most valued by employers, namely, a practical way of thinking, resourcefulness, an ability to communicate, the correct attitude towards dignity of labour and a sense of discipline.

b)   Teaching of technical subjects should be application/industry-oriented. Science and Mathematics syllabi should be carefully matched with the requirements of the technical subjects. They should be taught as subjects interwoven into the other subjects of the course and not as unrelated subjects as they are so often regarded.

c)   The study of language should be emphasised as an effective tool of technical communication – oral and written.

d)   Besides the proper framing of curricula, several other steps are necessary to give an industrial orientation to the educational programme. Teachers must have considerable industrial experience and should be encouraged to keep in continual contact with industry in several ways. Increased attention should be paid to the matter of equipments and the use of teaching aids to make the teaching as realistic as possible. Project work based on actual industrial problems and the use of the problem method are indispensable. It is important to get as many experts from industry as possible, to teach the technology courses on a part–time basis or under any other feasible arrangement. Their participation will be particularly valuable in guiding the project work. Arrangements should be made, wherever possible, for representatives from nearby industries to participate in seminars and deliver special lectures. They may also help polytechnics by supplying technical information, flow charts, detailed drawings etc. Visits to industries and work sites should be given due importance.

5.45   Laboratory work

a)   Laboratory courses have a crucial and specific role to play in technician education programmes. Properly organised, they could contribute greatly to the understanding and appreciation of the principles and theory learnt and help the acquisition of ability in the application of knowledge and techniques. Unfortunately, in our polytechnics, the laboratory remains an aspect to which the least attention has been paid with the result that its educational potentialities have not been fully exploited.

b)   The three aspects of laboratory work which deserve serious attention in this context are : (i) the prescription of the laboratory courses in the curriculum (ii) the planning, organisation and evaluation of laboratory work by the teacher and (iii) the work and performance of the student in the laboratory.

c)   At present, the laboratory classes are normally assigned to junior teachers who do not teach the related theory classes. This practice must be immediately changed. Senior teachers who handle the theory classes should also conduct the laboratory classes. Properly trained laboratory assistants must be made available in each laboratory to give them the necessary assistance.

d)   The present laboratory courses in the various technical and science subjects are not properly planned to integrate them with the desired objectives of technician education. Some of the experiments included at present are absolutely unnecessary. For some others, demonstrations will be sufficient. Laboratory programmes should be formulated to develop an understanding of principles and concepts, acquisition of skills, mastery of techniques, ability in creative thinking and a practical way of thinking. Laboratory programmes and experiments should be designed to give the student a clear idea of the measurement of various physical parameters he has to deal with, the instruments he has to use in his profession and the experimental techniques he has to apply. A laboratory programme cannot be organised properly without proper instructional material in the form of laboratory manuals. Laboratory manuals in the various disciplines suited to the needs of each course should be prepared. It may be mentioned here that when revised laboratory programmes are implemented, some changes in the existing equipment pattern will become necessary. Some new equipments may also have to be procured or developed. Adequate funds should therefore be available to the institutions for this purpose.

5.46 Workshop practice

a) Since the polytechnic workshops are equipped only to impart the necessary fundamental skills, the Committee recommends that workshop practice should be designed mainly to give the basic training so as to lay the foundation for later shop floor experience.

b) Basic training in Mechanical Engineering, for example, would include the basic skills related to metal forming, removal and joining, casting processes, heat and surface treatment of materials, methods of measurement, drawing, etc. Basic training should help the student to learn the correct use of hand tools and a variety of machine tools. He must at least be required to acquire appreciable competence in operating a few of them. This experience will enable him to understand better the interrelation of tolerances, piece work times, inspection and shop organisation. It must be understood, however, that the aim is not to give him the proficiency of a craftsman, but to make him appreciate the problems involved in manufacture, the possibilities and limitations of processes, the skill of the craftsman and the part played by long experience.

c) Basic training should be based on sound teaching and this in turn demands experienced and qualified instructors specifically trained for workshop teaching. In respect of existing workshop instructors, it is desirable that specially designed short-term courses should be organised for providing them industrial training. The cooperation of the Central Training Institutes should be secured for providing training in respect of skill appreciation

d)   In the workshop practice periods there must first be instruction on the principles underlying the tools or processes being dealt with followed by experience on the part of the learner himself with the actual process or machine. The apprentice should not spend undue time on repetitive machine work or on the mere observation of processes conducted by others.

5.47   Laboratory and workshop facilities

a)   The equipping of laboratories and workshops should be governed by a careful consideration of the needs of the courses, the teaching approach of the polytechnics and the availability of equipments in collaborating industry and the Industrial Training Institutes situated in the neighbourhood. The present practice of rigidly following "Standard" lists should be discontinued, although they could serve as guides of minimum requirements. Each polytechnic should determine the laboratory and workshop equipment it requires having regard to the nature of the courses offered from time to time.

b)   The Committee emphasises the need for keeping the polytechnics uptodate, as far as possible, with respect to equipment. Existing equipment should also be maintained in good working condition. Therefore, it is recommended that there should be specific provision in the annual budgeting for modernisation and replacement of equipment.

c)   Provision should be made for appointing competent laboratory technicians in each laboratory for the proper maintenance and upkeep of the laboratories and equipment. This would help the better and fuller use of the laboratory facilities.

d)   Greater reliance should be placed on the faculty to develop and fabricate items of laboratory equipment needed for the courses and deserving proposals in this regard should receive financial support.

e)   Technical Teacher Training Institutes should collect details of equipment devised and fabricated by polytechnics and circulate the details to all polytechnics in the country.

f)   As regards the workshops, the Committee finds that the annual maintenance (contingencies, consumables) expenditure at present provided for, viz., about Rs.120 to 150 per student is grossly inadequate even to meet the expenditure on consumables required for organising an effective and comprehensive basic training. Calculations by the Committee indicate that the expenditure on consumables alone in a well-organised workshop course comes to the order of Rs.375/- per student. The Committee therefore recommends strongly that, in the annual recurring expenditure, provision must be made for at least Rs.300/- per student under maintenance and materials.

5.48   Project work

Project work can be of the greatest value in stimulating and maintaining the student technician's enterprise and initiative. An ideal project should involve the application of the knowledge and skills already acquired, the exercise of judgment, an appreciation of the cost and human effort involved and the need for compromise. Properly selected project work fosters ability in the synthesis of knowledge and skills and their purposeful and critical use, and imparts an awareness of the several practical limitations in translating ideas into practice. The Committee recognises the importance of project work in technician education and recommends that project work requiring design and/or fabrication should find an important place in the final year of the diploma programme and in the advanced diploma course. Project work must be based on real problems involving industrial/commercial practices and procedures.

5.5   Teaching methods

5.51   The present methods of teaching in the polytechnics consist of class room lectures, set exercises in laboratories, and design and drawing classes. By and large, these have not changed over the years. There is very little evidence of co-ordination between theory and laboratory practice. Although the syllabi of various courses prescribe tutorials, the implementation of tutorials has been far from satisfactory. In short, our system

of teaching in the class-room consists only of information-feeding to the students without a provision for feed-back at regular intervals. The present examination system disregards the role of assessment and evaluation as a powerful aid to learning. The lecture as a teaching method relies only on the appeal to the sense of hearing and disregards the other senses which are equally important in the learning process. Personal attention to the student is largely lacking. As a result, the present system of instruction is ineffective in developing mental skills and ability in the application and creative use of knowledge. Nor does the approach help the development of independent thinking and the spirit of enquiry or the habit of self-study. Moreover, the present approach is unequal to the challenge of teaching increasing amounts of course material within the limited duration of the course. If the quality of technician education is to be improved it is necessary to use more modern and effective teaching methods including the tutorial method, the problem-solving method, the project method and seminar method in our polytechnics wherever appropriate.

5.52   In our polytechnics, very little use is being made of teaching aids. Obviously there has been no attempt at a planned development of teaching aids. A concentrated effort is required to develop teaching aids and institutions should be provided with sufficient funds to acquire them. There has been, however, some evidence, in recent years, of the development of teaching aids in various

institutions of the country by individual teachers; but these individual efforts have not been exploited and coordinated properly and the aids thus developed in one institution are not available to other institutions. The Technical Teacher Training Institutes should take the lead in developing teaching aids and coordinate the efforts of other institutions so that, for each subject and topic, suitable aids could be made available. In the immediate future, the preparation of slides, film strips, blow-ups, charts and films could be undertaken. Class-room demonstration models and instruction sheets should be prepared and produced on a large scale. These efforts are essential for better class-room instruction.

5.53   At present, the class-room teaching in polytechnics is largely concept-centred; problems from industry very rarely find entry into the class-room situation. The problem-solving approach is very essential if learning is to gain realism and students are to develop a practical way of thinking. Case studies for use in the class-room could be collected by the teachers in collaboration with industry. The Technical Teacher Training Institutes could compile these problems and bring out case books and catalogues of case studies. These should be made available to all polytechnics. Such case studies should be carefully examined and edited by experts before publication.

5.54   Attention also needs to be paid to saving the time spent in descriptive lectures. Increasing use should be made of text books, duplicated course materials, and hand-outs. One of the serious deficiencies noticed by the Committee is the present lack of suitable text books for technician students. Organised efforts must be made to develop text books and other supplementary course material suitable to the different technician courses. Incentives should be provided to teachers and experienced persons in industry to write such text books and material and to print and publish them at reasonably low prices. Text books in use should, moreover, be scrutinised from time to time and brought uptodate with reference to the latest technological changes.

5.6   Libraries in Polytechnics

5.61   There is hardly any evidence of self-study by the students in the various polytechnics. Self-study techniques involving library assignments are essential in raising the standard of students. This develops a proper attitude and confidence in the students and also helps them to tackle problems independently. Self-study habits also raise the level of activity in a class-room and ensure the active participation of students.

5.62   In this context the Committee stresses the importance of libraries in Polytechnics as an effective aid to intensify and support the educational process of teaching and learning. A high degree of integration of library services and resources with the instructional programme will change the motivational pattern of students to use the library as a source of information and reference and thereby promote their learning.

5.63   In our polytechnics, the students have not been made to appreciate the need for supplementing their knowledge by independent reading of books and journals. The students have rarely been guided and helped to learn how the books and journals in the library should be consulted. Besides, there has been very little conscious effort to devise schemes that will make the use of the library essential.

5.64   The formal education and training in the polytechnic should give the student not only the basic knowledge, skills, and attitudes in his chosen discipline but also impart a spirit of continuing education through his independent effort even after the cessation of his formal education at the polytechnic. Hence the polytechnics have the responsibility of training the student to keep himself continuously abreast of developments in his field through the use of the library.

5.65   The state of libraries in most of our polytechnics is
unsatisfactory. They do not contain the adequate number of
books and journals for meeting the educational requirements of
polytechnic students. There are no reading rooms. Other
facilities too are conspicuous by their absence. In most of the
libraries adequate attention has not been paid to appoint qualified
and competent librarians.

5.66   The Committee therefore recommends strongly that all
polytechnics should have well-stocked, well staffed and attractive
libraries. Necessary provision should be made for creating and
maintaining adequate library facilities and services. Students must
be trained in their effective use. Some suggestions and recom-
mendations of the Committee regarding the physical facilities,
staff, finance and administration and promotion of the use of
libraries have been given in Annexure 5.5 to this chapter.

5.7   Need and nature of organisational changes

5.71   Autonomy for Polytechnics

a)   The basic objective of the recommendations made on
course reorganisation including diversification of courses,
and the organisation of part-time and special courses is that
polytechnic education should meet the needs of industry
closely. Further, since technician education comprises
partly institutional education and partly industrial training
its effectiveness depends on close collaboration between
polytechnics and industry particularly at the local level.

In the context of the vast diversity of industries in respect of the technician functions therein and with regard to their capability for participation in the education and training of technicians, the basic objective can only be effectively met if courses are planned and organised at the unit level subject to certain general requirements regarding standards and levels. Technician education must moreover be sensitive to continual changes in technology and industrial practices. The development of technician courses on effective and proper lines is thus a process of continuous experimentation in which the teachers in the polytechnic and experts from industry have to play a vital role.

b)   The Committee finds that the present system of academic organisation and control neither permits the flexibility in course planning and course-organisation nor provides the freedom for polytechnics and teachers to experiment and innovate along new lines in collaboration with industry. The system offers very little opportunity for the faculty of polytechnics and experts from industry to effectively participate in the total process of technician education in its planning, development, organisation and assessment. Consequently the teacher does not feel that he is responsible for educating the student. Nor does he feel impelled to experiment with new teaching methods or to introduce the new developments into his teaching.

c)   Changes are therefore essential in both the aspects which characterize the present system of educational organisation, namely (i) the system of framing and prescribing uniform courses and curricula and (ii) the system of common external examinations.

d)   The reform of the examination system leading to complete internal assessment and evaluation by the institutions themselves is necessary because the concept of the common external examination is not consistent with freedom and flexibility in course planning. Besides, a switch-over to continuous internal assessment is vital if education is to improve in quality and become purposeful. (This aspect is discussed in detail in chapter VIII).

e)   Keeping these considerations in view, the Committee is convinced that for the proper development and growth of technician education and its improvement in quality, autonomy for polytechnics is essential. Polytechnics should have complete freedom to experiment with much needed reforms, restructure their courses, establish cooperative relationships with industry in their region in training and employing technicians, develop the new curricula suited for such courses, evolve their own methodology for education and training and assess and evaluate their students.

f)   Some of the States have experimented with the grant of autonomy to selected polytechnics. The study of such polytechnics shows that by giving academic freedom the standard of instruction in those polytechnics and the quality of their products have considerably improved.

g)   The Committee therefore recommends that a beginning must be made by selecting atleast one but not more than two polytechnics in each State and Union Territory for the immediate grant of autonomy. These polytechnics must be selected on the basis of the sustained excellence of their standards, facilities, faculty and performance. Based on the experience gained with the working of the autonomous polytechnics initially selected, other polytechnics must be given such freedom as and when they are are ripe enough to take up such responsibilities. For this purpose, the polytechnics must be assisted to attain the required standards and levels, through a phased programme of development over the next 10 years.

h)   If autonomy is to be meaningful, the autonomous polytechnics must be provided with the necessary administrative authority and financial resources. The principals must be delegated adequate administrative and financial powers to manage their institutions and implement new programmes. These powers are particularly needed for implementing the necessary measurers of reform and development such as faculty development, improvement of laboratory and workshop facilities and other measures of quality improvement.

i) For the proper exercise of the autonomy given to polytechnics and to plan and implement the developments on the right lines the Committee recommends that each autonomous polytechnic should have a Governing Council and an Academic Board.

j) The Governing Council will be responsible to guide and control the planning, development and administration of the polytechnic and should consist of teachers, representatives of local industry and representatives of the State Council of Technical Awards (recommended later), the State Board of Technical Education, the AICTE and the State and Central Governments. The Principal of the Polytechnic should be the member-Secretary of the Council.

k) The Academic Board will deal with such matters as assessment and evaluation, course development, relations with industry, research and other academic matters. The proposals of the academic board should be placed before the Governing Council for ratification. The Academic Board should consist of representatives of the faculty, experts from industry and eminent educationists in the fields of Technical and Secondary education. The principal of the Polytechnic should be the Chairman of the Board.

5.72 <u>State Council of Technical Awards (SCTA)</u>

a) In granting autonomy to polytechnics, adequate arrangements must exist to coordinate and safeguard the necessary standards with respect to curricula, organisation and implementation of courses, and assessment and evaluation of

students. Moreover, it is necessary to guide, help and oversee the progressive development of the autonomous polytechnics, and also to evaluate their performance on a continuing basis and feed back the information to the concerned agencies which are in immediate charge of technical education.

b) With the above considerations in view, the Committee recommends that an independent and autonomous body that may be called the State Council of Technical Awards should be set up in each State.

c) The SCTA will set and assess standards not by framing and imposing courses and curricula and by conducting examinations, but by inspecting and approving institutions, scrutinizing and approving the new courses and curricula (or changes in existing ones) and the schemes of assessment and evaluation framed by the polytechnics themselves. The Council will thus act as the guardian of the standards of courses, curricula and performance of polytechnics.

d) The State Council of Technical Awards will work through appropriate subject panels, standing committees and inspection commissions set up by it. The Council will establish the guidelines and detailed procedures in regard to the approval of courses, institutions and evaluation systems. It will have the power to inspect the polytechnics, their faculty and facilities, their methods of teaching, the arrangements for training, and the records of assessment including valued answer books etc. Once a course and

system of evaluation it will award the diplomas to the students as recommended by the institution.

e)   Since the grant of autonomy to polytechnics will be a phased process to be completed within the next 10 years, the SCTA will have further responsibilities within this 10 year period in respect of polytechnics yet to gain autonomous status. In respect of such polytechnics, the SCTA will help them to frame and change their courses and curricula, conduct the external examinations and suggest the methods of internal assessment to be followed. In this sense it may take over the functions of the present Board of Studies and Board of Examinations of the State Board of Technical Education.

f)   The Council will assist these polytechnics to develop the standards of facilities, performance, and expertise needed to gain autonomy by making suggestions for improvement and development in various aspects. To this end it may also be an advisory body to the Government.

g)   The Committee feels that the best interests of technician education will be served only if the SCTA is an independent and autonomous body consisting of experts and representatives of the various interests concerned, with a non-official chairman, so that it could work effectively and with expedition. The awards made by such a body would moreover enjoy public recognition and the confidence of industry.

h)   The Committee has recommended earlier that in order to enhance the status of technicians, opportunities should be provided for part-time degree courses and that selected polytechnics should be authorised to conduct such courses. It is important that polytechnics should have the opportunity to grow and develop along new lines and acquire the stature and position due to them in the expanding field of technical education. The Committee envisages a vital role for the State Councils of Technical Awards in this development. In the not-distant future the Councils could develop into important organisations for the award of degrees of national standard, both under-graduate and post-graduate for students of institutions of higher education, post-matric education and polytechnics. In this process they should maintain their essential character, constitution and approach which is to safeguard high standards without restricting the freedom and flexibility in course planning and the autonomy of institutions.

i)   The broad framework of the constitution, functions, and working of the SCTA is suggested in Annexure 5.6 to this chapter.

SOME SUGGESTED AREAS FOR DIVERSIFIED COURSES

Civil Engineering:
General Civil Engineering
Public Health Engineering
Construction Technology
Estimating, Detailing, Drafting
Architectural Assistantship

Mechanical Engineering:
General Mechanical Engineering
Foundry Technology
Welding Technology
Production Technology
Design and Drafting Technology
Mechanical Machinery Maintenance
Automobile Engineering (Repair and
                                    Maintenance)
Refrigeration and Airconditioning
Fluid Machinery
Power Plant Engineering

Electrical Engineering:
General Electrical Engineering
Maintenance of Electrical
        Machinery and Systems
Manufacture of Electrical Machinery
        and Components
Industrial Electronics
Electrical Generation, Transmission
        and Distribution (Power Systems)
Communication Engineering

Chemical Engineering:
General Chemical Engineering
Ceramics and Plastics Technology
Petroleum Technology
Paint Technology
Industrial Chemistry
Textile Chemistry

Textile Engineering and
Manufacture:
General Textile Technology
Cotton Yarn Manufacture
Fabric Manufacture
Textile processing and finishing
Man-made fibre Yarn Manufacture

Metallurgical Engineering :	Hot and Cold Rolling and Metal Forming Processes Fuel and Furnace Technology Foundry and Forge Technology
Commerce and Business Education : (See also Annexure 5.4)	Commercial Practice Secretarial Practice Office Administration and Data Processing Sales and Marketing Banking and Insurance Advertisement and Display
Agricultural Engineering :	Agricultural Engineering Farm Machinery and Equipment Agro-industries options
SOME OTHER COURSES	Mining Engineering Printing Technology Printing Processes Film Technology Graphic Reproduction Processes Wood Technology Rubber Technology Clothing and Apparel Manufacture Paper and Pulp Technology Catering Technology Food Technology

ANNEXURE 5.2

SANDWICH COURSES

A) Specialities

A few of the specialities in which sandwich courses may be started
are suggested below. (The list is not exhaustive).

Mechanical Engineering: Foundry Technology
Machine Tool Technology
Production Engineering
Sheet Metal and Welding Technology
Agricultural Engineering and
Farm Machinery
Automobile Engineering
Tool Design Technology

Electrical Engineering: Instrumentation and Control Systems
Generation and Distribution
Electronics
Electrical Machinery

Civil Engineering: Construction Engineering
Architecture

Chemical Engineering: Petro-Chemicals
Oil Refining
Fertilisers and Acids

Textile Technology: Man-made fibres
Cotton Textiles
Spinning, Weaving, Bleaching, Dyeing

Printing Technology: Printing Technology
Printing Processes

B) Location

At present it may be possible to start sandwhich courses in the
centres noted below and in the fields noted against each. This
list is only suggestive and it is subject to variation according to
local needs and requirement.

Bombay	Automobile Engineering
	Production Engineering
	Electronics
	Printing Technology
	Chemical Engineering
Calcutta	Foundry Technology
	Production Engineering
	Printing Technology
Madras	Sugar Technology
	Foundry Technology
	Pteroleum Technology
	Architecture
	Printing Technology
Bangalore	Production Engineering
	Electrical Machinery Manufacture
	Machine Tool Technology
Coimbatore	Foundry Technology
	Production Technology
	Machine Tool technology
	Spinning and Weaving
	Textile Technology
Ahmedabad	Textile Technology
	Spinning and Weaving
Bhopal	Production Engineering
	Drafting and Design
	Instrumentation and Control
Hyderabad	Electronics
Ranchi	Production Engineering
	Metallurgical Engineering
Delhi	Construction Technology
Ludhiana	Farm Machinery
Trichy	Mechanical Engineering
Waltair	Chemical Engineering
	Marine Engineering
	Ship Building
Kalamassery	Machine Tool Technology
	Chemical Engineering

ANNEXURE 5.3

SOME SUGGESTED AREAS FOR ADVANCED DIPLOMA COURSES

Civil Engineering   Concrete Technology and Structures
                           Architectural Design and Drafting
                           Town Planning

Mechanical Engineering   Instrument Technology and
                           Control Engineering
                           Tool Design Engineering
                           Heat Treatment
                           Air-craft Engine Maintenance
                           Workstudy and Industrial Engineering

Electrical Engineering   Instrument Technology and
                           Control Systems
                           Illumination Engineering
                           Sound Engineering

Textile Technology   Textile Machinery Maintenance and
and Manufacture   Statistical Quality Control
                           Textile Chemistry

Chemical Engineering   Petro-Chemicals
                           Polymer Science and Plastics
                           Plant Design

ANNEXURE 5.4

COMMERCE AND BUSINESS EDUCATION

The Special Committee for Commerce Education under the Chairman-
ship of Dr. V.K.R.V. Rao recommended as follows :

"In order to provide efficient personnel in business and commerce
as also to reduce the present rush to colleges for training for
commerce occupations, we recommend the institution of the
National Diploma in Commercial Practice or D.C.P. The course
should be spread over two years and be strictly vocational in content
and training and the subjects taught should include English, Regional
language, Commercial Arithmetic, Commercial Geography, Elements
of Commerce, Typewriting and Elementary Book-keeping with one
of the following as optional: Short-hand, Banking Practice,
Accountancy, Secretarial Practice and Salesmanship. Admissions
should be confined to those who pass High School or Matriculation
wherever these exist or the tenth class where the Higher Secondary
Course has already been introduced"

Action taken since the VKRV Rao Committee Report

The Sub-Committee of the All India Board of Technical
Studies in Commerce prepared the curriculum and syllabus
for a two -year Diploma Course in Commercial Practice.

The subjects under the compulsory group were: English, Commercial Arithmetic, Commercial Geography, Elements of Commerce, Book-Keeping and Elements of Accountancy, Elements of Business Organization and Management including Office Management, and Typewriting.

The electives, of which one had to be chosen, were : Banking Practice, Insurance Practice, Secretarial Practice, Shorthand and Typewriting in English or Regional Language, and Salesmanship and Marketing.

The Sub-Committee suggested that "Apart from reorganising the existing commerce schools on these lines, the need for additional commerce education in a State should be met as far as possible by setting up commerce departments in polytechnics rather than by establishing new schools as separate and independent institutions".

Subsequently, for several reasons, further changes were made both in the duration of the course and in the scheme of examination. In Madras, for example, the duration was increased from two years to three years and the first year was modelled after the Pre-University course.

Reorganization

In the context of the reorganization of polytechnic education, courses in commerce education have also to be reorganised to bring them to the technician diploma standard. The

courses must reflect the needs of technician level occupations in Business and Commerce. Since industry and trade are complementary activities, commerce also follows broadly the pattern of developments in industry. Technological advances are leading to new and sophisticated methods and techniques in commercial and business organization and administration. These in turn have created an increasing demand for trained personnel at the technician level in Commerce and Business. Diploma courses should satisfy these current and future demands.

Curriculum

Courses in Commerce and Business may be diversifed with suitable groups of subjects in the following areas as electives :

Advanced Accounting and Auditing
Cost Accounting
Incometax Practice
Stores, Purchase and Control
Materials Management and Transportation
Inventory Control and Store Layout
Market Study
Advertisement and Display
Export and Import Business
Distribution Trade
Insurance and Banking
Company Law and Company Secretarial Practice
Factory Laws, Regulations
Data Processing
Office Equipments and systems

In diversifying the courses, the aim should be to frame programmes suitable for such occupations as below :

Senior Secretaries and Personal Assistants, Office Super-
visors, Sales Supervisors, Purchase and Stores staff, Junior
Accountants, Senior Specialist Clerks, Organization and
Methods assistants, Marketing and Market research assistants,
Computer Programmers, etc. working in such specialised
professional fields as Accountancy, Retailing, Costing,
Computer Programming, Data Processing, Insurance, Banking,
Taxation, Transport, Real Estate and Legal Executive work.

It is desirable to have in each subject a list of topics
on which practical work will be done in the class room or in
the business laboratory/office.

It is also necessary to examine the scope for sandwich
courses for Commerce students.

LIBRARIES IN POLYTECHNICS

Buildings and Furniture

A majority of polytechnic libraries do not have adequate space to satisfy the operational and educational requirements. In most cases they lack reading rooms with adequate seating capacity. In the future design of libraries adequate provision must be made for reading rooms, office room, space for storage of books and display of journals and service areas, keeping in mind possible future expansion. The reading rooms should be well furnished lighted and ventilated.

As a broad guideline reading rooms may be designed for a seating capacity of at least 10% of the student body.

Library Staff

The recognition of the important role of the library as an essential part of the educational system demands that it should have a well qualified, competent and well-paid librarian with adequate staff to assist him.

Hitherto, the position of the librarian has not been clearly appreciated and he has been thought of as someone 'looking after the books'. As the library has an important educational role, it is necessary that the librarian should be given the recognition and appropriate status due to him as an important member of the academic team. The Committee

recommends that the librarian should be given a grade at least equal to that of a Lecturer and granted the status of the Head of Department. The Librarian should serve on the Committee of Heads of Departments to be able to develop the library services in conformity with the changing needs of the polytechnics.

Additional staff will be required to supervise the library throughout the day, to issue books, to look after their return, to shelve the books, to assist readers, to check books and periodicals, to prepare accession lists, to collect overdue books, clean the halls and to carry out a host of other routine duties. Due provision should also be made for staff for over-time work.

Finance and Administration

The financial requirements of the library depend on the range of courses offered, the size of the student body, the nature of services to be offered and the procurement policy regarding books and journals.

However, the Committee would suggest the following as a guideline in equipping and maintaining a library in a polytechnic with a strength of about 500 students.

Initial number of books	5000
Annual expenditure on new additions	Rs. 20,000
Annual expenditure on Journals	Rs. 10,000

Suitable modifications of these figures will be necessary dpending upon the number of students, number of courses etc.

The library exists for the benefit of the readers and the administrative procedures should be streamlined to serve this end. There should, no doubt, be rules to govern the borrowing of books, discipline in the library, readers' entry and leaving etc., but these should be carefully examined from time to time and restrictions kept to the minimum consistent with the need for maintaining efficiency. The open access system is preferable.

The promotion of library use

It is not merely enough to stock the library with adequate books and journals and to man it by competent staff. Polytechnics must find means to derive the greatest benefit from the library. The Committee therefore makes the following suggestions for the promotion of library use.

1. Libraries must be kept open for at least 4 or 5 hours longer than the normal working hours of the polytechnics. It must remain open on Saturdays and during the vacations.

2. The librarian has the key role in the promotion of library use. He should assign all routine duties to the other staff and make himself free for more creative work,

guidance and promotional activities. He should have an insight into academic attitudes and methods of study and a desire to serve the readers. He should also be fully familiar with the proper classification of the literature available in the library. For this purpose he should have undergone proper orientation training in the organisation and management of a technical library.

3.   It is incumbent on the part of the librarian to familiarise the potential users with the available resources. Besides stencilled guides, the librarian will have to usually rely on introductory talks involving demonstration of catalogue components and the classification scheme and explanation of loan facilities and procedures. For the first year students, intensive guidance and orientation are necessary to familiarise them with the library set up and the use of the library. Those teachers really interested in library work and well-acquainted with the students' needs and intellectual levels may also be involved in this orientation work.

4.   In some cases, personal attention and guidance may be necessary. The subject teacher and the librarian may help the individual students in solving their problems. They can help the students in the search for information and materials.

5.   Individual or group projects or term papers should
be set in such a way as to make it necessary for students
to have recourse to library sources.

6.   The teacher should give reading lists covering
his lectures. Such lists should be compiled for all
subjects and made available to the students.

7.   The library should contain carefully selected
books in humanities and social sciences. Reading these
books will instil liberal values and broader outlook in
the students. Reading for pleasure, self discovery, and
personal growth should be encouraged and cultivated among
the students.

8.   A majority of students in the polytechnics
come from poor families and many cannot afford to
possess text books of their own for all subjects. Therefore,
there is a need for separate text-book libraries in the
polytechnics and, if possible, in the Halls of Residence.

CONSTITUTION AND FUNCTIONS OF THE STATE COUNCIL OF TECHNICAL AWARDS

Constitution of the Council

The State Government should determine the manner and method of setting up the State Council of Technical Awards and specify its relationship to the State Board of Technical Education. The Council should consist of the representatives of industry, trade and commerce, technical experts from Government departments, representatives of the professional bodies, progressive educationists, polytechnic and college teachers and principals etc. It is also recommended that the Chairman of the Council should be a non-official, preferably a distinguished educationist or a progressive industrialist, interested in the promotion of technical education.

The Director of Technical Education in each State should be the Member-Secretary of the Council and his Directorate should be responsible for giving secretariat assistance to this organisation.

The State Council of Technical Awards may constitute separate subject panels for each field of studies to advise it on matters related to the concerned field. The subject panels should consist of experts in each field drawn from polytechnic teachers and industry. All academic matters relating

to the concerned field should be referred to these panels of experts and on their advice the Council may take such action as · it deems necessary. The Council may be empowered to draw upon the expertise and experience of persons not only within the State but also in other parts of the country as and when necessary. The Council will constitute appropriate inspection commissions for inspecting polytechnics, their faculty, facilities and working, including their assessment and evaluation system, for purposes of approval of institutions and courses, or for periodic review.

Functions of the Council

The Committee recommends that the Council should have the following functions:

i)   To lay down the standards required of polytechnics by way of physical facilities, faculty etc. and the general guide-lines and requirements for courses with due regard to national standards and coordination.

ii)   To select polytechnics for the grant of autonomy.

iii)   To scrutinize and approve, or suggest modification of courses and assessment systems framed by autonomous polytechnics and to help and guide them in implementing reforms, experiments and projects.

iv)   To recognise polytechnics for its awards on the basis of inspection.

v) To help polytechnics not granted autonomy to frame courses and curricula and to guide and advise on their progressive development.

vi) To conduct external examinations for polytechnics not granted academic freedom and to devise the system of internal evaluation and assessment for them.

vii) To conduct research on all aspects of technician education and suggest improvement to all polytechnics.

viii) To award diplomas to students passing out of all polytechnics.

ix) Any other functions which may be entrusted to the Council by the State Government or the All India Council for Technical Education.

The Council should function as an independent, autonomous body in respect of academic matters stated above. However, it should also act as an advisory body to the State Government/ State Board of Technical Education in all matters connected with technician education and training.

C H A P T E R VI

6.0 FACULTY

6.01 In the reorganisation of any educational system to make it more meaningful and purposeful, the teacher who is the key element in the system, deserves important consideration. The success of any educational system depends upon the supply of properly trained, experienced and devoted teachers in adequate numbers. In the field of polytechnic education another essential qualification required of a teacher is adequate industrial experience. According to a survey conducted in 1969, a majority of the teachers of polytechnics have very little or no industrial experience. This lack of industrial experience in the teachers is one of the main reasons why polytechnic education, at present, is not sufficiently application-oriented.

6.02 In an ideal situation, the teachers in technical institutions at all levels should be able to guide or advise industry in the matter of the adoption of new techniques and new processes. To that end, the polytechnic teachers must be in constant contact with industry and should have a first hand knowledge of the processes, techniques etc. used by industry as also an idea of the problems faced by it. Familiarity with current practices, problems and development trends in industry would help teachers bring in a better approach and orientation to teaching.

6.03   In improving the faculty position in polytechnics,
one has to consider its several integral aspects such as
staff structure, qualifications, industrial experience,
conditions of service, salaries and faculty development.
Factors such as the type of teachers available, the metho-
dology of teaching adopted, the staff-student ratio,
and the facilities available for upgrading the knowledge
of the teachers and for providing industrial exposure,
influence the building up of a proper faculty. All these
aspects are considered in this chapter.

6.1   Present staff structure and qualifications

6.11   The staffing pattern as laid down by the All India
Council for Technical Education for a polytechnic conducting
diploma courses in Civil, Electrical and Mechanical Engineering
with an annual intake of 120 students or a total student
strength of the order of 300 to 400 is given below:

Designation	Qualifications	
1. Principal	(i)	Bachelor's degree in Engineering or Technology (or equivalent) OR AMIE (By Examination) OR TTTI Diploma
	(ii)	8 years professional and/or teaching experience
	(iii)	Industrial experience preferable

Designation	Qualifications

2. **Head of the Department**
   i) Bachelor's Degree in Engineering or Technology (or equivalent) OR AMIE (By Examination) OR TTTI Diploma
   ii) 5 years' professional and/or teaching experience
   iii) Industrial experience preferable.

3. **Lecturer (Technical)**
First Class Diploma in Engineering and TTTI Diploma
        OR
Bachelor's Degree in Engineering/Technology or equivalent)   With 2 years industrial
      OR   experience
AMIE (By Examination)

4. **Licturer (non-technical)**
Master's Degree in the subject with 2 years' teaching experience

5. **Workshop Superintendent**
First Class Diploma in Engineering with 8 years' workshop experience

NOTE: In the absence of candidates with the above qualifications, candidates with a Bachelor's degree in Engineering with 5 years' experience may be considered.

6. **Senior Instructors/ Assistant Lecturers**
First-class diploma in engineering with at least two years' industrial and/or teaching experience
      OR
Degree of Bachelor of Technology Education of the Regional College of Education at Mysore, Bhopal, Bhubaneswar and Ajmer with at least two years' industrial and/or teaching experience.

7. **Junior Instructors/ Demonstrators**
First-class diploma in Engineering or degree of Bachelor of Technology Education of the Regional Colleges of Education at Mysore, Bhopal, Bhubaneswar and Ajmer.

The above qualifications for Senior Instructors and Junior
Instructors are applicable only when these posts are on the
teaching side and not for Instructors in Workshops. As for
Workshop Instructors, the qualifications and experience
should be specified in terms of ITI certificates or Junior
Technical School Certificates or appropriate competency
in the concerned trades.

6.12 If all the categories of staff mentioned above
are taken into consideration, the present staff-student
ratio comes to about 1:12. In calculating the staff-
student ratio, normally the teaching staff only is
considered which, in this case, would comprise the Heads
of Departments, the Lecturers and the Instructors for
Science and Mathematics. Even if the Demonstrators are
considered as teaching staff the actual staff-student
ratio works out to about 1:20.

6.2 Salary structure

6.21 The salary scales for teachers in polytechnics as
recommended by the All India Council for Technical Education
and normally adopted in various polytechnics are given below:

Designation of post	Salary Scale
Principal	... Rs. 800-40-1000-50-1250
Head of the Deptt. (Lecturer-in-charge)	... Rs. 600-40-1000
Lecturer	... Rs. 350-350-380-380-30-590-EB 30-770-40-850

Workshop Superintendent   ... Rs. 350-350-380-380-30-590-
EB-30 -770-40-850

Senior Instructor   ...   Rs. 260-20-300-15-450-25/2-500

Junior Instructor   ...   Rs. 160-10-300

6.22 In comparison with the salary structures in engineering colleges and other sectors of employment, the salary structure of the polytechnic teachers is rather poor. The Committee recomends that the present disparity in salary structure between polytechnics and engineering colleges should be removed. It is therefore recommended that the salary scales and designations of teachers in Polytechnics should be the same as those prevailing in the engineering colleges.

6.3   <u>Recommended Staff structure</u>

6.31 The Committee recommends that the normal pattern of teaching staff categories in a polytechnic should be as follows:

    Professor or Head of the Department;

    Assistant Professor; and

    Lecturer/Associate Lecturer.

The ratio between senior positions and junior position i.e. Professors/Assistant Professors and Lecturers/Associate Lecturers, should be of the order of 1:2.

6.32 ~~To improve the quality of polytechnic~~ education, it is recommended that as far as possible the strength in lecture classes should not be more than 30 students. In laboratories and workshops, the number of students per teacher should be restricted to 10. The same may be the case with the tutorial classes. As far as possible not more than two students should be put in a batch for conducting experiments.

6.33 Teachers of theory classes in a subject should also be made responsible for organising and conducting the laboratory courses in the subject. Theory classes should not normally be handled by teachers lower in rank than lecturers.

6.34 In order that the tutorial system, laboratory teaching and project work may be effective, the present teacher-student ratio should be raised to not less than 1:10. In counting this ratio, only teaching posts of Associate Lecturers and above should be taken into account.

6.35 It is recommended that for every diversified course in an institution at least one professor assisted by an Assistant Professor or Lecturer be provided, supplemented by part-time lecturers from industry.

6.36 Coordination of courses in polytechnics in close proximity could help the use of highly qualified staff in the most efficient manner.

6.37 Principals and Heads of Departments of polytechnics

that educational efficiency could be increased. More generous

provision should be made of clerical and laboratory assistance

to teachers.

6.4 Staff qualifications

6.41 Considering the various aspects of polytechnic education

and the reforms suggested in this report, the Committee recommen‹

that teachers of technical subjects should have the following

minimum qualifications:

(a) Associate Lecturer:	A degree in engineering or technology with at least two years of industrial experience. However, a diploma holder with not less than five years' industrial experience in the field may also be considered subject to his suitability to teaching and improving his academic background through teacher-training programmes and/or extension/summer school courses.
(b) Lecturer and above:	A degree in engineering or technology or equivalent, with three years of industrial experience, or, Diploma of TTTI training with five years of industrial experience.

6.42 For teachers of professional courses like Commerce, etc.

the minimum qualification should be a degree in the appropriate

field with two years of professional experience in the field.

6.43 For teachers of other subjects like the Sciences, Humanities

etc. the minimum qualification should be a post-graduate degree,

preference being given to persons with industrial experience.

6.44 For all polytechnic teachers, training of at least one

year in the art and technique of teaching technical subjects

is desirable.

6.5   Essential conditions of service

6. 51 It is recommended that all teachers of similar categories, irrespective of their subject-field, should be given the same scales of pay and benefits.

6.52 With a view to attracting better type of staff in polytechnics and retaining them, it is recommended that a composite scale, with suitable stages of entry for each category, should be prescribed for all teachers starting from the Associate Lecturer to the Assistant Professor.

6.53 In order to make the teaching of sciences, mathematics, languages, etc. more effective and application-oriented, the practice of transferring staff between polytechnics and arts and science colleges, wherever it exists, should be discontinue

6.54 Provision should be made for suitable incentives to encoura serving teachers to augment their academic qualification and experience.

6.55 The Committee is of the view that there should be adequate provision in the service conditions of teachers for obligatory periodic in-service training so that the authorities may send any teacher for in-service or industrial training as and when needed. When teachers are deputed for such training, they should be paid their full salary in addition to travelling allowances and stipends.

6.56 Teachers should be given the freedom to take up consultancy work. Consultancy and research work will provide opportunity for the self-development of teachers. To regulate such work, proper code of conduct should be drawn up by the institutions.

6.57 There should be provision for sabbatical leave for teacher to pursue research or write books or work in industry. Liberal grants should be made to polytechnics to enable teachers to pursue research work in their own spheres of specialisation.

6.58 In planning new accommodation, due attention should be given to the provision of amenities and residential quarters for staff.

6.6 Part-time teachers from industry

6.61 The use of part time teachers drawn from industry, commeɪ and the professions constitutes a major means of maintaining tl essential contact between education and industry and of ensurin that teaching takes account of day to day industrial and commercial experience and of the latest developments.

6.62 It is in the more highly specialised and advanced fields like industrial design and studies involving production techniques and practices and in guiding project work that the services of part time teachers are especially valuable. In order to attract senior staff of the calibre required, it

would be necessary to offer them a special place in the polytechn

life besides adequate remuneration.

6.63   Industry must be willing to accept, enoourage and assist

the transfer of experienced staff to part-time and full-time teachir

work.   There must be a much greater interchange of staff betweer

industry and polytechnics.

6.7   Faculty training

6.71   Opportunities should be made available to teachers for

acquiring the needed industrial experience, pedagogic training

and higher academic qualifications, through seminars, short-term

courses of various kinds, summer institutes, in-service training

programmes, deputation to Technical Teacher Training Institutes

during vacation or during the academic year and secondment to

industries.   Teachers must be required to attend such courses an

acquire such training several times during their career to facilitat

continuous development and updating.

6.72   Specially designed short-term courses should be organis

for providing industrial training to workshop instructors.   The c

operation of Central Training Institutes should be secured for

providing training in respect of skill appreciation.

6.73   A crash programme for retraining at least 25 percent of the existing polytechnic teachers (particularly the experienced teachers) within a period of two years, should be formulated by each State authority in association with the Technical Teacher Training Institute or other appropriate agencies. This will consist of several courses of short duration on such subjects as examination and evaluation system, teaching methodology and techniques, curriculum development and organising laboratory work, as well as courses for providing industrial orientation.

This crash programme should be followed by a second stage of comprehensive industrial training especially for teachers in certain subjects which are highly practice or industry-oriented.

A third stage of longer duration should cover training in communication skills.

6.74   A crash programme should be organised, at selected centres in India, for Principals of Polytechnics to familiarise them with the different aspects of the reorganisation of polytechnic education and management as recommended in this report relating to sandwich courses, diversified courses and special courses, new techniques in imparting education and implementing training programmes, new systems

of evaluation and grading, teaching aids, subjects for new courses to meet the latest technological needs, administration and management of institutions etc. This programme will help the Principals of polytechnics to translate the suggested reforms and new developments into actual practice in their institutions.

6.75   Teachers of Language, Mathematics and Physical Sciences should be given special orientation courses to make their teaching more effective.

6.76   Each State may :

a)   assess the total number of teachers to be trained annually say in the first ten years,

b)   indicate the type of training programmes relevant to Instructors, Associate Lecturers, Lecturers and Heads of Departments to be planned for, and

c)   work out financial estimates.

These measures will enable the implementing authorities to plan phased programmes. In this regard, the appropriate advisory machinery should advise the Government on the supply and training of teachers for polytechnics. This machinery should continually review the arrangements and provisions for training and keep in touch with polytechnics about supply and demand for teachers and demand for different types of training courses.

6.77   Closer participation and exchange of ideas on the

pattern and content of teacher training is essential between the

world of technical education, industry and commerce and univer

6.8   Role of Technical Teacher Training Institutes

6.81   The courses at the Technical Teacher Training

Institutes should emphasise the training of teachers in the

several aspects of polytechnic education and training rather

than advanced subject studies.

The main functions of Technical Teacher Training

Institutes should be :

a)   Organisation of courses on the art and technique
     of teaching and special subject-teaching courses

b)   Research on methods of assessment, evaluation
     and grading and the training of teachers in these
     techniques;

c)   Research and training in teaching methods and
     development and production of teaching aids,
     charts and publication;

d)   Collection and dissemination of information on
     curricula, examination system, equipment,
     teaching aids, technical literature, teaching
     methods etc. to all polytechnics in the country.

The Committee commends the good and useful work

now being done in the Technical Teacher Training Institutes.

The Committee feels strongly that they can serve better in the

field of teacher training if they concentrate their energy on it

instead of proliferating their activities in other fields.

6.82   In order to effect all round development, close liaison should be established and maintained between the Technical Teacher Training Institutes on the one hand and the principals and senior faculty members of polytechnics on the other. It would also be desirable to make use of senior faculty members deputed from polytechnics for limited periods of time to teach and work at the Technical Teacher Training Institutes. The work of teaching in polytechnics is undergoing continual change in response to changes in the methods and processes of industrial production. To respond to such changes the staff of the Technical Teacher Training Institutes should not only retain a close association with neighbouring polytechnics but should also be in touch with industry. For this purpose, they should be encouraged to return periodically to polytechnic teaching and to industry.

6.83   Technical Teacher Training Institutes should be outward looking and provide extension services in different centres. They should organise short-term courses for lecturers and instructors on the fabrication and use of teaching aids.

CHAPTER - VII

7.0   STUDENTS

7.1   Admission Requirements

7.11   The quality of technicians prepared by polytechnics will greatly depend upon the quality of the students admitted. Therefore, the selection of students for polytechnic courses needs very careful consideration so that they may derive the best advantage from the education and serve the best interests of industry. In the technically advanced countries, students enter technician institutions at a more mature age than in India. During the Committee's discussions with the various authorities and persons involved in polytechnic education and with the foreign consultants, employers, professional bodies and others, one of the points which emerged clearly was that the present age of entry to polytechnics is low. The consensus was that the entrants to polytechnics should be mature both intellectually and physiologically.

7.12   Taking into consideration various factors, including the structure of school education which differs from State to State, the Committee recommends that the qualification for entry to polytechnics should be raised from SSLC or Matriculation to Higher Secondary, Pre-University, Pre-engineering or equivalent.

Such a measure will not only give an opportunity for polytechnics to admit students of greater maturity but also help in revising the curricula of polytechnics so as to make them more purposeful. This measure will substantially cut down the curricular load in the fundamental sciences and mathematics and the time thus saved could be gainfully employed in teaching the applications of science to engineering and technical studies. Otherwise, the only way to improve quality will be to lengthen the period of education in polytechnics which would involve additional financial commitments.

7.13   While recommending higher qualifications for entry into polytechnics the Committee also took into consideration the poor industrial and environmental background of the majority of the students. Further, the Committee found that in West Bengal, Madhya Pradesh and a few other states, a large percentage of students seeking admission to polytechnics in fact possess higher qualification than the SSLC or Matriculation. Therefore, at present, most of the time in the first year of the courses is spent in bringing up the academic level of the students possessing only the SSLC or Matriculation qualification. This not only wastes the valuable time of the majority of the students but also makes them dispirited as they have to repeat the science and mathematics courses which they have already undergone earlier.

7.14   In the course of discussions with the Committee,
a majority of the representatives of the professional bodies
and employers and others, including some of the foreign
consultants, felt that it would be highly desirable to arrange
for some sort of pre-entry training.   In this respect, the
Committee recommends that efforts be made to infuse a vocational
bias at the Higher Secondary School level.   Further, there are
about 350 Industrial Training Institutes and 284 polytechnics in
our country, all with fairly good workshop facilities.   Selected
students interested in joining polytechnics may be assigned to
these institutions during the vacations and given a well graded
programme of workshop practice and instruction in drawing etc.
so that they may be conditioned better for polytechnic education.

7.2   Selection Procedures

7.21   At present it is observed that there are no uniform
selection procedures.   Selection is based on one or more of
the following :

a)   Marks secured in the qualifying examination
      particularly in subjects like mathematics and
      science;

b)   Weightage for co-curricular activities;

c)   performance in an interview or personality test;

d)   performance in a common entrance test.

Some representatives of industry and professional bodies suggested that the selection for admission to polytechnics should be based on an aptitude test. The Committee, while accepting that the performance in an aptitude test may be one of the criteria for admission to polytechnics, does not favour its wholesale adoption at the present stage. It, however, suggests that a beginning may be made in selected polytechnics (autonomous polytechnics) with a view to developing some standard aptitude test for the selection of students. Later on, such tests, if found successful, may be extended to other polytechnics.

7.22   The Committee recommends that admission to polytechnics should be made on the basis of merit. This may be on the basis of either the relative merit in the last public examination or the performance in the qualifying examination. The Committee also recommends that some weightage should be given for participation in extra-curricular activities like sports, social service etc.

7.3   Guidance and Counselling

7.31   It is very important to realize that our polytechnics have in their charge very young persons. Polytechnics have not only the responsibility for organising education, but also the obligation to consider the student as a person and assist him to proper development -- emotional, social and physical.

7.32   Individual students differ from one another in their abilities, attitudes, prejudices, biases, interests, personal characteristics, socio-economic backgrounds and cultural outlook. These individual differences are crucially important to the proper choice of the type of education and to the potentialities of success. But most of the students know very little about themselves or their abilities and potentials and even less about the nature and aims of polytechnic education. Consequently, most students enter polytechnics without the clear aspirations and motivation which can make their studies meaningful and purposeful.

7.33   Coupled with this, our students enter polytechnics at a very immature age. Many, for the first time, enter hostels away from their homes and often encounter a bewildering environment of life and learning. They often get into serious personal problems of financial, emotional and social character and problems of adjustment to the academic and social environment. In order that the student may gain the maximum benefit of his education and life at the polytechnic it is necessary that he is helped to understand his goals, aspirations, and weaknesses and that he is helped to solve his problems for himself.

7.34   It is in this context that well-organised guidance and counselling services could be of immense value in our polytechnics. The Committee notes that, at present, there are no organised Guidance and Counselling Services either in the schools or in the polytechnics and recommends their progressive establishment in the polytechnics in a phased way. To begin with, Guidance and Counselling Centres should be set up on an experimental basis in the autonomous polytechnics. Depending on the experience, the scheme should be extended to cover all the other polytechnics in the course of the next 10 years.

7.35   Each Guidance and Counselling Centre should have a Guidance and Counselling officer of the rank of a professor, assisted by suitable staff. The officer should be professionally qualified with adequate training in educational psychology and vocational guidance. The Centre will need to have library facilities and a testing laboratory for assessment and diagnosis of students' abilities and disabilities.

7.4   Information to Prospective entrants

One of the difficulties faced by students in making a choice in favour of polytechnic education is the lack of information and publicity about the nature and scope of polytechnic courses and the employment opportunities available for diploma holders. Too many youngsters, and their parents, choose institutions and courses on the basis of inadequate information and knowledge. Adequate information about the polytechnics, courses and employment opportunities must be made available in advance to prospective candidates. Hence the Committee recommends that the Directorate or Department in charge of technical education should collect details of the available technician courses and career opportunities and transmit the same to the Directorate of Secondary Education for publicity among the students in Higher Secondary, Pre-University or SSLC classes.

7.5   Hostel and Campus Life

7.51   Most of our polytechnics are situated in industrial and urban areas. This is in the fitness of things, since the effectiveness of polytechnic education rests on close collaboration with industry. Consequently, it becomes necessary to provide adequate hostel facilities for students coming from rural and other areas beyond a reasonable daily travelling distance. The Committee finds that the present position regarding hostel accommodation is not satisfactory in many polytechnics and recommends that hostel arrangements be made in all polytechnics for at least 50% of the students.

7.52   Moreover, since the students in technical institutions
spend longer periods daily in the campus compared to other students,
it is desirable that accommodation is available to all polytechnic
students who need it, so that they may work with higher efficiency.
Hostel life facilitates the frequent exchange of ideas by students
among themselves and with their teachers. Provision of adequate
hostel accommodation will thus serve as an important measure
of quality improvement in technician education.

7.6   Extra-Curricular Activities

7.61   One of the reasons for student unrest and indiscipline
is perhaps the lack of interesting, meaningful and creative
activities within the campus for students to utilise the free
time available. Apart from this aspect, it is absolutely necessary
for the total development of students that they should be initiated
to extra-curricular activities which inculcate self-discipline,
self-reliance, leadership, integrity, cooperation and other
qualities. The Committee, therefore, strongly recommends that
there should be adequate facilities for the out-door and in-door
activities of students. There should be provision for good
libraries, attached both to the students' common room and the
hostel. Adequate provision should be made for sports, cultural
activities, debating clubs, group discussions and other extra
curricular activities.

7.62   The Committee feels that educational administrators can get very useful ideas from students in the planning and conduct of educational programmes and recommends that at least the final year students should be associated with and involved in the various advisory bodies of polytechnics, particularly those concerning student discipline, curriculum development etc.

7.7   Scholarships and Financial Assistance

7.71   According to a survey carried out in 1965-66 by the Education Commission, about 55.8% of the parents and guardians of the students were having an income less than Rs. 150/- per month. The majority of students joining polytechnics are from the low income group. Hence there is a need for adequate provision for financial assistance to such students. It was brought to the notice of the Committee that the present practice of paying the entire amount of scholarship in cash to the students leads to many difficulties. There is a tendency for some students to spend the money carelessly; in some cases the parents utilise the money. The Committee is therefore in favour of extending financial assistance by way of free studentships, hostel facilities, free books and other educational materials etc. rather than through cash allowances or loans. In addition, there should be provision for merit scholarships to attract talented students to polytechnics in adequate numbers.

CHAPTER - VIII

8.0 ASSESSMENT AND EVALUATION

8.1 Objectives

8.11   Assessment and evaluation form an integral part of the total educational process. It is essential that, during and at the end of a course of study, both the teacher and the taught should evaluate how far they have succeeded in the attainment of the objectives of teaching and learning. Assessment and evaluation is a continuous activity which should be designed simultaneously with curriculum development.

8.12   A well designed system of assessment and evaluation is a powerful educational device. It serves the following purposes : it indicates what is important in the subject, how the facts, concepts and principles are recalled and used in a given situation, and whether the requisite mastery has been achieved by the student in the course; it furnishes some rational basis of judgment of the student's accomplishment and provides a basis for comparing each individual student's attainment with that of the rest of the class; it points to the direction for further learning and serves as a guide to the teacher to evolve effective and suitable teaching methods and techniques; and finally, it indicates whether the objectives of the curriculum have been achieved.

8.2   Defects in the existing system

8.21   Evaluation of students on the basis of external final examination is in vogue in all the polytechnics. Under this system it often happens that the subject is taught by one person, the question paper is set by another and the student's answer scripts are valued by a third person.

8.22   The teacher at the polytechnic has no direct role in evaluating the student he has taught. The present system exerts a confining influence on teaching and is liable, in any event, to give a false picture of the real achievement of the student.

8.23   The present type of written examinations tempt the student to prepare for the examinations by memorising lecture notes for reproduction in the examination and thus place a premium on note learning. The student is subject to unnecessary stress and fear on the eve of the examinations. The percentage of failure in the system is very high with the result that the student is likely to resort to malpractice to secure a pass.

8.24   Since the goal of the students is to pass the final examination, the teacher in his turn aims to prepare the student for it. He cannot introduce the latest developments in the subject to the students as the examination is restricted to the prescribed syllabus. The present practice of setting question papers and valuation of answer scripts arouses very little interest and enthusiasm to improve the methods of teaching.

8.25   Further, there is a large time-lag of two or three months between the date of examination and the date of declaration of results. During this period, the student is kep waiting and the institutions are precluded from starting the next academic session. If this time-lag is drastically reduced the institutional facilities could be better utilised.

8.26   Almost everyone - the teachers, students and representatives of industry and business - with whom the Committee had discussions has stated categorically that the present examination system is one of the greatest drags on our efforts to improve technical education.

8.3   Suggested Reform

8.31   Education has a dual role - the dissemination of knowledge by teachers and the assimilation of knowledge by students. This is best served if the teacher simultaneously carries on the tasks of teaching and assessment. Such assessment will clearly reveal to the teacher whether his teaching is effective and whether learning is achieved. Continuous evaluation based on this principle will not only remove the fear-complex in the mind of the student but also motivate him for effective learning. Consequently, the student will find his studies interesting.

8.32　The system of continuous internal assessment and evaluation is superior to the traditional time-test examinations. In the new system the students will consider evaluation as another learning activity. The system allows the student to study his valued answer scripts, to discuss them with his teachers, to seek clarification on the basis of assessment and to obtain guidance for improvement. This would act as an incentive to learning and help the student to plan his studies carefully. The teacher on the other hand would know where he has helped the students to understand and where he has not. This feed back will help him plan effective teaching. The system will take into account such qualities of the student as his initiative, industry and discipline. The system of continuous evaluation is also a means by which the work of the student on the entire syllabus may be judged and not merely his work on parts of the syllabus on which an examiner may base his questions.

8.33　The Committee is quite convinced of the efficacy and purposefulness of the system of continuous internal assessment and evaluation. However, it is conscious of the difficulties in the way of implementing this system in our polytechnics immediately and in toto.

8.34   Internal assessment is a continuous process, which means that the final assessment in any subject should be made up of the results of a large number of tests, assignments etc.

Different methods could be used for assessment; these include the following :

a)   Quiz or unannounced tests

b)   Home assignments

c)   Periodic tests

d)   Oral tests

e)   Project work, term papers

f)   Participation in seminars and discussions.

Each of these methods is effective in certain situations and not suitable in others. The nature of the subject and the objectives to be realised in the subject will to a great extent determine the methods of assessment. Therefore at the time of curriculum planning itself the methods of assessments suitable for each subject, the relative weightage for the methods and the timing and sequence of their use must be carefully determined. In the light of such consideration and choice of techniques a great amount of planning will have to go into the methods and programme of teaching. The teacher will have to carefully plan and schedule his work of teaching and assessment.

8.35   The success of the system depends on its acceptance by students. Tests, assignments etc. must be framed to enable objectivity in assessment. The student must be briefed clearly and in advance about the programme of assessment, its contents, timing and criteria and the weightages attached to each method of assessment. He should also be allowed to discuss the valuation of his assignments, answer books or other work at every stage and be convinced of its fairness.

8.36   In order to maintain proper standards of assessment, it is necessary that the records of assessment are carefully maintained in detail and made available for scrutiny by the concerned authorities.

8.37   Frequent interchange of views and experience between polytechnics would be very valuable in developing satisfactory methods and techniques of internal assessment and in arriving at acceptable and standard patterns allowing the necessary flexibility to suit the different subjects and methods of instruction.

8.38   Internal assessment calls for a great deal of planning and time-consuming work by the teachers concerned and this fact must be taken into account in determining the work loads of teachers. In the initial stages the teachers may experience some difficulties in carrying out internal assessment. They will require some training in the methodology, objectives and techniques of assessment and the preparation of test materials.

8.39   Taking into consideration the initial difficulties, the Committee feels that it would be advisable to start with a mixed evaluation system consisting of continuous internal assessment carrying equal weightage with the external examination. This should however be a transitory arrangement.

8.4   Implementation of the reform

8.41   The Committee recommends that the system of annual final examinations should ultimately be replaced in all polytechnics by the system of continuous internal assessment. The proposed reform should be introduced as suggested below.

8.42   Proposals have been made earlier in this report for constituting a State Council of Technical Awards and for the phased selection of polytechnics for the grant of autonomy. The autonomous polytechnics may institute their own system of internal assessment and evaluation. They will however be required to submit their scheme of assessment and evaluation, as well as the names of external examiners proposed to be appointed, to the Council for approval. The Council will have powers to call for the question papers and other relevant records of assessment to satisfy itself that the requisite standards are maintained.

8.43   In respect of non-autonomous polytechnics, for the time being, external examinations may continue to the extent of 50% of the total assessment. These examinations will be conducted by the State Council of Technical Awards. The remaining 50% of the total marks should be awarded on the basis of continuous internal assessment by the polytechnics themselves. The internal assessment should take into account the student's achievement in assignments, periodic tests etc.

8.44   The State Council of Technical Awards should continuously review the methods of internal assessment and evaluation and suggest necessary improvements.

8.45   Courses in the methods of assessment, evaluation and grading should be arranged for teachers in the form of short training programmes and summer courses.

8.46   The complete change-over to the system of continuous internal assessment and evaluation should be effected in all polytechnics within a period of 10 years.

C H A P T E R - IX

9.0   TRAINING AND EMPLOYMENT

9.1   Education and training

9.11   In the earlier chapters, the terms 'education' and 'training' have been used synonymously to denote the total process of preparing students for technician functions. In a strict sense, education means a relatively open-ended process; it produces a state of mind in which further development can occur. Training is a relatively closed process in the sense that it has a definite end at a given level of skills. To be clear about these distinctions, the terms 'education' and 'training' are being used in this chapter to comprise the two parts of the total process of technician education.

9.2   Training needs of technician education

9.21   Any type of education implies some training. The relative proportion and type of training in the overall education depends on the type and level of education.

9.22   It is obvious that in any education intended for a profession or a vocation, the training content will normally be greater than in liberal or general education. The amount and kind of training will also depend on whether the kinds of skills to be imparted are manual, mental conceptual or creative. To arrive at the quantum

and kind of training needed in the education of a technician, one has to take into account the nature and level of his work.

9.23   It is the job of a technician to interpret and work out the details of plans, designs or programmes, to determine the techniques to be used and to choose the tools, machines, processes and procedures best suited for the job. In doing so, he is required to exercise judgment in the sense of diagnosis, appraisal and initiative.

In most cases, technicians will have to supervise the work of skilled craftsmen. Therefore, they must be conversant with the skills and aware of the nature and problems of the work of skilled craftsmen.

9.24   The technician thus combines specialist knowledge, experience and skill with the ability to apply them. The special characteristics of his work must determine the nature of his education. Therefore, the technician courses should be so organised as to comprise the following five elements :

    i)   basic and applied sciences (theory)

    ii)   basic and applied sciences (Practical)

    iii)   technology (theory)

    iv)   technology (practical)

    v)   general education

Frequently, in discussion, these five elements are coalesced to form two, viz., 'academic education' and 'practical training'. Whilst the boundary between the two is not well defined, 'education' can be considered to embrace (i), (iii), (v), and commonly part of (ii), while 'training' consists of (iv) and the rest of (ii). Technology (practical) consists of institutional training backed by adequate industrial training.

9.25   Practical training is thus an integral part of the education of technicians and the success of technician education programmes will depend on the degree to which academic education is integrated with, or supplemented by, relevant practical training. It is also clear that the training should closely reflect actual technician work.

Practical training should not be confused with the practical work that must be carried out along with the theoretical studies. Academic education is concerned essentially with providing the knowledge of why a job is done in certain ways; practical training is concerned with how the job is done and with the acquisition of specific industrial skills. Its main objective is to relate theoretical knowledge to actual practice in the industry.

9.26   A training programme should introduce the potential technician to a variety of operational problems obtaining in the practice of his occupation, whether these relate to the selection of operational procedures, manufacturing processes, machines, materials and methods, or to the ensuring of control of production sequences, quality and cost. It should also expose him to conditions of work involving, among other things, organisational procedure, group activities, human relations and production economics.

9.27   Practical training must aim to provide the student with an understanding and appreciation of the following :

a)   The potentialities and limitations of basic workshop processes;

b)   The properties of materials used in engineering workshops;

c)   The role of the technician in industry, and the significance of the abilities and skills demanded of other persons engaged in the same industry;

d)   The general principles of organisation and management.

A sound practical training will inculcate a respect for the value of actual practical work. By such training the individual should come to realise his own limitations and potentialities and gain confidence by developing his interests and aptitudes. It should aid his growth not only as a technician but also as a person, and enable him better to make his unique contribution

9.3   Phases and contents of practical training in industry

9.31   The specific contents of practical training schemes

for technicians will vary greatly owing to the many different

types of technicians found throughout industry. Commonly,

however, any training scheme can be split up into three phases,

namely, induction, basic training and secondary training.

9.32   All training should begin with a short induction

period designed to give the student an introduction to an

industry or establishment of the type in which he would get

his further training. This should preferably be arranged in an

industry or firm. Where this is not possible, the training

officer can organise an induction programme in the institution

itself.

9.33   Basic training

The aim of basic training is to impart the necessary

fundamental skills, such as the basic workshop skills, so

as to lay the foundation for the later shop floor or field

experience. Basic training should normally be provided by

the Polytechnics themselves. (For this reason, basic training

has been discussed under workshop practice in para 5.46).

In this context the Committee recommends that, besides

strengthening the existing workshop facilities in polytechnics,

wherever possible, closer links should be established between polytechnics and Industrial Training Institutes. Some firms possess excellent apprenticeship centres or training workshops, and in such cases, basic training may take place in the actual factory.

9.34   Secondary training

This phase should have as its object a broadening of technical knowledge and the gaining of insight into some of the workings and problems of industry in general. In the later stages, the training should be more specifically related to the actual work on which the technician will be engaged when he has finished his training. For example, for mechanical engineering technicians, this phase should include more advanced work on tools and workshop processes as they are related to some of the operations among Component manufacture and inspection; Assembly; Plant erection, installation and test; Operation and Maintenance; and Design, drawing and development with accent on detailing. Project work should be encouraged during the period of training. Arrangements should be made for senior staff of the industry to lecture and explain the practices.

While some aspects of secondary training, particularly design, drawing and detailing, can be organised in the institutions themselves, the major part of secondary training could only be imparted in the production shops, process control departments, testing laboratories and technical offices of

In the case of sandwich courses, part-time courses, and diversified courses it will be essential to integrate and match the institutional programme and industrial training so that education and training may complement each other.

During the periods of training in the industry, it is most important that apprentices should carry out the actual operations themselves, so as to extend and develop the skills and knowledge they have acquired during the basic training period, and to become aware of the procedures and practices which are part of the technician's sphere of work as well as to come into contact with problems associated with management, labour and industrial relations. The importance of making decisions, giving clear instructions, preparing reports and similar activities should also be stressed in the training.

9.4 Principles of training

9.41 Training must be made an interesting and challenging experience and must encourage the student technicians to use their initiative and persistence in understanding and solving problems themselves. The practice of learning by observation should be kept to an absolute minimum.

9.42   Assignment of specific work involving some degree of responsibility and its proper planning and supervision should constitute the basis of practical training in any establishment. Personal or group projects or assignments should be introduced wherever possible.

9.5   Assessment and evaluation of training

9.51   Training must be assessed and evaluated. It should preferably have adequate weightage in the total evaluation. There is a need to devise adequate scientific methods to assess the results of training and evaluate the degree to which the objectives of training have been realized.

9.6   Training facilities - present and future

9.61   The present position regarding training in industry is quite unsatisfactory. Training under the Stipendiary Training Scheme is available to very few students. A few other students manage to get some sort of training placement largely on their own initiative. Such training is neither planned to specifically meet the objectives of any diploma programme, nor organised and supervised properly by either the institution or the industry. Very often, the trainee is largely left to himself to move around and pick up whatever knowledge he could, so long as he does not hamper the routine activities in the industry. Certain large organisations do organise training programmes for new recruits but this training is in the nature of job-orientation, being

solely governed by job considerations rather than by the educational objectives of technician training. It should, therefore, be the endeavour of all concerned to make arrangements to provide well-organised and supervised practical training in industry for all diploma students during vacations and/or after the completion of course. Since several departments such as industries, labour and technical education are administering several kinds of training programmes, an effective coordination of their efforts should be brought about.

9.62 It was brought to the notice of the Committee by representatives of industry that the facilities presently available in industry are inadequate to provide training places to all the graduates and diploma holders coming out of technical institutions. The recent recession in the economy and the growing unemployment among engineers have added to the difficulty in finding training opportunities for diploma holders. The Committee notes in this context that, in countries such as Britain and West Germany, attempts are being made to provide the much needed practical training by setting up industrial training centres with simulated production conditions. Keeping in view the important need to ensure practical training to all students in polytechnics and the practical difficulties obtaining in industry, the Committee recommends that production-cum-training centres may be set up at places wherever two or more polytechnics are situated. The facilities available at these centres should also be used for providing training

during vacations or after the diploma courses. The centres could also provide practical training to students of polytechnics in rural areas where industries do not exist.

9.63   Training forms an integral part of technician education. Planning and organising suitable training programmes and coordinating them with the requirements of different technician courses in co-operation with industry, constitute an important facet of the work of polytechnics. This imposes heavy responsibilities on the polytechnics and calls for the services of a full-time training officer with considerable industrial background and contacts. Such an officer would, moreover, be able to guide and assist students in finding suitable employment and help employers to recruit suitable technicians. The Committee, therefore, strongly recommends the setting up of a separate training and placement department in each polytechnic manned by an experienced training and placement officer of the rank of a professor, with suitable assistance.

9.64   Finally the Committee is of the firm view that if any training scheme is to be effective, whether it be in industry, in the production-cum-training centres, or in the Industrial Training Institutes, it is absolutely necessary to set up training departments in these organisations manned by capable executives who could work in close collaboration with the Principals/Heads of Departments and Training Officers of the Polytechnics.

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10.0 PARTNERSHIP WITH INDUSTRY AND COMMERCE

10.01   Unlike the other streams of higher education, the education of technicians is primarily governed by the needs of industry and commerce. Moreover, the very nature of technician training and the limitations of institutions with regard to training facilities, require that industry and commerce should assume the responsibility for giving a part of the training for which they are best equipped. For these reasons, technician education needs to be regarded as a venture in partnership between educational institutions on the one hand and industry and commerce on the other. In this process, both have common interests and concerns to share. The problems facing technicians, the problem of industrial productivity, the gap between educational objectives and industrial requirements and the challenge of rapid advances in science and technology are all but a few examples of such common interests. In the reorganisation of polytechnic education, the Committee would stress the need for both of them to come closer.

10.02   At present, the partnership of industry in technician education is mostly confined to participation in higher level policy making by way of the association of a few experts from industry in the All India Council for Technical Education and its Regional Committees, and in the bodies at the State level concerned with technician education policy. At the unit level, barring a few instances of the collaboration of industry in running sandwich courses, or in offering training facilities for students, there is little evidence of partnership. This, however, is not surprising because, at the unit level, there is in fact very little opportunity or incentive for

The individual polytechnics have very little authority or control over the planning and organisation of technician education and, therefore, the question of their forging links with local industries hardly arises.

10.03   The Committee is convinced that the collaboration of industry in the education of technicians will be real and effective only if it exists at all levels of the Polytechnic education system from the national to the unit level. At the national, regional and state levels, the partnership should be made more effeotive than hitherto. It is at the unit level, however, that there is the greatest need for the most active collaboration. The association of industry with the proposed State Councils of Technical Awards and with the autonomous polytechnics in framing and changing polytechnic courses will form a very important aspect of the collaboration. Conditions must, moreover, be created which favour the establishment of close collaboration in other aspects, particularly in the implementation of the programmes of education and training. The specific areas and aspects of partnership as implied in the Committee's recommendations for the reorganisation and improvement of polytechnic education are briefly considered below.

10.1 Cooperation of industry and commerce in the educational process

10.11 Industry and commerce, being the largest consumers of the products of Polytechnics, have the responsibility to specify the nature and quality of the products to be turned out from polytechnics. This calls for closer collaboration and cooperation of industry and commerce in the planning and development of educational programmes and the provision of facilities for training.

10.12 It has already been emphasised that training is an essential part of technician education. Effective training cannot be achieved without the active and whole hearted participation of industry. It will, therefore, be necessary for industrial establishments to determine the availability of proper training facilities with reference to the number of training places, types of facilities and training personnel. It is also necessary for them to determine whether they will be able to offer appropriate facilities for running sandwich courses. Once this point is made clear, the polytechnics should work out the educational and training programmes with the assistance of industry. Similarly, in the case of diversified and special courses, industry should take the initiative to collaborate with the polytechnics in identifying the areas and fields in which courses are needed and in designing the appropriate courses. Industry should also assist polytechnics in the planning, implementation and supervision of training programmes for students after they have completed their institutional education.

10.2   Industrial training for teachers

10.21   It has been stressed earlier that polytechnic teachers should be familiar with the working, practices and trends of industry and be able to give an industrial orientation to teaching. This is a matter on which both the polytechnics and industry should be vitally concerned. It is therefore recommended that industries should extend their fullest cooperation in providing the much needed industrial experience to polytechnic teachers either by short-term or long-term training or through other arrangements.

10.3   Research and development

10.31   One of the areas of fruitful collaboration between industry and polytechnics is in the area of research, design and development. The Committee recommends that industries in the neighbourhood of polytechnics must be encouraged to refer their research, development and production problems to the polytechnics. Industries may also support other research or development projects undertaken by polytechnics.

10.4   Industrial orientation to teaching

10.41   The above measures will enable teachers to perceive actual industrial and field problems and suitably use them for class room or laboratory work. Close contact of teachers with industry will moreover help in planning project work based on the actual problems and practice in industry and commerce. In addition, the Committee recommends that experts from industry should be invited to discuss some typical problems of the shop floor and explain through special lectures and seminars how they are solved. Such lectures and seminars are among the best ways of integrating industrial experience and polytechnic education, and can contribute greatly to motivate students towards a practical way of thinking.

10.5   Manpower forecasting and planning

10.51   The Committee has recommended earlier that special units should be set up in the Directorates or departments in charge of Technical Education for the estimation of future technician demand, speciality-wise, on the basis of analysis of occupations. Industrial collaboration is essential in such an activity; it is therefore recommended that industry and commerce and their federations should be fully involved in the work of these units. In this respect, cooperation with the Industrial Liaison Boards, wherever these are established, will be fruitful.

C H A P T E R - XI

11.0   STATUS AND PROFESSIONAL DEVELOPMENT OF TECHNICIANS

11.1   Role and status of technicians

11.11   The rapid pace of technological development and its
increasing adoption by industry have led to a growing
complexity of industrial activity. As new materials and
new industrial processes emerge, the problem of manufacturing
products characterized by greater reliability and improved
performance becomes increasingly difficult. Simultaneously,
industry and commerce are confronted with the problem of
providing high quality products at competitive prices in
the face of the continually rising costs of both material
and labour. Industry and commerce can meet these challenges
only if they make the most efficient use of manpower at all
levels. This means that the several middle level functions
in industry relating to the details of design, drafting,
production quality control, supervision, maintenance, sales
and servicing have to be performed by persons specifically
trained for such jobs, leaving only the more advanced and
creative work in management, innovation, research, design
and development to the engineers, scientists and profes-
sionals. Craftsman level experience is quite inadequate
to meet the requirements of the middle level functions.
Herein lies the importance of recognizing technicians as a
very important and separate entity with distinct functions
and clearly identified requirements of knowledge and skills.

It is essential to realize, moreover, that these requirements call for an education and training quite distinct in nature, contents and approach from that of engineers or craftsmen.

11.12   In this context, the supply of adequate numbers of properly educated technicians will largely depend on the status accorded to them appropriate to their qualifications, and their role and importance in industry. The capability of polytechnics to attract talented students in sufficient numbers, the motivation and performance of students, the dedication and effectiveness of teachers, the image of the polytechnics in society and consequently the resources they will command - are all greatly influenced by the status of technicians in society and industry.

11.13   Status is a complex concept involving several factors, the most important of which are : attitude of, and recognition by, society and industry, economic incentives, promotional opportunities and scope for personal growth and development. The traditional attitude of society to regard work-oriented education as of a lower kind compared to the more glamorous intellectual pursuits underlying university education, and society's lack of appreciation of the dignity of labour, need to be reversed if technician education is to claim its rightful place in society in the context of economic development. While this is a social

problems, the solution of which lies in a change in the attitudes and beliefs of society as a whole, much positive action can be undertaken to accelerate and aid this change. The Committee commends the following steps to ensure the proper status for technicians :

1. Industry and commerce should rationalize their manpower structure and indentify specific technician functions. They must appreciate the role of technicians in the complex of industrial and commercial occupations and accord a recognisable career structure adequately reflecting the importance of their position. Formal technician qualifications should be insisted upon for recruitment. The Survey of Industries by the Committee shows that at present only 36% of technician posts in industry are held by diploma holders, the rest being held by degree holders (16%) and those with craftsmen level experience (48%). It is obvious that a majority of the industries are yet to clearly appreciate and recognise the separate identity of technicians with reference to their work and educational requirements. It is essential that graduates should not be employed as technicians except to the extent necessary to give them job-training. Engineers should also appreciate the role of the technician in the technical team. Where craftsmen are promoted, industry should see to it that they receive the necessary education at the polytechnics.

ii.   Technician courses must have an integrity of their own; they must meet the specific needs of technician functions in industry and commerce. The courses must be framed in consultation and cooperation with industry.

iii.   Technician courses should not lead the technicians to a dead end. They must therefore, be broad-based to facilitate further studies.

iv.   Polytechnics should organise a variety of updating, refresher and extension courses including short-term and advanced-diploma courses for technicians in service. They may also eventually organise part-time degree courses. Through these courses, technicians should be enabled to qualify for higher positions and promotions. Industries must encourage the development of their technicians and offer better promotion opportunities to those who improve their qualifications through these courses.

v.   The image of polytechnics as centres of career education should be promoted through the development and organisation of new courses and experimentation with educational programmes. For this purpose, polytechnics should have the flexibility and freedom to develop in new directions and explore new horizons. In this context, the Committee stresses the important and valuable role of the proposed State Councils of Technical Awards as a means to ensure the academic freedom of polytechnics and to guide

their development and safeguard the necessary standards.
The awards of the Councils will not only set the seal of
standard and quality on the products of polytechnics but
also enhance their recognition and acoeptability, by virtue
of the close association of industry and commerce in the
work of the Councils.

vi.   Universities, technological institutions and poly-
technics should establish closer rapport and understanding
and work as partners in education.   They should take positive
steps to remove, from the minds of the student community and
others, the prevailing tendency to regard vocational and work-
oriented education as inferior to university education.   Students
must be made to appreciate that different types and patterns of
education are but different means to meet the present and future
educational and manpower needs of society and industry.   To
this end, college and University professors and administrators
should try to associate themselves with polytechnic education.

11.2   Development of professionalism among technicians

11.21   The question of the status of technicians is closely
related to the development of a sense of professionalism
among them.

11.21   A professional person is one who applies certain knowledge and skills, usually obtained by education and training, for the service of society. In addition, a professional person observes an acceptable code of conduct, uses discretion and judgement in dealing with people, and respects their confidence.

11.23   Professionalism is not inherent in a person's nature. Like technical skills, it has to be acquired. A person does not become a professional immediately upon completion of his formal education. He can be introduced to such concepts during his study but he has to widen his outlook by contacts with professional bodies. Each technician should recognize the need to join professional societies.

11.24   A professional body would provide technicians an organised forum for discussing common problems and articulating their needs and aspirations, besides giving them a sense of belonging to a group which has an ethos of its own and an influential voice on all matters connected with the development of technicians and their education and training. It would thus help to maintain and enhance the standing of technicians and greatly contribute to the recognition of technicians by society.

11.25   By and large, technicians are at present yet to

develop a sense of professionalism or an awareness of their

own distinct identity in industry as a group of people with

specific roles in much the same way as engineers. Opportunitie:

for their responsible association and participation with prefession.

bodies are largely non-existent. For example, at present, diplon

holders are eligible to enrol themselves only as student members

of professional bodies such as the Institution of Engineers (India)

11.26   The Committee feels that technicians should have

an organised forum which will enhance their status and

enable them to contribute effectively to increased productivity

and to the development of technician education and training.

A separate professional body or association of technicians

may not be viable or effective at present. Therefore, the

Committee favours their association in a responsible way with

the several professional bodies and other organisations

representing industrial and commercial interests. The Govern-

ment should take the initiative in persuading the professional

bodies and other organisations and associations concerned

with technical education, training, industrial and commercial

interests etc. to set up technician sections/technician education

and training sub-committees etc. in which the teachers of

polytechnics should also be involved. Some of these bodies

and associations are listed in Annexure 11.1 to this chapter.

LIST OF PROFESSIONAL BODIES AND OTHER ORGANISATIONS*

1.   Indian Society for Technical Education
        New Delhi.

2.   Institution of Engineers (India)
        Calcutta-20.

3.   All India Manufacturers Organisation
        Bombay.

4.   Indian Engineering Association
        Calcutta.

5.   All India Management Association
        New Delhi-13.

6.   National Productivity Council
        New Delhi.

7.   Federation of Indian Chambers of Commerce and Industry
        New Delhi.

8.   Institute of Chartered Accountants of India
        New Delhi.

9.   Institute of Indian Foundry Men
        Calcutta-20.

10.   Indian Institute of Chemical Engineers
        Calcutta-32.

11.   The Institution of Telecommunication Engineers
        New Delhi.

12.   The Textile Association (India)
        Ahmedabad.

13.   Indian Society of Agricultural Engineers
        New Delhi.

14.   The Aeronautical Society of India
        New Delhi-1.

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* Note: The list is not exhaustive.

CHAPTER - XII

12.0   ADMINISTRATION, FINANCE, CONTROL AND INSPECTION

12.01   Organisation of technical education is complex and involves considerable financial outlays and expenditure. In view of this, judicious administrative control is necessary to make the best use of all available resources. This, in turn calls for firm Central policy-making and planning and also implies consultation and liaison on a continuing basis among a wide group of individuals and organisations. Effective coordination at the national level is therefore absolutely necessary.

12.02   The seventh schedule, Union list I entry 66 under Article 246 of the Indian Constitution envisages that in the matter of coordination and determination of standards in institutions for higher education on research and scientific and technical institutions, Parliament has exclusive power to make laws. This, in turn, puts the major responsibility for the proper development of technical education on the Central Government. It follows that there should be a strong machinery at the Centre for discharging its Constitutional obligations and responsibilities in Central policy-making and planning in respect of technician education. This involves continuous study and evaluation of schemes connected with the development of

technician education, and consultation and liaison with industry, technical organisations, State Governments etc. in order to ensure that the facilities created in the country are properly utilised according to the manpower requirements of the country as a whole. In this context, the Committee recommends that adequate provision should be made to strengthen the present administrative machinery at the centre i.e. the Ministry of Education, for the effective discharge of its responsibilities.

12.03 Technician education cannot be planned on a rigid basis. Flexibility in planning is essential in order that the education may continuously answer the demands and changing needs of local industries and other organisations absorbing technician manpower. There is no doubt that, for planning technical education, a strong national policy is necessary; but such a policy should be flexible enough to permit modification according to the peculiar regional or local needs with reference to the type and level of technicians. Mobility of technicians is another factor which calls for the formulation of Regional and State policies within the overall frame-work of the national policy and plans.

12.04   Considering all these aspects, and in the best interests of the country, the responsibility for the administration and control of technician education should be shared appropriately by bodies at the Central, Regional, State and Unit levels. The responsibilities at each administrative level should be properly defined. The Committee's view on the pattern of administration and allocation of functions and responsibilities at the different levels are discussed below and indicated in the charts in Annexures 12.1 and 12.2 to this chapter.

12.1   National level

12.11   The formulation of general national policy and the planning, coordination and determination of standards of technician education should rest with the Central Government. Otherwise, a variety of policies may be imposed from various organisations and States which may ultimately be unsuited to the national economy and the needs of industries. In this respect, the All India Council for Technical Education and its Committees and Boards should continue to act as the advisory machinery to the Government. However, in order to make it more effective, it may be necessary to reorganise the Boards of studies of the All India Council for Technical Education. At present, there is no separate Board of Studies or Committee for technician education. Technician education is being dealt with by the different Boards of Studies of the AICTE dealing with the different aspects of engineering and technology. It is recommended that a separate Committee on Technician Education and Training may be constituted under the auspices

of the All India Council for Technical Education to deal with all aspects of technician education and training at the national level.

12.12   In order to give efficient secretariat help to the Committee proposed above, a separate unit may be created in the Ministry of Education. This unit should also serve as an effective medium for the collection and dissemination of information connected with technician education. It should undertake studies on manpower requirements at the national level including job analysis etc. with reference to educational preparation. It should also collect and analyse information regarding the direction of changes in technology and industrial development in the country and the changes taking place in technician education abroad.

12.2   Regional level

12.21   The All India Council for Technical Education has to keep in close touch with the States through its Regional Committees, in order to formulate national policies and plans with due regard to the regional needs and check the haphazard growth of technician education. In this respect, the Regional Committees of the AICTE and the regional organisations of the Central Government may have to be reorganised keeping in view their overall responsibility in the administration of technician education vis-a-vis those of the Central and State organisations. The Regional authorities should maintain constant

touch with the industries, technical institutions and State Governments located in the region and help to bring about a balanced development of technician education in the region according to the demands and needs of the economy and industry. The regional organisations should act as a forum for the exchange of ideas and experiences among the States located in the region.

12.3   State level

12.31   The Committee recommends that detailed studies of manpower demands in the State, training in industry, programmes of development, teacher development and administration of polytechnics with respect to financial control and coordination at State level, should be the direct responsibility of the State Government so that programmes and schemes may be effectively implemented. The State Governments should constitute a separate authority, i.e. the State Council of Technical Awards (SCTA) to be responsible for control and supervision over all academic matters, including approval and development of curricular and academic programmes, coordination and maintenance of standards etc. The State Governments may also authorise the SCTA to advise them on various aspects of technician education both academic as well as administrative. The role and functioning of the State Council of Technical Awards have been discussed in detail in chapter V, para 5.72.

1 .4   Unit level

12.41   In view of the special need for the growth of
technician education, it is felt that unless administration
and control are decentralised and more autonomy is given to
individual institutions, it may not be possible to stimulate
the healthy growth of polytechnic education. Therefore it is
necessary to delegate sufficient administrative control to the
unit level. This has already been discussed in detail under
the autonomous institutions (para 5.71). It should be the
endeavour of all that, as far as possible, the academic
responsibilities and general day-to-day administration should
gradually be delegated to the polytechnics authorities. There
should be adequate delegation of financial power to the Heads
of Polytechnics to function efficiently.   This will not only
help involve the faculty and administrative authorities of
polytechnics in the development of technician education but
also make them responsible for the proper implementation of
schemes.

12.5   Industry level

12.51   Apart from the devision of responsibilities between the
Central and State Governments, there should be some division
of responbibilities between the Governments and the industry
in the administration and control of technician education.
Although the main responsibility to provide the basic technical
education at various levels rests with the governments, it is

specialisation it needs. What is needed is a strong
partnership and cooperative effort in which the basic
and theoretical education are provided through institutional
efforts and the practical training and expertise are
available through industry. The industry should be
involved completely in the control and administration
of technician education, as far as possible at all levels,
through the medium of the All India Council for Technical
Education, its Regional Committees, the State Councils of
Technical Awards and the Advisory Committees of various
polytechnics etc.

12.6   Finance

12.61   As regards the financing of polytechnic education
the Government hss to take the major responsibility both
at the Central and State levels but industry should also
be a party to the financing as it directly benefits from it.
This can be achieved through voluntary efforts. Selected
industrial establishments may be persuaded to contribute
the necessary funds and facilities for the development of
sandwich courses, special types of short-term or extension
courses etc. So far as new experiments and innovations
in technician education are concerned, the Central
Government should take the entire financial responsibility
by sponsoring pilot projects and other programmes.

12.7 Evaluation

12.71 Academic evaluation at the State level has been dealt with in detail under the State Council of Technical Awards. At the National level, adequate provision should be made for the evaluation of the entire system to ensure that the money spent is effectively and properly utilised and that proper standards are maintained with regard to the overall national needs. Without a proper feed-back system , it may be difficult to formulate worth-while national policies or plans to serve the needs of the national economy.

12.8 Cost analysis

12.81 As the cost of establishment and maintenance of a polytechnic depends on various factors such as field of studies, type and contents of courses, and student strength, it is extremely difficult to give any probable cost analysis for establishing a polytechnic. Therefore the Committee has not attempted to give any analysis of capital costs. It is suggested that whenever a new polytechnic or a new technician course is started, the administrative authority concerned should appoint an expert committee with representatives of the concerned industry and faculty to work out the cost of the project.

`2.82   An analysis of the present expenditure pattern in

a polytechnic shows that about 85 % of the total recurring

expenditure is incurred on the wage bill. Only the remaining

15 % which works out to Rs. 120/- per student per

year, is left for other expenses including consumable stores.

This amount is grossly inadequate even to meet the expenditure

in providing effective training to students, not to mention the

other items of maintenance expenditure. Therefore it is

imperative that the annual provision under contingencies,

materials etc. should be raised to a minimum of Rs. 300/-

per student against the present provision of Rs. 120/- to

Rs. 150/-.

If the recommendations of the Committee made under various

chapters are accepted, the annual per capita expenditure

(recurring expenditure) may have to be revised to a

figure of Rs. 1700/- to Rs. 1800/-. The basis on which

this figure has been worked out is given in Annexure 12.3

to this chapter.

ANNEXURE 12.1

PATTERN OF ADMINISTRATION

GOVERNMENT OF INDIA	Central finance, Job analysis, Manpower estimates, Control of available placement and training facilities.
ALL INDIA COUNCIL FOR TECHNICAL EDUCATION, COMMITTEE ON TECHNICIAN EDUCATION AND TRAINING	Coordinating body for inter-State matters, consideration of finance from centre.
REGIONAL COMMITTEE	Body for coordination between States in the Region.
STATE GOVERNMENT DIRECTOR OF TECHNICAL EDUCATION STATE BOARD OF TECHNICAL EDUCATION	Job analysis, Manpower study, Development planning Finance from the State.
STATE COUNCIL OF TECHNICAL AWARDS (SCTA) *	Independent autonomous body for Control, Inspection, Approval, and Maintenance of Quality and Standards and Award of Deplomas; Other advisory functions.
POLYTECHNICS	Autonomous with respect to curriculum framing assessment, academic experimentation and development programmes.

GOVERNING   ACADEMIC
BODY   BOARD

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* Note:

The SCTA is not an examining body to determine and impose
syllabuses on the polytechnics or to set examinations;
the polytechnics themselves are to be given the responsibility
of constructing curricula and conducting examinations. The
SCTA is an inspecting and supervising body which works through
subject panels, standing committees and visiting commissions
appointed by it.

ANNEXURE 12.2

ALLOCATION OF FUNCTIONS AND RESPONSIBILITIES

Level of Administration	Advisory Bodies and Agencies

Central and Regional Levels

1. Overall planning of technical education vis-a-vis Five Year Plans and perspective plans.) All India Council for Technical Education/Committee on Technician Education and Training/Regional Committees.

2. National policies and objectives with reference to coordination of standards, foreign aid etc.) Ministry of Education/Regional Offices.

3. Sharing of financial costs.)

4. National manpower needs.)

State Level

1. Programmes of development Detailed manpower needs; Approval and development of curricular and academic programmes; Teacher development; Training in industry.) State Board of Technical Education State Council of Technical Awards (The State Director of Technical Education is to be the Member-Secretary).

2. Administration of Polytechnics Financing, Coordination of standards at State level.) (The State Government to determine the manner and method of setting up the SCTA and specify its relationship to the State Board of Technical Education.)

Institution Level

(a) Autonomous Polytechnics)

    1. Day to day administration) Governing Council

    2. Planning and organization of academic programmes and training in industry.) Academic Board

    3. Implementation of academic programmes and training)

(b) Non-Autonomous Polytechnics) Directorate of Technical Education/Governing body.

    1. Day to day administration)

    2. Implementation of academic programmes and training.)

ANNEXURE 12.3

ESTIMATED ANNUAL RECURRING EXPENDITURE FOR A POLYTECHNIC

A tentative estimate of the annual recurring expenditure

on the running of a polytechnic with an intake capacity

of 180 per year has been worked out here based on certain

asuumptions. It is realized that various factors including

the strength of the polytechnic and the number, type and

pattern of courses, affect the annual total, as well as

per capita, recurring expenditure. Expenditure on experi-

mental projects and other special programmes of quality

improvement, training etc. has been excluded. The estimate

is therefore to be regarded only as a broad guideline for

working out the annual recurring expenditure.

The strength of the polytechnic is assumed to be about

500 to 550 which generally is the case with most of our

polytechnics at present. However, the optimum strength

of polytechnics could well be of the order of 1200 to 1800

students, without substantial additonnal capital outlays.

For purposes of the estimate, it has been assumed that

the polytechnic offers a total of five courses (including

general and diversified courses).

In making the estimate, the recommendations made earlier regarding teacher-student ratio and staff pattern have been kept in mind. Accordingly a teacher- student ratio of about 1 : 12 and a senior to junior teaching staff ratio . of approximately 50 : 50 have been assumed. Also, provision has been made for a training and placement department, better library-staff and for increased laboratory and office assistance.

Due provision has been made for regular additions to the library (vide the Committees suggestions in Annexure 5.5) and for increased expenditure on maintenance, consumables and materials necessary to ensure effective laboratory and workshop training. With regard to the latter, the Committee has recommended earlier (para 5.47 f) that a minimum of Rs, 300/- per student should be provided in the annual budget.

Salaries have generally been assumed to be at par with the scales of pay applicable to engineering colleges.

Extra expenditure will have to be allowed if the courses are conducted on the sandwich pattern. In this regard the Ministry of Education (vide D.O. NO. F. 3-5/70 T.3 dt. 4th May 1970 of the Jt. Educational Adviser (T) has already initiated a programme in which an allowance of Rs. 150/- p.m. per student is made for a 12 month period for each sandwich course student. This has not been included

Items of Expenditure	Amount per annum Rs.	Total Rs.
SALARIES AND WAGES		
Principal (1)	18,000	
Professors (3)	45,000	
Assistant Professors (9)... ...	1,08,000	
Lecturers (12)	1,15,000	
Associate Lecturers (16)... ...	1,25,000	
Workshop Instructors/Demonstrators/ Lab. Assistants/Draftsmen/Lab. ... Technicians	60,000	
Office Staff (including P.A., ... Superintendent, Assistants)	50,000	
Skilled workers	35,000	
Unskilled workers, Attenders, ... Watch & Ward	32,000	
Librarian (1)	10,000	
Library Assistants (including an ... Assistant Librarian)	12,000	
Training & Placement Officer with ... an Assistant	20,000	
Physical Education Director ... (including attenders)	10,000	
Provision for Provident Fund etc. @ 6 1/4% ...	45,000	
Total Salaries and Wages		6,85,0
MAINTENANCE AND MATERIALS		
Library additions (Books and Journals)	25,000	
Equipment modernizing and replacement @ 5 % of capital value (approx.) ...	50,000	
Maintenance including workshop and ... laboratory consumables, materials and contingencies @ Rs. 300 per student	1,50,000	
Total Maintenance and Materials ...		2,25,0
Total Annual Recurring Expenditure ...		9,10,0
Annual Recurring Expenditure per student		Rs. 1,

In the case of larger polytechnics, provision must also be made for setting up a Guidance and Counselling Department as recommended in Chapter VII. The annual expenditure on this account will be of the order of Rs. 20,000/-.

13.0   PLAN OF ACTION

13.01   In this chapter, some of the lines on which
action needs to be taken for implementing the recommendations
of the Committee on the reorganisation and development of
polytechnic education are considered. Such action is
required at the planning, decision-making and implementation
levels involving not only the Central and State Governments
but also industry and, more importantly, the polytechnics
themselves.

13.1   Technician manpower estimates and surveys

13.11   It is observed that, notwithstanding the
provisions made in the Second and Third Five Year Plans,
for such quality improvement programmes as increased
hostels, staff quarters and teacher training and refresher
courses, the demand for more institutions and additional
admission capacity in polytechnics has had a higher
priority in the Annual Plans of the State Governments,
often at the cost of the much-needed improvement and
consolidation of polytechnic education.

13.12   The Committee noted in this context that, according
to some recent estimates, made by the Institute of Applied
Manpower Research, of the probable demand for technicians
during the Fourth and Fifth plans, the overall facilities
at present created in the polytechnics would, by and large,

what is required is the careful planning of speciality-wise

admission taking into account the nature and type of

technician requirements in local industries. The Committee

is of the considered view that, at least for the next five

years, there is no need to start any new polytechnic. The

existing intake capacity in polytechnics is adequate to

meet the demands for technicians in the next three years.

Thereafter the position may be reviewed and the intake may

be changed to meet the actual needs. Meanwhile, concentrated

attention has to be given to the question of reorganisation

and modernisation of the existing polytechnics.

13.13   Efforts should be made immediately to make

reliable estimates of the demand for technicians for the

Fifth and Sixth Plan periods. These need to be undertaken

at least on a regional basis, if not by the States, and in

terms of the different types of technicians, branches of

engineering and specialisation and their distribution

according to industry, commercial organisations, public

utilities and other sectors of employment. The Central

Government should sponsor these studies to be undertaken

by institutes like the Institute of Applied Manpower Research

in collaboration with industry and the State Governments.

13.14   In addition to this, it is necessary that the speciality-wise assessment of technician demand including the analysis of occupations should become a continuous activity so that technician education may at all times be geared to meet the changing technician manpower needs and the changing requirements of technician jobs. The Committee has therefore recommended the setting up of special units in the Directorates or Departments in charge of technical education in the States. At the Centre, this should be one of the responsibilities of a separate unit in the technical division of the Ministry of Education in its function as the Secretariat of the proposed Committee on Technician Education and Training

13.15   In this context, the Committee reiterates a suggestion made by the Education Commission that investigations should be carried out in cooperation with industry, aimed at job analysis and specifications in terms of levels and clusters of skills and responsibilities for technicians. It is learnt that the All India Manufacturers' Organization is sponsoring a comprehensive survey in this regard to be undertaken jointly by the National Institute for Training in Industrial Engineering and the Institute of Applied Manpower Research. The Committee wlecomes this survey and recommends that is should become a regular feature.

13.2   Reorganisation of existing polytechnics

13.21   The main emphasis of this report is upon the
need to coordinate the educational programmes in polytechnics
with such training in industry as would help to turn out
technicians who will meet the actual manpower needs of
industry. For this purpose, a number of recommendations
have been made for (a) modernisation of the curricula for
conventional courses; (b) reorientation of courses in
relation to newer fields of activity in rural areas,
non-industrial urban areas and industrial areas, depending
upon the location of polytechnics; (c) introduction of
courses related to technician level occupations in commerce,
business and other fields; (d) introduction of special
courses in Women's polytechnics; (e) introduction of
diversified courses wherever possible; (f) organisation of
sandwich courses in cooperation with industry; and (g) provison
of suitable programmes for skilled craftsmen and
technicians working in industry to equip them better for
their present as well as future work. Recommendations have
also been made for changes in the structure of staffing the
departments, the addition of training and placement, and
quidance and counselling, services in the polytechnics and
improvement in the existing methods of learning and teaching
processes including better campus and library facilities.
It is suggested that these recommendations be studied by
all the individual polytechnics and adapted into an
integrated plan of development of the concerned polytechnic.

This would require an acceptance, by all concerned, of the need for planning at the institutional level and for strengthening the institutions to undertake this function efficiently and with competence.

13.22   It is not the idea of the Committee that this effort on the part of the individual institutions will substitute the need for action at the State and the National levels. On the other hand, the strengthening of development planning at the level of an institution, which is strongly recommended, will supplement the data-base for policy formulation by the appropriate agencies in the State and Central Governments.

13.23   In formulating development plans, the polytechnics should be "outward-looking" to take note of the actual needs of the community they serve; in that process, they would also be "forward-looking" in as much as their plans would be related not only to the current situation situations but also to future trends. The proposals in this regard by Principals and senior faculty members of polytechnics should receive careful consideration and support from the Government and the industry.

13.3   Autonomous institutions

13.31   The Committee has also given sufficient thought to the question as to how the necessary momentum can be generated within the technician education system, in order to make it dynamic and alive to the changing requirements of industry and the changing methods and concepts of education. In our country of vast dimensions, with varying levels of economic and industrial development and diverse sociocultural patterns, it is neither possible nor necessary to aim at total uniformity in our approach to the development of technician education. Furthermore, the Committee is of the view that innovations and experimentation should be sponsored, promoted and encouraged keeping in view the limited financial resources likely to be available for the purpose. This should initially be done in selected polytechnics which, in due course, would set the pace and direction for all the other institutions. Such institutions should be accorded sufficient flexibility and freedom without being hampered by routine regulations aiming at uniformity at the 'average' level.

13.32   It has accordingly been recommended that

about 25 polytechnics (comprising at least one and not more

than two polytechnics in each State or Union Territory)

should immediately be selected and developed into autonomous

institutions with sufficient administrative authority,

academic freedom and flexibility and financial resources

so that they may initiate worthwhile experimental projects

in the field of technician education.   These projects should

include the identification of technician areas, design of

new courses of study and training, organisation of suitable

types of programmes in association with industry, formulation

of rational curricula and teaching methods and aids, and

development of better systems of assessment and evaluation.

13.33   These institutions should be selected from those

which maintain high academic standards and competence and are

located conveniently close to industries and establishments

which are most forward-thinking in technical development and

professional training.

13.34   Each selected polytechnic should prepare a detailed

plan of its development projects and evaluate the progress

periodically in consultation with the State Government concerned,

professional bodies, industry and the Regional Committees of the

All India Council for Technical Education.

13.35   It is recommended that the State Governments should endeavour to develop all the existing polytechnics into autonomous institutions during the next 10 years.

13.4   State Council of Technical Awards (SCTA)

13.41   In order to facilitate the rapid and effective reorganisation of educational programmes through the flexibility and freedom of polytechnics to experiment with new courses, patterns, new methods of course organisation, evaluation and assessment and at the same time to set and maintain high standards in accordance with national requirements, it has been recommended that an autonomous and independent body to be called the State Council of Technical Awards should be set up in each State. The State Governments may determine the manner and method of setting up the State Council of Technical Awards and specify its relationship to the State Board of Technical Education.

13.42   The SCTA should be assigned the responsibility to look after all academic aspects of technician education in polytechnics in the State. Besides guiding the autonomous polytechnics and evaluating their progress, the Council would assist all the other polytechnics in the State to frame new courses and provide guidance in respect of the maintenance of standards of instruction and the reform of examinations. The Council would advise the Government on the selection of polytechnics for autonomy, and also on measures to develop all polytechnics towards the attainment of high standards of facilities, faculty and performance.

13.43   The Committee has recommended that sleected polytechnics should in due course be authorized to conduct part-time degree courses for techniclans. Such a measure would contribute to enhance the status of polytechnics, their teachers and the technicians. The SCTA could play a valuable role in fostering the development of polytechnics along these lines, by becoming, in due course, important organisations for the award of degrees and diplomas for students of post-matric education, higher education and polytechnics.

13.5   **Committee on Technician Education and Training**

13.51   If the proposals of reorganisation of polytechnic education are to be implemented speedily and effectively, the administrative and advisory machinery at the Centre and in the States need to be geared up. The Committee has therefore recommended that a Committee on Technician Education and Training should be consti tuted under the auspices of the All India Council for Technical Education to advise the Council on all matters relating to the coordination and development of technician education in the polytechnics.

The functions of the Committee would be:

(i)   to plan and keep under review the development of a unified national pattern of education for technicians in industry, commerce and other services, and

(ii)   to advise the All India Council for Technical Education on the establishment and development of suitable courses and the assessment of standards of performance

13.52   The proposed Committee may be constituted with about 15 to 20 persons drawn from those interested in technician education, experts from industry and commerce and representatives of professional bodies. In order to give efficient secretariat help to the Committee, a separate unit may be created in the Ministry of Education.

13.6   A crash programme of teacher training

13.61   The Committee is convinced that the success of implementation of its recommendations regarding qualitative improvement of polytechnic education depends to a large extent upon the responsiveness of the faculty to such programmes. In particular, it refers to the need to bring about a practical orientation of polytechnic teaching, to adopt modern methods of instruction based on live problems of the industry, and to develop in the faculty appropriate skills of communication and teaching.

13.62   In order to start the process of improvement of the quality of polytechnic education in a comprehensive manner, it is recommended that a crash programme be formulated by the State Government, preferably in consultation with the State Council of Technical Awards, to cover at least 25 per cent of the teaching staff during the next three years. This should aim specifically at (a) training teachers on such aspects of polytechnic education as evaluation and assessment, curriculum development, industrial orientation to teaching and reorganisation of laboratory programmes, (b) providing them with training in industry for a period of about 3 months so as to help link class-room instruction with the practical needs of

industry with particular reference to problems of design, process and production control, selection and use of machine tools and manufacturing processes: (c) improving the art of teaching for effective transfer of knowledge and skills and (d) training workshop instructors in the technique of imparting manipulative skills.

13.63   Such a crash programme is required not only for the selected autonomous polytechnics but also for all other polytechnics.   The programme should be implemented in close cooperation with industry, Technical Teacher Training Institutes and other training and educational agencies under the universities and the Directorate General of Employment and Training.

13.64   The State Governments should prepare, in consultation with the SCTA, a perspective plan of faculty development by assessing (a) the number of teachers to be selected annually for training in industry, for updating of subject-knowledge and for education in teaching principles and techniques; (b) the levels and categories. of such teachers; (c) the types and places of such training; (d) the provision for a training reserve in the staff structure; and (e) the financial implications of such a programme. During the next ten-year period all the faculty members in polytechnics should have completed a programme of professional training, based upon the type of technician courses offered and the personal needs of the

13.65   Closely related to the above suggestion for faculty-development is the preparation of laboratory projects, manuals, casebooks of problems, teaching aids etc., for polytechnics. The Committee has expressed its view elsewhere that the present practice of equipping laboratories according to a standard list should be discontinued. In its place there should be carefully prepared lists of equipment which would take into account the types of technician courses, the pattern of their organisation, viz. sandwich, part-time or full-time and the nature and kind of educational situations to be provided in the different laboratories. The autonomous polytechnics, which have been recommended, should take up this work on a high priority basis with such guidance and help as will be available from the State Council for Technical Awards, industry, professional bodies like the Indian Society for Te Technical Education and the Institution of Engineers (India) and the Technical Teacher Training Institutes.

13.7   Technical Teacher Training Institutes

13.71   It is noted that these Institutes are presently in a process of establishment and that it would take some more years before they are in a position to provide their servicing facilities to all polytechnics in the concerned regions. In devising their programme of work for the immediate future these Institutes should attempt to coordinate their work to supplement the proposed activities of the autonomous polytech so that the thrust for modernising polytechnic educ generated on wider front.

13.72   One way of ensuring this would be for these Institutes
to associate in their academic bodies the principals and senior
members of the faculty of selected polytechnics. It is
desirable that the principals of the Central Craft Teachers
Training Institutes (CCTTI) should also be associated. The
Technical Teacher Training Institutes should establish a
continuous and intimate dialogue with the polytechnics with
regard to their programmes. It is understood that one Institute
has already initiated an extension service to all the poly-
technics located in its region. This programme should be
commended to all the Institutes. The Committee also hopes
that the polytechnics will use the facilities in these
Institutes for a variety of educational purposes and not merely
to depute their faculty for conventional training courses.

13.73   A suggestion has been made to the Committee that
admission to polytechnics should be based on aptitude tests.
The Committee was also told that efforts are being made by
the Directorate General of Employment and Training and the
National Council of Educational Research and Training to
evolve and validate tests which would be "culture-free"
and a suitable for students irrespective of their rural/
urban background or socio-economic status. The Committee
recommends that the Technical Teacher Training Institutes
should take up this work in collaboration with other
concerned agencies and develop batteries of tests suited to
the specific requirements of technician education and training.

Training in Industry

13.81   The proposals for initiating action for training
in industry of faculty and of students have been made earlier.
In order to facilitate quick progress in this direction,
it is suggested that each establishment in industry,
commerce and public utilities should immediately set up
a separate unit for developing liaison with polytechnics and
help them formulate, implement, supervise and evaluate
specific training in industry.   Their training officer will
also associate himself with the design of the institutional
part of technician education.

13.82   Some of the other proposals of the Committee
in connection with augmenting training facilities for
students are:

(i) Setting up of Production-cum-Training centres
at places where two or more polytechnics
are situated in order to provide practical training
to the students of these polytechnics as well as
to the students of other polytechnics in rural and
non-industrial areas.

(ii) Establishing closer links between polytechnics
and Industrial Training Institutes.

(iii) Setting up Industrial Training Institutes in
the proximity of polytechnics in non-
industrial urban and rural areas.

(iv) Setting up of Training and Placement

13.9   Library services and text books

13.91   In the reorganised set up of polytechnic education, the

aim is to modernise the educational process through, among others,

an increasing emphasis on developing attitudes and motivations to

learning.   Consequently, the Committee attaches considerable

importance to the provision of better library facilities and to an

extensive system of self-study and home assignments.   In order

to implement this recommendation, it is necessary to view the role

of library as an effective medium of education and to ensure

sufficient support to the development of well-stocked, well-staffed

and attractive libraries in all polytechnics.

13.92   An equally significant recommendation the

Committee makes is about text-books and course materials

for technician education.   It draws pointed attention to

the present deficiencies in this regard, e.g. the

non-availability of suitable text-books which are intelligible

to the average student with the current socio-cultural

background, adapted to local technology and engineering

practices and sold at a price the students can afford.

It is also the Committee's view that more and more

text-books should be written by the teachers in the

polytechnics themselves, using case materials and

examples from the Indian situations.   With the training

of teachers in industry, which is recommended as a

pre-requisite for polytechnic faculty, the teachers would

be in a better position to prepare text-books suited to

our polytechnic students.   In this connection, the

should immediately formulate a scheme to give encouragement and incentives to practising teachers and professionals to write standard text-books for technician courses and to print and publish them at reasonably low prices.

13.93   The Committee hopes that the services of the Indian Society for Technical Education, the proposed State Council of Technical Awards and the Technical Teacher Training Institutes will also be available for the programme of book production.

13.10   A blue-print of action

13.10.1   The report covers a wide range of subjects relating to polytechnic education and training in which industry, polytechnics and government are partners. The success and effectiveness of its implementation therefore depends on the simultaneity, timeliness and speed with which each of these agencies initiates action.

SUMMARY OF RECOMMENDATIONS

Chapter II : A review of the development of polytechnic education

1. Polytechnic education should be coordinated with the state of industrial and commercial development and the economic resources of the country as a whole.

2. Over the next 10 years, higher priority in technician education development should be accorded to the qualitative improvement of courses and consolidation of existing institutions rather than to quanti..tive expansion.

3. At least for the next five years, there would be no need to consider the establishment of new polytechnics. As for the intake capacity of existing polytechnics, the position may be reviewed after three years and any changes necessary may be made so as to meet the actual needs.

4. Efforts should be made to prepare realistic estimates of the demand for technicians for the fifth and subsequent plans, region-wise and by specialities and types of technician functions in industry, commerce, services and public utilities, so that appropriate programmes of educational development could be formulated and included in the Fifth Five Year Plan.

Chapter III : Concept of technician and his education

5. In Industrial organisations there is a broad spectrum of occupations lying between the craftsmen at the one end and the professional engineer at the other. Within this spectrum there are wide differences, both in specialities and degrees of expertise, which must be taken into account when planning educational and training programmes, but the whole band represents a separate and distinct group of people, who can be classified as technicians whatever their specific functions may be. Polytechnics, in association with industry and business, should have the responsibility of educating and training persons for technician functions.

6. The purpose of polytechnic education is to lay the foundation for the future technicians and for the persons who play a comparable role in business and commercial activities by way of a sound, broad-based theoretical knowledge of the chosen field that helps them to understand the basic principles underlying their activities together with training in the actual practice thereof.

7.   Technician education should not lose sight of the human and social aspects of the work and life of technicians. The confidence and competence needed for self-employment should also be developed.

8.   Programmes of technician education and training should be properly drawn up in an integrated manner with the cooperation of industry.

Chapter V : Reorganisation of Polytechnic education

9.   The major concern of polytechnics should be to run regular diploma courses designed to meet the educational requirements of the technician positions near the professional level. At the same time, it should be the endeavour of poly-technics to extend their institutional facilities to cater to the needs of the other category of technician positions by organising a variety of short-term and/or part-time courses for technicians and craftsmen in service.

10.   Apart from these courses, polytechnics should organise special refresher and retraining courses as well as advanced diploma courses for technicians already employed.

11.   Certain selected polytechnics should be authorised to offer part-time degree courses.

12.   Part-time diploma courses should be started at the initiative and with the cooperation of industry in selected subject fields so as to benefit a large number of skilled persons working in the local industrial and business firms.

13.   Within the broad framework of certain general guidelines as regards the standards, objectives and scope of technician courses, there should be a great deal of flexibility in course planning to permit local variations in their structure, contents and organisation.

14.   Where two or more polytechnics are situated in a centre, coordination should be brought about in order that they may avoid duplicating their efforts in the kinds of courses they offer.

15.   Technician courses should aim to prepare the student for entrance into a technician function and at the same time facilitate mobility and future occupational advancement.

16.   At present, narrow specialization should not be the aim of technician courses at the first diploma level. The courses should be designed to be broad-based with provision for diversification.

Diversified courses should be started in those institutions where the need for such courses is fully established and may be introduced, in the initial stages, by means of elective subjects within the broad-based diploma courses.

18. In order to correlate the polytechnic educational programmes with the diverse needs of technicians from time to time, well-organised units should be set up in the departments in charge of technical education at the Centre and in the States for the estimation of future **technician** needs, **speciality-wise** on the basis of analysis of occupations.

19. A technician who emerges from a diploma course should be in a position to tackle most jobs that he may be confronted with. Hence there is need for planning education and training programmes on the basis of analysis of occupations by functions. However, the education should look beyond the boundaries of such occupation-analysis because, in developing countries like India, the technician may have to deal with activities related to, but not necessarily part of his basic functions.

20. Sandwich courses should be started only after specific study in depth about the adequacy of the industrial cooperation available at any proposed location. They should be so organised that the industrial training is effectively supervised, coordinated and evaluated by the polytechnics and the industry.

21. Educational programmes in engineering fields should be given a design and production orientation appropriate to the level of technician functions.

22. Polytechnics should also offer courses in fields such as commerce, business administration etc. which are closely related to industrial activities.

23. A variety of courses suitable to the temperament and special aptitudes of girls should be organised in Girls Polytechnics. In particular, diploma courses in Home Science and Home Economics options should be introduced in all Girls' Polytechnics.

24. In respect of polytechnics situated in non-industrial areas, a careful study may be made of the types of courses required for those regions and in the light of such study suitable courses may be organised. However, these institutions may concentrate on offering generalised courses. Efforts should be made to set up Industrial Training Institutes in their vicinity to stimulate their growth.

2 . Polytechnics in rural areas may offer courses in agricultural engineering and courses applicable to agro-industries. In such areas, the possibility of setting up Industrial Training Institutes in the proximity of the polytechnics may be considered with a view to augment the training facilities for students.

26. The duration of polytechnic courses should be determined with reference to the nature and requirements of each course. The following normal durations are recommended :

  i. Full time institutional courses at first diploma level : 3 years.
  ii. Full time Sandwich courses at first diploma level : 3 1/2 years.
  iii. Part-time evening courses at first diploma level : not exceeding 4 years (Actual duration should be governed by the subject unit requirements).
  iv. Advanced diploma courses : one year.
  v. Short term and special courses : Duration should depend on the subject matter requirements of the course.

27. The minimum academic qualification for admission to a course at the first diploma level should be a pass in the Pre-University course or Higher Secondary course or its equivalent. Students who have passed only the SSLC or matriculation should undergo successfully a preparatory technical course of one year in the polytechnics.

28. The curriculum of technician courses should be based on a clear definition of the objectives of each course - both the specific objectives of technician specialities and the general objectives of technician education.

29. The curriculum should be flexible enough to permit addition or deletion of subjects and alteration in their levels depending upon the pre-entry preparation, the varying needs of industry and the direction of technological changes.

30. The syllabi of polytechnic courses should be regularly reviewed and revised to meet the changing requirements.

31. Syllabi should not merely specify the topics but should indicate the depth of their treatment.

32. Whenever changes are to be effected in the curriculum, it is desirable to take into account the views and suggestions of students.

33. Curricula should be designed to enable a study in depth of the subjects of specialisation and a broad coverage of other related subjects.

34. The study of basic sciences should be properly oriented to suit the needs of each course and should not only enable the student to understand and learn the technical subjects that follow but also lay the foundation for future adaptability and further studies. They should be taught as subjects interwoven into the other subjects.

35. The study of English language should be emphasized and developed as a tool of effective communication for technical purposes.

36. As and where relevant to the needs of technician courses, study, in appropriate depth, of topics from Industrial Organisation, Human Relations, Factory laws and Labour Laws, Materials Management, Industrial Hygiene, Industrial Safety and Concepts of Systems Engineering should be included.

37. Polytechnic education should develop in the students practical skills and the attitude to understand, appreciate and apply concepts to practical situations through carefully planned laboratory work, workshop practice and project work.

38. Practical work must form a substantial part of technician courses, particularly of the full-time regular courses. It should reflect similar work in industry, commerce or other field as closely as possible, within the limitations of institutional facilities.

39. Project work requiring design and/or fabrication should find an important place in the final year of the diploma programmes and in the advanced diploma courses. Project work must be based on real problems involving industrial/commercial practice and procedures.

40. Through co-curricular and extra curricular activities and seminars and project work, polytechnics should endeavour to develop in their students the confidence and competence needed for self-employment.

41. The main criteria in planning laboratory work and practical/field work should be (1) to further a clear understanding of the scientific principles taught, (2) to foster innovation and original thinking, (3) to help develop the ability in the creative use of knowledge and critical appraisal of test results, (4) to develop an appreciation of, and a facility in, the use of the experimental approach to problem solving and (5) to encourage the fabrication and assembly of simple types of instruments and scientific apparatus and set-ups.

42.   The main objective of workshop practice should be to give the basic training so as to lay the foundation for later shop-floor experience. Workshop practice should aim at helping students to understand, apply and use the basic principles, skills, tools and processes.

43.   The equipping of laboratories and workshops should be governed by a careful consideration of the needs of the courses, the teaching approach of the polytechnics and the availability of equipments in collaborating industry and the Industrial Training Institutes situated in the neighbourhood.

44.   The present practice of rigidly following "Standard" lists of equipment should be discontinued, although they could serve as guides of minimum requirements. Each polytechnic should determine the requirements of laboratory and workshop equipment, having regard to the nature of the courses offered from time to time.

45.   Provision should be made for appointing competent laboratory technicians in each laboratory for the proper maintenance and upkeep of laboratories and equipment.

46.   The faculty of polytechnics should be encouraged to develop and fabricate items of laboratory equipment needed for the courses. Deserving proposals in this regard should receive financial support.

47.   Technical Teacher Training Institutes should collect details of equipment devised and fabricated by polytechnics and circulate the details to all polytechnics in the country.

48.   In addition to the regular teaching methods, the more modern and effective methods including the tutorial method, the problem-solving method, the project-method and seminar method should be used in polytechnics.

49.   Wherever possible, lectures should be supplemented by audio-visual aids such as slides, film-strips, blow-ups, charts, films, class room demonstration models and instruction sheets.

50.   A concentrated effort is required to develop teaching aids. Polytechnics should be provided with audio-visual equipment such as over-head projectors, film and slide projectors, epidioscopes etc.

51.   Technical Teacher Training Institutes should develop and produce proto-types of all kinds of teaching aids. They should also keep in touch with polytechnics, other institutions and firms engaged in the development and production of teaching aids and disseminate information about them to all polytechnics in the country.

52.   Case-studies of actual industrial and field problems should be collected by teachers for use in the class-room. The Technical Teacher Training Institutes should compile these problems and bring out case-books and catalogues of case-studies. These should be made available to all polytechnics.

53.   Incentives should be provided to teachers and experienced persons in industry to write text books and other supplementary course materials suitable for the different courses and publish them at reasonably low prices.

54.   Text books in use should be scrutinised from time to time and brought uptodate.

55.   The use of the library by teachers and students for reference, information and self-development must be encouraged and fostered. The teaching should be so organised as to require and encourage a great deal of self-study and use of library facilities by the students.

56.   All polytechnics should have well-stocked, well-staffed and attractive libraries, with reading room facilities for at least 10% of the student body. Necessary provision should be made for creating and maintaining adequate library facilities and services and for the periodic addition of books and journals.

57.   The library should be in the charge of a well-qualified, competent and well-paid librarian with adequate staff to assist him. The librarian should be given a grade at least equal to that of a Lecturer and granted the status of the Head of Department.

58.   Separate text-book libraries should be set up in the polytechnics and, if possible, in the Halls of Residence, for the benefit of students.

59.   For the proper development and growth of technician education and its improvement in quality, autonomy for polytechnics is essential. Polytechnics should have complete freedom to experiment with much-needed reforms, restructure their courses, establish cooperative relationships with industry in their region in training and employing technicians, develop the new curricula suited for such courses, evolve their own methodology for education and training, and assess and evaluate their students.

60.   A beginning must be made by selecting at least one, but not more than two, polytechnics in each State and Union Territory for the immediate grant of autonomy. These polytechnics must be selected on the basis of the sustained excellence of their standards, facilities, faculty and performance. Based on the experience gained with the working of the autonomous polytechnics initially selected, other polytechnics must be given such freedom

as and when they are ripe enough to take up such responsibilities. For this purpose, the polytechnics must be assisted to attain the required standards and levels, through a phased programme of development over the next 10 years.

61.   In addition to academic freedom, the autonomous polytechnics must be provided with necessary administrative authority and financial resources.

62.   To plan and implement the development programmes on the right lines, each autonomous polytechnic should have a Governing Council and an Academic Board.

63.   The Governing Council of an autonomous polytechnic will be responsible to guide and control the planning, development and administration of the polytechnic and should consist of teachers, representatives of the State Council of Technical Awards (recommended later), the State Board of Technical Education, the All India Council for Technical Education and the State and Central Governments. The principal of the polytechnic should be the member-secretary of the Council.

64.   The Academic Board of an autonomous polytechnic will deal with such matters as assessment and evaluation, course development, relations with industry, research, and other academic matters. The proposals of the Academic Board should be placed before the Governing Council for ratification. The Academic Board should consist of representatives of the faculty, experts from industry and eminent educationists in the fields of technical and secondary education. The principal of the polytechnic should be the chairman of the Board.

65.   A State Council of Technical Awards (SCTA) should be set up in each State as an independent and autonomous organisation to co-ordinate and safeguard the necessary standards with respect to technician education and to award diplomas.

66.   In respect of the autonomous polytechnics, the SCTA should set and assess standards not by framing and imposing courses and curricula and conducting examinations, but by inspecting and approving the institutions, scrutinizing and approving new courses and curricula, and schemes of assessment and evaluation, framed by the polytechnics themselves.

67.   The SCTA will lay down the standards by way of facilities and faculty and the general guidelines and requirements for courses.

68.   In respect of the non-autonomous polytechnics, the SCTA should help them to frame and improve their courses and curricula, conduct the external examinations and suggest the methods of internal assessment.

69. The SCTA should assist the non-autonomous polytechnics to develop the standards of facilities, performance and expertise needed to gain autonomy.

70. The State Government should determine the manner and method of setting up the SCTA and specify its relationship to the State Board of Technical Education. The SCTA should consist of representatives of industry, trade and commerce, technical experts from government departments, representatives of the professional bodies, progressive educationists, polytechnic and college teachers and principals etc.

Chapter VI : Faculty

71. The normal pattern of teaching staff categories in a polytechnic should be as follows :

> Professor or Head of the Department;
> Assistant Professor; and
> Lecturer/Associate Lecturer.

The ratio between senior positions and junior positions i.e. Professors/Assistant Professors and Lecturers/Associate Lecturers should be of the order of 1 : 2.

72. The teacher-student ratio should be not less than 1 : 10. In counting this ratio, only teaching posts of Associate Lecturers and above should be taken into account.

73. For every diversified course in an institution, at least one professor assisted by an assistant professor or lecturer should be provided, supplemented by part-time lecturers from industry.

74. Principals and Heads of Departments of polytechnics should be provided with suitable administrative staff. Provision should be made for clerical and laboratory assistance to teachers.

75. The designations and scales of pay of teaching posts in polytechnics should be the same as in engineering colleges.

76. The minimum qualification for the post of Associate Lecturer should be a degree in engineering or technology with at least two years of industrial experience. However, a diploma holder with not less than 5 years of industrial experience may be considered subject to his suitability to teaching and improvement of his academic background.

77. The minimum qualification for posts of Lecturers and above should be a degree in engineering or technology, or AMIE, with at least 3 years of industrial experience or a TTTI diploma with five years of industrial experience.

78. For teachers of other professional courses like commerce and business, the minimum qualification should be a degree in the appropriate field with 2 years of professional experience in the relevant field.

79. For teachers in science, humanities and arts, a post-graduate degree is essential, preference being given to persons with industrial experience.

80. Training of at least one year in the art and techniques of teaching is desirable for all polytechnic teachers.

81. All teachers of similar categories whether in engineering, business and commerce, or humanities, arts and science should be allowed the same scales of pay and benefits.

82. For all teachers from the Associate Lecturer to the Assistant Professor, there should be a composite scale of pay with suitable starting stage for each category.

83. In view of the industry/application orientation of teaching in polytechnics, the practice of transferring teachers between polytechnics and arts and science colleges, wherever it exists, should be discontinued.

84. Suitable incentives should be provided for teachers to improve their academic qualifications and gain experience.

85. Teachers deputed for training etc. should be paid their full salary in addition to travelling and other allowances and stipends.

86. Subject to certain conditions, polytechnic teachers should be given the freedom to take up consultancy work.

87. Polytechnic teachers may be allowed to take sabbatical leave to pursue research or undertake writing of books or to work in other institutions or industry.

88. Industry must be willing to accept, encourage and assist the transfer of experienced staff to part-time and full-time teaching work. There must be a much greater interchange of staff between industry and polytechnics.

89. Opportunities should be made available to teachers for acquiring the needed industrial experience, training in the art and techniques of technical teaching and higher academic qualifications through seminars, short term courses of various kinds, summer institutes, in-service training programmes, deputation to Teacher Training Institutes during vacation or during the academic year and secondment to industries. Teachers must be required to attend such courses and acquire such training several times during their career to facilitate continuous development and to remain uptodate in their

90.   Specially designed short-term courses should be organised for providing industrial training to workshop instructors. The cooperation of the Central Training Institutes should be secured for providing training to workshop instructors of polytechnics in respect of skill ution.

91.   A crash programme should be implemented for retraining at least 25 percent of the existing polytechnic teachers within a period of two years. The programme should consist of several courses of short duration on such subjects as assessment and evaluation techniques, curriculum development, laboratory work and industrial orientation in teaching.

92.   This crash programme should be followed by a second stage of comprehensive industrial training especially for teachers in certain subjects which are highly practice-oriented or industry-oriented.

93.   A third stage of training of longer duration should cover training in communication skills.

94.   A crash programme should be organised at selected centres in India for Principals of polytechnics to familiarize them with the different aspects of polytechnic education and management and its reorganisation as recommended in this Report.

95.   Teachers of languages, mathematics and the physical sciences should be given special orientation courses in the application-based teaching of these subjects.

96.   Each State should (a) assess the total number of teachers to be trained annually in the first ten years, (b) indicate the type of training programme relevant to Instructors, Associate Lecturers, Lecturers and Heads of Departments to be planned for, (c) work out financial estimates and (d) implement phased programmes of training.

97.   The main functions of the Technical Teacher Training Institutes should be :

    a)   Organising courses on the art and techniques of teaching and special subject-teaching courses.

    b)   Research and training on the methods of assessment, evaluation and grading.

    c)   Research and training in teaching methods and development and production of teaching aids, charts and publications.

    d)   Collecting and disseminating, to all polytechnics in the country, information on curricula, examination systems, equipments, teaching aids, technical

98.   Close liaison should be established and maintained between the Technical Teacher Training Institutes on the one hand and the principals and senior faculty members of polytechnics on the other.

99.   In order that the Technical Teacher Training Institutes could be successful and effective in their function of training polytechnic teachers, the TTTI's should maintain close relations with industry. The faculty of TTTI's should be encouraged to return periodically to polytechnic teaching and industry.

100.   TTTI's should organise short-term courses for lecturers and instructors on the fabrication and use of teaching aids.

101.   The Technical Teacher Training Institutes should concentrate their energy on the several aspects of teacher training rather than on organising post-graduate courses in subject specialisations.

Chapter VII : Students

102.   Information about technician courses and careers should be collected by the Directorates or Departments in charge of Technical Education and transmitted to the educational authorities concerned with institutions conducting pre-university or Higher Secondary courses for due circulation and publicity.

103.   While the performance in an aptitude test should be one of the criteria for admission to polytechnics, its wholesale adoption at the present stage is not favoured. However, a beginning should be made to develop some standard aptitude tests for admission to polytechnics.

104.   Admissions should be made by Polytechnics on the basis of merit. Some weightage may be given for participation in extra-curricular activities.

105.   Guidance and Counselling Services are essential in Polytechnics to give direction and purpose to the aspirations and activities of students and to assist them to make decisions and adjustments from time to time in respect of their academic, family, social and vocational - educational problems. To begin with, Guidance and Counselling Centres should be set up on an experimental basis, in the autonomous polytechnics. Depending on the experience, the scheme should be extended to cover all the other polytechnics in the course of the next 10 years.

106.   Each Guidance and Counselling Centre should have a Guidance and Counselling officer of the rank of a professor, assisted by suitable staff. The officer should be professionally qualified with adequate training in educational psychology and vocational guidance. The Centre will need to have library facilities and a testing laboratory for assessment and diagnosis of students' abilities and disabilities.

107.   Arrangements should be made in all polytechnics to provide hostel facilities for at least 50% of the students.

108.   Polytechnics should take interest not only in the time students spend in the campus but also in the time they spend outside the campus. Interest to do independent work and study, and in hobbies outside formal study hours, should be cultivated in the students. The required facilities for extra curricular activities such as sports, music, arts, histrionics etc. should be provided to develop and foster healthy community life. Student organisations and activities should be encouraged to enrich campus life.

Chapter VIII : Assessment and evaluation (Examinations)

109.   The assessment of a student should be continuous and should ultimately be the responsibility of the teachers themselves.

110.   The overall internal assessment of a student's performance and progress should take into account his achievements in assignments, periodical tests etc.

111.   An immediate and complete changeover to purely internal assessment, even though desirable, may not be feasible in all polytechnics in our present set up. Therefore, to begin with, in respect of the non-autonomous polytechnics, continuous internal assessment should be given equal weightage with the final external examination. Complete switchover to continuous internal assessment should be effected within a period of 10 years.

112.   The State Council of Technical Awards should continuously review the methods of assessment and evaluation in each polytechnic and suggest necessary improvements.

113.   Training courses in the methods of assessment, evaluation and grading should be arranged for teachers in the form of short training programmes, summer courses etc.

Chapter IX : Training and employment

114.   Basic training covering the basic skills should normally be provided by the polytechnics themselves. For this purpose, the workshop facilities in polytechnics should be strengthened. Wherever possible, closer links should be established between polytechnics and Industrial Training Institutes.

115.   Secondary training should be organised as practical training in industry and should have as its objective a broadening of technical knowledge and gaining of insight into some of the workings and problems of industry in general. In its later stages, the training should be more specifically related to the actual work on which the technician student will be engaged when he has completed his training.

116.   The training programme should introduce the potential technician to a variety of operational problems obtaining in the practice of his occupation, whether these relate to the selection of operational procedures manufacturing processes, machines, materials and methods, or to the ensuring of control of production sequences, quality and cost. It should also expose him to conditions of work involving, among other things, organisational procedure, group activities, human relations and production economics.

117.   The programme of practical training should be carefully drawn up by individual polytechnics in cooperation with the collaborating industrial units to suit the needs of each course and should be properly and jointly supervised by the institution and industry.

118.   Training must be properly assessed and evaluated. It should preferably have adequate weightage in the total evaluation. There is a need to devise adequate scientific methods to assess the results of training and evaluate the degree to which the objectives of training have been realized.

119.   It should be the endeavour of all concerned to make arrangements to provide well-organised and supervised practical training in industry for all students of diploma courses during vacations and/or after the completion of the courses.

120.   Production-cum-training centres may be set up at places wherever two or more polytechnics are situated. The facilities available at these centres should also be used for providing training during vacations or after the diploma courses. The centres could also provide practical training to students of polytechnics in rural areas where industries do not exist.

121. • Since several government departments, such as industries, labour and technical education, are administering several kinds of training programmes, an effective coordination of their efforts should be brought about.

122. A separate training and placement department should be set up in each polytechnic manned by an experienced training and placement officer of the rank of a professor with suitable assistance.

123. Training departments must be set up in all organisations offering training facilities manned by capable executives who could work in close collaboration with the principals/heads of departments and training officers of the polytechnics.

Chapter X : Partnership with industry and commerce

124. Industries should be fully involved in the planning and development of polytechnic education and in the training of diploma students at every stage.

125. At the national, regional and State levels, partnership must be strengthened. Industry must be adequately represented in the policy-making and coordinating bodies at these levels and must be closely associated with the proposed State Councils of Technical Awards and the autonomous polytechnics. At the unit level, conditions must be created which favour the close collaboration of industry in the implementation of the programmes of education and training.

126. Industries should be requested to extend their fullest cooperation in providing the much-needed industrial experience to polytechnic teachers either by short-term or long-term training or through other arrangements.

127. Industries in the neighbourhood of polytechnics must be encouraged to refer their research, development and production problems to the polytechnics. Industries may also support other research or development projects undertaken by polytechnics.

128. Experts from industry should be invited to discuss some typical problems of the shop-floor and explain through special lectures and seminars how they are solved. They may also provide the polytechnics with technical information and details of their design, development and production activities.

Chapter XI : Status and professional development of technicians

129.   There should be a rationalization of the manpower structure and a clear identification of technician functions in industry and commerce. Technicians must be accorded a recognisable career structure adequately reflecting the importance of their position. Formal technician qualifications should be insisted upon for recruitment.

130.   Polytechnics should organise a variety of updating, refresher and extension courses including short-term and advanced-diploma courses and part-time degree courses for technicians in service. Through these courses, technicians should be enabled to qualify for higher positions and promotions.

131.   The image of polytechnics as centres of career education should be developed. For this purpose, polytechnics should have the flexibility and freedom to develop in new directions and explore new horizons.

132.   Technicians should have an organised forum for discussing common problems and articulating their needs and aspirations.

133.   The Government should take the initiative in persuading the professional bodies and other organisations and associations concerned with technical education, training, industrial and commercial interests etc. to set up technician sections/technician education and training sub-committees etc. The teachers of poly-technics should also be involved in these sections and sub-committees.

Chapter XII : Administration, finance, control and inspection

134.   While a strong national policy on technician education and training is necessary, such a policy should be flexible enough to permit modification according to the peculiar regional or local needs with reference to the type and level of technicians.

135.   The responsibility for the administration and control of technician education should be shared appropriately by bodies at the Central, Regional, State and Unit levels. The responsibilities at each administrative level should be properly defined.

136.   A separate Committee on Technician Education and Training should be constituted under the auspices of the All India Council for Technical Education to deal with all aspects of technician education and training at the national level.

137.　　In order to give efficient secretariat help to the proposed Committee on Technician Education and Training, a separate unit may be created in the Ministry of Education.

138.　　The regional committees of the AICTE and the regional organisations of the Central Government may have to be reorganised.

139.　　Detailed studies of manpower demands in the State, training in industry, programmes of development, teacher development, and administration of polytechnics with respect to financial control and coordination at State level, should be the direct responsibility of the State Government so that programmes and schemes may be effectively implemented.

140.　　A State Council of Technical Awards (SCTA) should be set up in each State.

141.　　There should be adequate delegation of administrative authority and financial power to the Heads of Polytechnics to function efficiently.

142.　　As regards the financing of polytechnic education, the Government has to take the major responsibility both at the Central and State levels but industry should also be a party to the financing as it directly benefits from it.

143.　　So far as new experiments and innovations in technician education are concerned, the Central Government should take the entire financial responsibility by sponsoring pilot projects and other programmes.
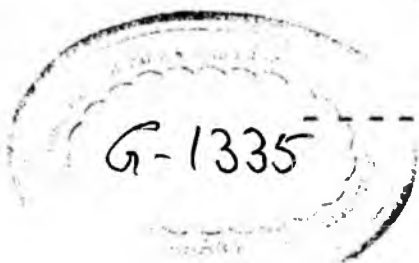
144.　　At the National level, adequate provision should be made for the evaluation of the entire system to ensure that the money spent is effectively and properly utilised and that proper standards are maintained with regard to the overall national needs.

145.　　The annual provision under contingencies, materials etc. should be raised to a minimum of Rs. 300/- per student against the present provision of Rs. 120/- to Rs. 150/-. The annual per capita recurring expenditure should be revised to a figure of Rs. 1700/- to Rs. 1800/-.