Education in the Commonwealth Series No. 12

A survey of Technician Training in Commonwealth Countries of Asia

Commonwealth Secretariariat

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FOREWORD

At the Fifth Commonwealth Education Conference held in Canberra in 1971 it was agreed that the Commonwealth Secretariat should study facilities in Commonwealth countries for the acquisition of practical experience in industry for students training to be technicians. For the developing countries in particular, the role of the technician and his education and training - both in educational institutions and in industrial and allied organizations - are vitally important. These countries are implementing massive programmes of industrialization with the aim of becoming increasingly self-sufficient in the manufacture of engineering and consumer goods, raising the productivity of agriculture, and building a society appropriate to their national, social and economic goals. To achieve this aim, the quality and quantity of the facilities available for the education and training of technicians must be satisfactory. For, as has been said elsewhere by Dr. L. S. Chandrakant, "In the final analysis, the pace and direction of the economic progress of developing countries will largely depend on how far they solve their technician problem."

In the past, considerable success has been achieved in providing practical experience in the developed countries, and thousands of overseas students have been able to make use of their facilities. However, the supply of training places has not equalled the demand, nor has this form of training always been the most relevant to the students' needs. More appropriate training may well emerge by means of co-operation among developing countries themselves, particularly on a regional basis, and it was with this in mind that the present survey was commissioned.

To carry out the survey, the Commonwealth Secretariat was very fortunate in obtaining the services of Mr. R. Dasgupta, Deputy Director of Technical Education for Madhya Pradesh, India. Besides having detailed knowledge of the situation in his own country, Mr. Dasgupta was able to visit Bangladesh, Sri Lanka, Malaysia, Hongkong and Singapore and see for himself the training facilities in existence there. The result has been a report of such interest and comprehensiveness that we are publishing it in our Education in the Commonwealth series where we believe that it will serve as an important source of reference not only to the countries included in the survey but to many other Commonwealth countries as well.

S. J. COOKEY
Director
Education Division
Commonwealth Secretariat

INTRODUCTION

The basic purpose of this enquiry, which arose from recommendations made at the Fifth Commonwealth Education Conference held in Canberra in 1971, was to consider the problem of providing practical training in industry and commerce for technicians and their equivalent, so as to determine its shape and characteristics and make suggestions as to how it might be alleviated. In carrying out that assignment I therefore focused my attention on three major topics, namely, training needs, training opportunities, and the suitability of the available training. For the first of these topics I concentrated on courses of education which require complementary practical training, and tried to build up pictures of the needs, in terms of subject and level, over the next two or three years, and to estimate the trends. For the second topic - training opportunities - I obtained as much information as I could about the facilities that were already available or could be created in the countries concerned, the factors influencing the provision of such facilities and, wherever it seemed appropriate, the opportunities for training students from other countries. For the third topic, I considered the value and relevance of the training provided.

I concentrated, as I was asked, on the education and training of technicians. This represents a new and encouraging activity for the developing countries of the Commonwealth, but not for the developed countries. It seemed necessary for me to adopt some sort of definition of the word "technician", but not to go to any great length to achieve precision. The Commonwealth Conference on the Education and Training of Technicians, held in Huddersfield in 1966, "deliberately rejected the temptation to attach a specific clear-cut meaning to the term 'technician' and accepted the impossibility of finding an acceptable definition." Nevertheless the Conference rightly "recognized that, through the whole range of industries and commerce, there is a broad spectrum of occupations lying between the craftsman, on the one hand, and the professional (or technologist) on the other; within this spectrum there are wide differences, both in subject interests and in degrees of expertise, which must be taken into account while planning educational and training programmes, but this whole band does represent a unique and distinguishable group of people who, whatever their specific functions, can be broadly classified as technicians." Equally to the point, Mr. (now Lord) Goronwy Roberts, then Minister of State, Department of Education and Science, U.K., in his closing speech to the Huddersfield conference, said: "It is essential that the technician be accorded a status of his own, that he feels himself to be a member of a body with an ethos of its own, a body of men - and women - who have wanted to become technicians rather than anything else, who have been selected as having the right qualities for a technician, who have had the education and training appropriate to a technician, and who are proud to bear the title 'technician'. One certain way of helping to achieve this status is to ensure that the relevant programmes of education and training are 'custom-built' for technicians, deriving neither from craft courses 'plus' nor from technologist courses 'minus'."

These, then, are the people who were the main subject of my survey. But I was asked to widen its scope to include some reference to the education and training of graduate engineers, if only because, for industry, this is part of the same picture in that some of the same resources and some of the same problems are involved. As a

result of my wide terms of reference, this report incorporates information on such matters as types of course (e.g. general, specialized, sandwich and post-qualification courses), on manpower assessment and planning, on measures taken to co-ordinate the activities of training organizations, on examinations and awards, and on gaps in resources, information, know-how, and experience. It also identifies shortcomings in the provision of technical education which tend to be common to all the countries of the region.

As Dr Cookey pointed out in his letter inviting me to carry out this project, one of the main drawbacks to technical education in developing countries is the theoretical nature of the curriculum so that graduates of technical schools are not always suitable for employment in industry. This is true. The end-products often lack any of the self-confidence needed to accomplish a job. They are not entrusted, even once throughout their entire course of study, with any technical problem. This leaves them high and dry. They are wanting acumen, and their approach to research and problem-solving is negative, therefore they are not readily accepted by industry and other major employers. What is, therefore, most desired is that technical education should be essentially linked with industry, production, design and construction work. This will enable them to learn about actual work situations and the manner in which various tasks are accomplished. The students will then have developed a degree of self-confidence and an insight into the intricacies of the employment market.

While conducting the survey I kept in mind the fact that some of the countries under review are industrially backward and a lot of work remains to be done towards proper exploitation of their natural resources. There is no lack of willingness on their part to link education with practical training in industry as an integral part of the courses of study, but there is a lack of industrial and economic development. At the end of my survey the belief that lack of practical training in the total process of education is circumstantial rather than intentional has only re-affirmed itself.

From my own experience in the administration of technical education and from my discussions with educational authorities in India and other countries, I know that the minds of educational planners, teachers and administrators are preoccupied with the immense difficulty of improving the pattern of technician training in the circumstances I have described. The immediate problems are: how to make the training more meaningful, constructive and practical; how to link education with gainful employment; and where to look for the resources which must ultimately throw open facilities for practical training as an integral part of technical education at any level. Because industry finds graduate engineers and technicians unsuitable or unable to put theory into practice and apply it gainfully, industrialists feel obliged to run their own training schools and programmes, thus diverting money, effort and resources which could have been invested in development and modernization. It is wrong for them to enter into educational territory and thereby overlap with and duplicate responsibilities which should rest with public technical institutions raised at great expense. This is a waste of national resources. I am not of course suggesting that industry should not train and re-train its staff to prepare them for sophisticated operations and modern machines.

I have been thinking over the problem, and although I was not asked to make formal recommendations, I have, in addition to comment made in the text and views already expressed, formulated the following suggestions which may be found useful in all the developing countries:

1. Sandwich programmes should be introduced for as high a proportion as possible of the admission capacity of technical and technological institutions. Industry in the vicinity should be encouraged to sponsor this proportion and so become automatically involved as an equal partner in the processes of course planning and theoretical as well as practical instruction. This is by far the most important method of linking technical education with practice. It also has the merit of inculcating the discipline

of the sponsoring organization. Long vacations should be used for practical training in industry at the end of each year, and short vacations can be used for project work.

2. Curriculum should be reviewed and renewed as a continuing activity by the authorities concerned, which should include Boards of Technical Education where they exist, degree and diploma awarding bodies, and the technical teacher training institution in the region. Courses should as far as possible be planned to provide for two or three connected specializations, these being carefully selected with due regard to the manpower requirements of the country. This can provide students with alternative openings to jobs without prejudicing the essential content of broad-based courses.

3. Industry should not be expected to provide more than its share of facilities and resources, but should be able to look to technical institutions and their teaching staffs for an important contribution. Teachers should visit industrial establishments regularly and apply their expertise and knowledge to live problems of product development, quality improvement, or design, and they should undertake consultancy work. Industry should in turn make available the services of their technical personnel to supervise the training and guide the project work of the students.

4. Amid the explosion of modern knowledge, the training of teachers in polytechnics and engineering colleges should be mounted as a continuing programme. These teachers should be encouraged to undertake postgraduate courses and/or research leading to doctoral degrees; the idea that higher theoretical studies for such teachers are useless must be discarded as obsolete, as it impedes both educational and economic development. Refresher and other short courses on special methods and other pedagogical topics should be arranged during long vacations, and 30-40% of the teaching staff, at a time, should be required to attend them, with compensatory leave or monetary benefits. Teachers should also be sent for short-term industrial training at intervals of two or three years, each time to a different industry, so as to learn actual work situations over a range of products and services.

5. No country can on its own keep pace with advances in science and technology. There should therefore be an exchange programme between the countries of the Commonwealth for technical teachers and industrial experts. The Commonwealth Secretariat could very well operate such a programme, in view of its central funding and co-ordinating role. Some of the exchanges should involve quite long stays in the host countries.

6. Each member country should have a "manpower cell" directed by a responsible senior person with a strong statistical background. In addition to conducting manpower surveys to establish requirements in terms of demand and supply, the cells should have the wider function of reviewing the scale and quality of training facilities, assessing needs for additional facilities, and determining whether the country has the capability for developing its own arrangements or needs external assistance. The cells in different countries should exchange information for their mutual benefit. Here again, Commonwealth Secretariat assistance would be appropriate.

7. The professional engineering bodies in the different countries should play an important part in the development of proper training facilities. They should communicate in a more meaningful way with technical institutions and with industry, and not confine themselves to conducting professional examinations but give real help with training. In this connection the role played by the Indian Society of Technical Education is commendable. A conference of the presidents of the main professional bodies in the various countries might well prove very useful in this connection.

Introduction

In conclusion, I should like to express my gratitude to the Commonwealth Secretariat for inviting me to undertake this assignment, and to all those individuals in government departments, educational and training institutions and related organizations, and in industry itself, who kindly assisted me with my enquiries. Without their assistance and co-operation, this report could never have been prepared.

BANGLADESH

PROGRAMMES OF TECHNICAL EDUCATION

For technical education, Bangladesh possesses the following educational institutions:

(a) Three engineering colleges, at Rajshahi, Chittagong and Khulna.

(b) A Technical Teachers' Training College at Dacca for imparting training and higher education to teachers for polytechnic institutes.

(c) 17 polytechnic institutes, one at each district town except Patuakhali and Tangail; a Swedish Bangladesh Institute of Technology in the district of Chittagong Hill Tracts, located at Kaptai; a Graphic Arts Institute at Dacca, and three monotechnics (Bangladesh Textile Institute, Bangladesh Leather Institute, and the Institute of Glass and Ceramics) all located at Dacca.

(d) A commercial institute at Dacca and 15 commercial sections attached to different polytechnic institutes.

(e) 35 vocational institutes at sub-divisional headquarters, and 13 second shift trade programmes attached to polytechnic institutes.

(f) A survey institute at Comilla.

(g) Bangladesh Educational Equipment Development Bureau at Dacca for the purpose of designing educational equipment for schools and colleges.

As there were only three polytechnics in 1961, it can be seen that the expansion of technical education has been considerable. Polytechnic education now reaches most parts of the country.

ENGINEERING COLLEGES - FIRST DEGREE IN ENGINEERING

The engineering colleges offer four-year courses of study leading to B.Sc. Engineering degrees in Civil Engineering, Mechanical Engineering, and Electrical Engineering.

Although these institutions are termed "colleges" they perform a university function by providing a four-year course (after Intermediate School) equivalent to a Master's Degree in other disciplines offered by different universities. The academic programmes are controlled by the Faculty of Engineering of the affiliating university.

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All the engineering colleges of the country form outer campuses of the Bangladesh University of Engineering and Technology. This step is expected to pave the way for harmonious growth of engineering education in the country.

Rajshahi Engineering College

Apart from the erstwhile Engineering College at Dacca which was ultimately upgraded to the present Bangladesh University of Engineering and Technology, the Engineering College at Rajshahi is the oldest, having been established in 1964.

Chittagong Engineering College

The Chittagong Engineering College was established in 1968 and is located about 20 miles from the main town. Though it started with 120 students, it now admits 180 students per year, and the total enrolment is 720. It suffers from a lack of workshop equipment, laboratory equipment, machine tools, etc, and the shortage of teachers is very acute.

Khulna Engineering College

This newly-established college, which is also located away from the main town, admits 131 students in the first year of the B.Sc. Engineering course. In addition, it admits about eleven students in the preparatory course for the polytechnic's diploma holders. The college is yet to be properly equipped in terms of teachers, equipment and physical facilities.

Technical Teachers' Training College

There is one technical teachers' training college in Bangladesh to provide training and higher education for teachers at polytechnic institutes. The college does not have a campus of its own and is located on the first floor of the Glass and Ceramic Institute. The College offers the following courses:

(a) A one-year course (diploma in technical education) after diploma in engineering.

(b) A two-year course (B.Sc. in technical education) after diploma in technical education.

The intake capacity of the college is 150 trainees a year (90 in the diploma programme and 60 in the degree programme). Training is offered in Civil Engineering, Mechanical Engineering, Power Engineering, Electrical Engineering, and Electronics Engineering.

There are two in-service programmes:

(a) Diploma in Technical Education

Duration:	1 year
Pre-requisite:	Diploma in Engineering
Examining body:	Bangladesh Technical Education Board, Dacca 2
Major employer:	Directorate of Technical Education, Bangladesh
Nature of job after training:	Mainly teaching at various polytechnic institutes of Bangladesh

(b) B.Sc. in Technical Education

Duration:	2 years
Pre-requisite:	Diploma in Technical Education
Examining body:	University of Dacca
Major employer:	Directorate of Technical Education, Bangladesh
Nature of job after training:	Mainly teaching and administrative jobs at various polytechnic institutes of Bangladesh

For the first of these courses, technical education subjects take up 35% of the time, and engineering and allied subjects, 65%. For the second, the proportions are 30% and 70% respectively.

POLYTECHNIC INSTITUTES IN BANGLADESH

At present there are 17 polytechnic institutes in Bangladesh having a total enrolment capacity of 3,300 in their first year classes. They offer three-year post-secondary Diploma in Engineering courses in the following technologies: civil, electrical, mechanical, power, radio-electronics, chemical, architecture, refrigeration and air conditioning, farm, automobile, machine shop, industrial wood, electrical machine, and food (this course is in the offing).

The first-year course comprises science, mathematics, drawing, shop, and management courses, offered in two semesters to all students. Specialized courses start in the second year and continue for two years in four semesters. To obtain the Diploma, students take a final examination in two parts under the Bangladesh Technical Education Board.

Diploma holders are frequently employed as sub-assistant engineers to perform work of a supervisory nature in engineering activities in government departments, autonomous bodies and private enterprise. They are also appointed as Junior Instructors (Technical) in polytechnic institutes.

A list of all Polytechnics and the courses run in them is given in Appendix 2, page 14.

MONOTECHNIC INSTITUTES

Bangladesh Institute of Glass and Ceramics

This Institute was established in 1951 under the Ministry of Commerce, Labour and Industries, and is located in the Tejgaon Industrial Area. It is the only institute of its type in Bangladesh. It offers a one-year artisan course in ceramic technology. The present enrolment of students is 25. The opening of a similar course in glass technology is under consideration. In addition to regular academic programmes, the Institute provides testing and production facilities for allied industries.

Bangladesh Textile Institute

Established in 1950 under the Ministry of Commerce, Labour and Industries, this, too, is the only institute of its type in Bangladesh. It is located in the Tejgaon Industrial Area.

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The Institute offers the three-year diploma courses after S.S.C. in jute technology and in textile technology; and a two-year diploma course after H.S.C. in textile chemistry.

Bangladesh Leather Institute

The Institute, established under the Ministry of Commerce, Labour and Industries in 1969, offers the following courses: a three-year diploma course after H.S.C.; a two-year certificate course after S.S.C.; and a one-year artisan course after VIII grade.

Bangladesh Institute of Graphic Arts

The Institute of Graphic Arts, the only Institute of its type in Bangladesh, offers a three-year (post S.S.C.) diploma course in printing, specializing in six different branches. It has an admission capacity of 30 students per year and its present enrolment is 80 students. In addition to regular academic programmes, the Institute has a production unit and offers printing facilities to government and non-government agencies for rare and quality works.

Bangladesh Survey Institute

The Bangladesh Survey Institute at Comilla offers a one-year (post S.S.C.) course in draftsmanship and a two-year course leading to a Survey examination.

VOCATIONAL TRAINING INSTITUTES

In Bangladesh there are 35 vocational training institutes of which 13 are attached to polytechnics and have no separate premises of their own. They provide very useful courses which fit well into the overall economy of the nation. They are evenly and judiciously distributed throughout the country. Their special feature is that they produce people who are not mere job-seekers but have the capacity to start their own industry and become self-employed.

MANPOWER PLANNING

The data made available to me clearly indicates that the Government is aware of the importance of manpower planning. A stock-taking of the whole situation appears to have been done. The surveys of manpower could prove very useful. An obvious conclusion one can draw from the data is that employment will be available to technically-trained personnel and they will not face unemployment at least in their own category of manpower.

Appendix 3 shows the input and output of engineering graduates and diploma holders (engineering technicians) for the last few years and the projected manpower supply of these categories have been shown. Appendix 4 shows the numbers of posts available, their minimum academic requirements, and the numbers of qualified people seeking employment. (See pages 16 and 17.)

SPECIALIZED TECHNICIAN COURSE

Bangladesh is a riverine country and its economy depends largely on the improvement of river transport. In order to provide the necessary manpower for the construction, operation and maintenance of river craft, a Marine Diesel Training Centre was established in 1958, with the assistance of I.L.O. (under UNDP).

Manpower required for operating, repairing and maintaining diesel-driven vehicles, power plants, pumps, compressors etc. are also produced by this training centre.

The courses run by the Centre are shown in the following table:

DESCRIPTION	DURATION	ENTRY QUALIFICATION	AGE	FIRST YEAR ENTRY
Marine Diesel	2 yrs	VIIIth Class Pass	14 to 18 yrs	50
Marine Diesel Artificer Course	- do -	Matriculate	15 to 20 yrs	20
Shipbuilding Draftsmanship Course	- do -	- do -	- do -	20
Welding Course (Arc & Gas)	- do -	VIIIth Class Pass	15 to 28 yrs	20
Refresher Course	1 to 3 mths	-	14 to 18 yrs	20

Method of Admission of Trainees

Proper advertisement is made in the daily newspapers. Reputable firms and industries are also informed by circulars inviting nominees for admission. Selection is made by a Committee on the basis of a written test and interview. The trainees are awarded a trade certificate on successful completion of their training either by the head of the institution or by the Director of Labour. The Centre does not take any responsibility for providing jobs for the trainees when they have passed out.

Examinations and Awards

Examinations for first degree courses in engineering are conducted by the Bangladesh University of Engineering and Technology, Dacca. This university controls the academic matter in respect of all the engineering colleges in Bangladesh, although in all other matters these colleges are autonomous and enjoy the status of universities.

Examinations for technician diploma courses are conducted by the Bangladesh Technical Education Board, a Diploma in Engineering in the appropriate branch being awarded by this Board to those successfully passing the examinations after undergoing the approved courses of study.

APPRENTICESHIP TRAINING

Although the country is not properly developed industrially, the Government is keen to develop proper training for the personnel needed to man industry and other organizations. The Government has enforced the Apprenticeship Training Act, 1850, with necessary amendments in 1974.

Apprenticeship Training was introduced on a voluntary basis in May 1960. Although the Apprenticeship Act of 1850 was on the Statute Book, it was not implemented, and the Apprenticeship Ordinance, 1962, repealed it. Apprenticeship was

made a provincial government matter in 1962. Apprenticeship Ordinance was enforced on 61 undertakings on 22.7.1968; on 18 more undertakings on 14.3.1974; and 14 trades were declared apprenticeable on 2.11.1968. The above-mentioned list of designated trades was expanded to a total of 27 trades on 4.6.1974.

Between May 1960 and December 1968, the period during which apprenticeship training was carried out voluntarily, a total of 1,215 apprentices were enrolled. Of these, 830 completed their training, 195 dropped out without completing their training, and 190 were still under training on 31.12.1968. Total enrolment from May 1960 to Octover 1974 has been 1,745, of whom 1,268 have completed their training, 333 dropped out without completing their training and 144 were under training on 1.11.1974.

The following reasons have been suggested to explain the negative attitude of industries to apprenticeship: lack of training facilities, the unsound financial position of some organizations, lack of qualified supervisory personnel in an establishment to look after the practical training, and lack of technically qualified staff to provide related instruction to the apprentices.

ADVANCED TRAINING PROGRAMMES

Facilities have been created for advanced training programmes through the agency of the Bangladesh Industrial Technical Assistance Centre, Dacca, known as BITAC. The programmes are developed to meet the needs for highly skilled personnel in appropriate industries in Bangladesh, and designed to provide the engineer, the technician, the shop foreman, the supervisor, and the experienced shop worker with a concentrated, practical course in shop-work of a high order of precision and excellence.

This novel shop experience, gained under ideal training conditions, allows the trainee to re-examine his own shop practices and methods in the light of advanced techniques and high standards. During the course, the trainee is called upon to employ his highest skills in the performance of shop assignments, and these assignments increasingly make higher demands on his abilities. The trainee thus acquires new and higher skills. Classroom and workshop sessions will be devoted to safety, and assist the recognition of hazardous conditions and the reduction of accidents.

At present BITAC has facilities to impart training in machine and tool shop practices; machine and tool design; die design; heat treatment; pattern shop practices; foundry shop practices; welding; and protective coating.

PROFESSIONAL BODIES

The Institute of Engineers, Bangladesh, is probably the only professional body of engineers in the country. It admits members for Studentship, Graduateship and Associate Membership through professional examinations. In Bangladesh, the professional qualifications acquired in sections A and B of the professional examinations of the Institute of Engineers, Bangladesh, are recognized in part for the Bachelors Degree in Engineering. The Institute conducts no other academic activity having an important bearing on the quality and improvement of technical education in Bangladesh.

FUTURE NEEDS

It is apparent that the Apprenticeship Rules now in force in Bangladesh are inadequate. The country requires many training places for practical training in industry as the number of graduates and technicians admitted annually, or, failing that, at least half that number. This is necessary in view of the need for practice-oriented courses and experienced personnel.

APPENDIX 1: OFFICIALS MET AND VISITS UNDERTAKEN

Officials

Dr. Wahiduddin Ahmed	Director of Technical Education, Ex Dean of Faculty of Engineering
Mr. Abdur Rashid	Chairman, Bangladesh Technical Education Board
Mr. Saiful Haque	Vice-Principal, Dacca Polytechnic
Mr. Ruhul Amin	Chief Instructor (Clerical)
Mr. A. Karim	Chief Instructor (Mechanical)
Dr. Lutfar Rahman	Principal, Bangladesh Textile Institute
Mr. Nazmal Haque	Professor, Technical Teacher Training College

Some Institutions Visited

Polytechnic, Dacca; Technical Teacher Training College; Bangladesh Industrial Technical Assistance Centre (BITAC); Bangladesh German Technical Training Centre.

Bangladesh

APPENDIX 2: TECHNICAL INSTITUTIONS ABOVE CRAFT LEVEL

Educational Institution	Courses Offered	Annual Admission Capacity
1. TECHNICAL TEACHERS' EDUCATION		
Technical Teachers' Training College, Dacca	Diploma in Technical Education; B. Ed. (Tech.)	150
2. ENGINEERING EDUCATION		
Rajshahi Engineering College	Civil Engineering Mechanical Engineering Electrical Engineering	180
Chittagong Engineering College	- do -	180
Khulna Engineering College	- do -	120
3. POLYTECHNIC EDUCATION		
Dacca Polytechnic Institute	Civil Technology Electrical Technology Mechanical Technology Power Technology Radio and Electronics Technology Architecture Building Technology	640
Chittagong Polytechnic Institute	Civil Technology Electrical Technology Mechanical Technology Power Technology Radio and Electronics Welding Technology	480
Khulna Polytechnic Institute	Civil Technology Electrical Technology Mechanical Technology Power Technology	320
Comilla Polytechnic Institute	Civil Technology Electrical Technology Mechanical Technology Surveying Technology	320
Mymensingh Polytechnic Institute	Civil Technology Electrical Technology Mechanical Technology Farm Technology	320
Barisal Polytechnic Institute	Civil Technology Mechanical Technology Power Technology	240

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Bogra Polytechnic Institute	Civil Technology Mechanical Technology Power Technology	240
Pabna Polytechnic Institute	Civil Technology Mechanical Technology Power Technology Survey Technology	240
Rangpur Polytechnic Institute	Civil Technology Power Technology	240
Sylhet Polytechnic Institute	Civil Technology Mechanical Technology Power Technology	240
Dinajpur Polytechnic Institute	Civil Technology Mechanical Technology Power Technology	160
Faridpur Polytechnic Institute	Civil Technology Mechanical Technology Power Technology	160
Feni Polytechnic Institute	Civil Technology Mechanical Technology Power Technology	160
Jessore Polytechnic Institute	Civil Technology Mechanical Technology Power Technology	160
Kushtia Polytechnic Institute	Civil Technology Mechanical Technology Power Technology	160
Rajshahi Polytechnic Institute	Civil Technology Mechanical Technology Electrical Technology	160
Graphic Arts Institute, Dacca	Printing Management	40
4. MONOTECHNICS		
Swedish Bangladesh Institute of Technology, Kaptai	Industrial Wood Technology Automobile Technology Electrical Technology	100
Bangladesh Textile Institute at Dacca	Jute Technology Cotton Technology Textile Technology Textile Chemistry	100
Bangladesh Leather Technology Institute, Dacca	Diploma in Leather Technology Certificate in Leather Tech. Artisan Course in Foot Wear and Leather Goods Manufacturing	60
Bangladesh Glass and Ceramics Institute, Dacca	Artisan Course in Ceramic Technology Artisan Course in Glass Technology	60
Bangladesh Survey Institute	Aminship Course Survey Final Course	80

Bangladesh

APPENDIX 3: OUTPUT OF INSTITUTIONS

	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977	1977-1978
ENGINEERING COLLEGES (Degree Level)							
Rajshahi Eng. College	140	140	140	140	140	190	220
Chittagong Eng. College	-	-	140	140	140	160	200
Khulna Eng. College	-	-	-	-	-	90	140
TECHNICIAN EDUCATION (Diploma Level)							
Dacca Polytechnic Inst.	520	520	520	520	520	530	590
Chittagong " "	250	390	390	390	390	390	390
Khulna " "	190	240	250	250	250	250	230
Comilla " "	150	180	230	230	230	230	250
Mymensingh " "	150	180	230	230	230	230	230
Barisal " "	60	100	120	120	120	160	160
Bogra " "	60	100	120	120	120	200	230
Pabna " "	60	100	120	120	120	160	160
Rangpur " "	60	100	120	120	120	160	160
Sylhet " "	60	100	120	120	120	160	160
Faridpur " "	60	100	120	120	120	120	120
Rajshahi " "	60	100	120	120	120	120	120
Feni " "	60	100	120	120	120	120	120
Jessore " "	60	100	120	120	120	120	120
Kushtia " "	60	100	120	120	120	120	120
Dinajpur " "	60	100	120	120	120	120	120
Graphic Arts Inst. Dacca	20	20	20	20	20	30	30
Joydevpur Polytechnic Inst.	-	-	-	-	-	130	160
Tangail " "	-	-	-	-	-	-	60
Patukhali " "	-	-	-	-	-	-	60
Womens' Poly. Inst. Dacca	-	-	-	-	-	-	-
Swedish Bangladesh Inst. of Technology, Kapta	70	70	70	70	70	70	100
Bangladesh Textile Inst.	80	80	80	80	80	100	140
Bangladesh Leather Tech. Institute	16	16	16	16	32	32	32

APPENDIX 4: MANPOWER DATA IN ENGINEERING AND RELATED FIELDS

Minimum Academic Requirement	Number of Posts Available	Number of Qualified People
B.Sc. (Civil Engineering)	1,976	1,899
B.Sc. (Electrical Engineering) M.Sc. (Applied Physics)	1,321	1,187 (1)
B.Sc. (Mechanical Engineering)	998	849 (1)
B.Sc. (Chemical Engineering) M.Sc. (Applied Chemistry)	460	399 (2)
Degree in Metallurgy	31	39
B.Sc. (Architecture)	86	83
Diploma in Civil Engineering and Allied Technologies	4,164	4,469 (3)
Diploma in Architecture and Allied Technologies	74	66
Diploma in Mechanical and Allied Technologies	2,400	2,192 (2)
Diploma in Electrical and Allied Technologies	2,823	3,156
Diploma in Radio Electronics	601	256
Diploma in Chemical Technology	281	88 (2)

(1) The deficit has provided an opening for some surplus holders of M.Sc. (Physics) and B.Sc. (Pass).

(2) The deficit has provided an opening for some surplus holders of B.Sc. (Pass).

(3) Some of the surplus could be employed in posts meant for graduate engineers since the supply of B.Sc. (Civil Engineering) is short of the required number.

HONG KONG

PROGRAMMES OF TECHNICAL EDUCATION

Education in Hong Kong was initially the result of voluntary and philanthrophic efforts. In this initial period two prominent influences had a bearing on the social, economic and educational uplift of this British Colony, the first being traditionally British and the second being traditionally Chinese. Chinese influence is strong because the colony is very close to the Chinese mainland. But the education system has been greatly influenced by the British system, with its pyramidal structure and educational ladders, except for minor changes to suit local conditions.

The Government currently maintains one technical institute and nine secondary technical schools, of which five are for boys, one is for girls, and three are co-educational. The Salesian Society runs two secondary technical schools, one for boys and one for girls. The 18 secondary technical schools offer a five-year course which leads to Hong Kong Certificate of Education examinations. The course has a technical bias and provides a number of practical subjects such as wood-work, needle-work, metal-work, technical drawing and commercial subjects. Five aided modern schools offer three-year courses which have a strong technical bias.

There are also quite a few vocational schools which are run by private bodies and charitable societies. All are aided institutions; four have been converted into pre-vocational schools and are being financially assisted by the Education Department. The vocational institutions provide courses of varying standard. The pre-vocational schools provide courses of three years' duration after primary standard. The course curriculum comprises general education to the extent of 50% of its total content, and the remaining 50% provides a broad-based technical education in three main industrial fields.

The pre-vocational schools offer courses which do not essentially provide complete skills or knowledge of a particular occupation or a trade, but do provide skills which enable the student to choose a definite career/occupation. In any case, the products of these schools are prepared for apprenticeship in industries. The pre-vocational schools provide facilities for 1,000 students. After completing their studies in pre-vocational schools, the students have the option of undergoing higher studies in the Morrison Hill Technical Institute.

Technical institutes provide educational and training facilities for apprentices and workers in part-time classes which are held in the day and the evening. It is proposed to start two new institutes in 1975.

Morrison Hill Technical Institute runs craft and lower level technician courses, some of which were previously conducted in the Technical College, now part of the Hong Kong Polytechnic. This, the only polytechnic in Hong Kong, came into being in 1972. It has an initial capacity of 1,800 full-time students and a planned capacity of 8,000 in 1978.

TECHNICIAN TRAINING PROGRAMME

As stated above, technician-level courses are run in the Hong Kong Polytechnic. The Polytechnic had the Hong Kong Technical College as its initial base.

It has at present eight departments. These are Building, Surveying and Structural Engineering, Mechanical and Marine Engineering, Electrical Engineering, Accountancy and Management Studies, Textile Industries, Nautical Studies, Industrial and Commercial Design, and Mathematics and Science. The Department of Maths and Science is a core Department. The Polytechnic provides full-time courses leading to Polytechnic Higher Diplomas and the examinations of many British professional institutions.

This Polytechnic was set up by an Ordinance and is run by a duly constituted Board of Governors. The procedure of financing and administering the Polytechnic is the same as that for the two universities and all are funded through the Universities and Polytechnic Grants Committee. The Polytechnic Board has been vested with all powers necessary for the institution of particular courses and the organization and administration of the Polytechnic.

Admission to the technician courses run in the Polytechnic is granted to those holding the Hong Kong Certificate of Education with a minimum grade of E in particular subjects.

The Polytechnic runs full-time and part-time courses leading to its own Higher Diploma and Ordinary Diploma, also to various examinations organized by professional and examining bodies, mainly the City and Guilds of London Institute. It also covers a variety of qualifications in multiple subject groups in the fields of technology and commerce.

The Polytechnic was started in the former Hong Kong Technical College which already had excellent instructional facilities in the form of equipment, laboratories, workshops and well-trained staff. It is worth noting here that in its workshop and laboratories the Polytechnic has modern equipment and machinery which can produce sophisticated articles and instruments. Perhaps, in view of the existence of these excellent facilities, it may not always be necessary for a technician trained in the Hong Kong Polytechnic to need further in-plant training.

Evening courses form a major part of the Polytechnic's responsibility. It plans to admit in evening courses 20,000 students by 1978, an increase of almost 100% over a period of five years. It plans also to provide facilities for those in employment to acquire through part-time classes the same qualifications as the full-time students.

The students who achieve good results in their Higher Diploma are permitted to stay for one more year with a view to pursuing full-time professional courses leading to professional qualifications (known as CEI Part II) in Structural, Electrical, Electronics, Mechanical and Production Engineering, Building and Surveying, Textile Technology and Textile Chemistry. The Board of Governors has approved the award of a qualification known as the Associateship of the Hong Kong Polytechnic.

Academic developments in the Polytechnic have been excellent. Programmed instruction has been introduced with success. Technical teachers have been sent abroad for advanced pedagogical training. The methods of instruction in the classroom are modern and thought-provoking. Industrial visits are organized for the benefit of laboratory technicians and trainee cadets with a view to relating theory with practice. Intensified project work has been introduced for Higher Diploma students.

Hong Kong

The Polytechnic runs its own employment service. The employment prospects are on the whole very bright, and generally the demand exceeds supply. The student-counselling service will have to be developed to suit future needs.

In Hong Kong there are a number of modern and specialized industries. In spite of this, the facilities for in-plant training are almost non-existent, and this is why many students have been sent overseas for apprenticeship training in appropriate industries. The duration of such apprenticeships is two years. The idea behind this activity is to increase the student's knowledge of the actual work situations in different industries, and also to learn the methods of practical applications.

DEGREE-LEVEL ENGINEERING EDUCATION

There are two universities in Hong Kong. One is the University of Hong Kong and the other is the Chinese University of Hong Kong. Engineering degree courses are, however, run only by the University of Hong Kong, under the faculty of Science and Engineering. The faculty offers facilities for the following courses: Civil Engineering; Mechanical and Industrial Engineering; Electrical Engineering; and Architecture. The duration of the degree courses is three years. Degrees are divided into four Divisions. The standard attained in each of the three parts of the final examination is taken into account.

The University of Hong Kong's Faculty of Engineering comprises four Departments of Engineering and a Department of Architecture. The University turned out 134 engineers in 1973. It proposes to provide elements of marine engineering in the curriculum of mechanical engineering. It also plans to diversify the existing curriculum of graduate courses to introduce structural engineering and electronics engineering. For this purpose, intake would be increased.

Practical experience and field work form an essential part of the syllabus. The students are required to undertake field work on industrial training at the end of each year of examination during the summer vacations.

The Morrison Hill Technical Institute (Technician and Craftsman Courses)

This Institute's responsibility is to provide students with the basic knowledge necessary for their future personal and vocational "growth". Its courses are planned to expound fundamental concepts and to guide students in their application, as well as to prepare them for technical positions in industry and commerce and acquaint them with social and cultural developments. Guidance in vocation, and assistance in finding work of the right kind, is part of the Institute's structure.

Through its part-time courses the Institute offers opportunities for technical education to mature men and women. Through its short courses it serves local industry by providing up-grading and up-dating training as well as increasing knowledge and understanding in a wide variety of subjects.

The Institute is a technical institution aware of its social and economic roles, and attaches due importance to the education, training, and welfare of the individual student.

The Technical Institute occupies an important position in the local education system. Its main function is to provide a wide range of facilities for the training of craftsmen and technicians. It provides courses which are fully vocational. It does not duplicate the function of the secondary technical schools, which is to provide a full-time secondary education with a technical bias: nor is it similar to pre-vocational or secondary modern schools which provide courses with a high general education content.

The importance of integrating education with basic practical training is fully appreciated. For this reason all full-time courses are designed to fully integrate practical training with related theory.

The Institute provides systematic training in technical and commercial subjects and is administered through six different departments, each under the charge of a head. These departments are: Commercial Studies, Construction, Electrical Engineering, Mechanical Engineering, Preliminary and General Studies, and Printing.

The Technical Institute provides the following main types of course:

(a) Post-Secondary Level Courses

(i) Full-time, part-time day-release, part-time evening and short courses, at technician level.

(ii) Full-time, part-time evening and short courses in commercial subjects.

(iii) Full-time, part-time day-release, part-time evening and short courses for the training of technical teachers and workshop instructors employed in technical institutions or in industry.

(b) Craft Courses

Full-time, block-release, part-time day-release, part-time evening and short courses.

APPRENTICESHIPS AND THE MORRISON HILL TECHNICAL INSTITUTE

The Morrison Hill Technical Institute works closely with the Apprenticeship Training Unit of the Labour Department, so that apprentices in recognized apprenticeship schemes may be able to obtain complementary institutional training.

Modern and well-organized apprenticeship schemes incorporate both planned on-the-job training and related institutional training, as provided at the Institute. The aim is to ensure close co-operation between employers, the Technical Institute and the Apprenticeship Training Unit of the Labour Department. It is expected that the firms which have agreed to co-operate will supply the bulk of the industrial experience required. Properly planned on-the-job experience, on a sound job-rotation basis, is most important for any apprentice or trainee. There is no doubt too that part-time day-release courses are the lynch-pin of good apprenticeship training.

The one-year full-time craft courses at the Morrison Hill Technical Institute provide theoretical and basic practical training equivalent to the first year of an on-the-job apprenticeship. It has been recommended by the Industrial Training Advisory Committee that on the satisfactory completion of such a course a student should enter directly into the second year of an apprenticeship. A number of firms have already followed this recommendation.

Much more needs to be done by industry in Hong Kong to increase the number of apprenticeship opportunities if an adequate and constant supply of highly-skilled craftsmen is to be assured. This is a pre-requisite if industry is to continue to expand and venture into the realms of more sophisticated products.

Hong Kong

Sponsored Students

This is an excellent scheme of involvement of industry in the education and training system. Sponsored students are those already employed in an industrial organization who are released for attendance on a full-time, a block-release, or a part-time day-release course. The sponsoring firm pays the institute's fees for the students concerned. For full-time and block-release courses a firm may also, in some cases, pay the students a nominal wage. On completion of such a course, the student will return to his employer.

A number of one-year, full-time craft courses are organized, and firms are encouraged to employ apprentices and sponsor them on such courses. A list of industries appears on page 28. In addition to the sponsoring of full-time students, firms in Hong Kong and the Government pay or refund the fees of their employees who successfully complete part-time day-release or part-time evening courses.

Planning of Courses

The Technical Institute maintains close contact with industry and commerce. A number of members of staff are serving on the various committees of the Industrial Training Advisory Committee. Courses are planned by the Institute in close co-operation with various industrial organizations so that an integrated form of academic and industrial training is provided.

Satisfactory completion of the Preliminary Certificate Course, run by the Morrison Hill Technical Institute, is considered to be equivalent to the completion of Form III in related subjects, and applicants are therefore eligible for entry to most craft-level courses.

Satisfactory completion of the General Certificate Course, Year One, run by the Morrison Hill Technical Institute, is considered to be equivalent to completion of Form IV in related subjects, and permits students to enter directly into Year One of the Technician Evening Courses.

Satisfactory completion of the General Certificate Course, Year Two, run by the Morrison Hill Technical Institute, is considered to be equivalent to completion of Form V in related subjects: students may then apply to enter the Ordinary Certificate evening courses at the Polytechnic.

MANPOWER PLANNING

The first series of surveys on the manpower requirements of Hong Kong's ten major industries conducted between 1966 and 1969 indicated a requirement of 2,600 technicians annually. The second series of surveys has already been initiated. Its report was not available at the time of writing this report.

Industrial undertakings are themselves aware of proper planning. They are deeply involved in the process of course planning and industrial training. When they require technically trained manpower they recruit appropriate personnel and sponsor them for training in the Polytechnic or the Morrison Hill Technical Institute.

Manpower requirements of the major industries are periodically assessed. Forecasts of further requirements are based on mean growth factor obtained from a number of sources (existing workforce, wastage rates etc.).

The Government is well aware of the need and importance of manpower planning. From time to time it conducts surveys of the major industries in Hong Kong with a view to ascertaining what skill and technology are required

and what training is needed to maintain the supply of such skill. These activities are carried out under the auspices of the Hong Kong Training Council which will then outline the manpower requirements at various levels and make recommendations to the Government on policy on manpower planning and training. The Hong Kong Training Council will also recommend training programmes designed to meet the job standards, both for trainees and for trained officers who need retraining.

PRACTICAL TRAINING - THE ROLE OF INDUSTRY

Practical training is required by industrial employers and, in the case of technologists, by the professional institutions in the United Kingdom. In October 1973 the Governor appointed the Hong Kong Training Council to advise him on measures to ensure a comprehensive system of training geared to meet the developing needs of Hong Kong's economy. Ten industry training boards have since been set up under the umbrella of the Training Council to deal with the training problems of major industries. Five other committees have been appointed to deal with matters common to more than one industry, such as apprenticeship, instructor training, technical training in institutions, translation and vocational training. The training boards have taken over the work done by the former industrial committees (under the former industrial training advisory committee) and continue their work on drawing up minimum job standards and job specifications in various major industries. Among other purposes these standards and specifications aim at introducing a generally accepted skill level for principal jobs in the trades, and providing guidelines for courses at technical institutions or vocational training centres, run by the Government, private bodies or voluntary agencies.

The Industrial Training Division of the Labour Department is responsible for:

(a) Servicing the Hong Kong Training Council which has the responsibility for manpower planning and training in Hong Kong;

(b) encouraging and assisting employers to start organized training schemes; and

(c) enforcing the Apprenticeship Ordinance when enacted.

There is no legislation in Hong Kong pertaining to industrial training. Consideration is being given to the enactment of the Apprenticeship Bill to regulate apprenticeship in designated trades or occupations and to make provisions for matters connected therewith.

In 1974 the Government appointed two provisional industry training authorities to pave the way for the eventual establishment of statutory training authorities to administer two contributory training schemes in the construction and clothing industries. These statutory bodies, when established, would be empowered by law to impose a levy on employers for the purpose of setting up and maintaining training centres.

RELATIONSHIP BETWEEN EDUCATION AND TRAINING

There is a very close relationship between industries and technical education in that the technical educational institutions are constantly reviewing their curricula and syllabuses to cater for the needs of industries, which are rapidly changing and advancing and becoming more sophisticated. At the same time, industries are taking on undergraduates from these institutions during the summer vacation to enable them to experience the industrial environment and make use of the training

facilities. In return for this, the institutions of higher education are also providing a service to industries through consultancy and research by their staff.

Measures that assist integration between industry and technical education (besides sandwich, day-release and block-release courses) include the following:

(a) The universities offer a wide variety of courses both in vocational and professional training at their departments of extra-mural studies. These courses are normally run on a part-time evening basis.

The Polytechnic and the Morrison Hill Technical Institute both offer part-time day-release and part-time evening courses comprising a wide and comprehensive range of subjects. Most of the part-time day-release students are either recommended or sponsored by their employers. In addition, some block-release courses are being offered at the Technical Institute, and some are being organized by the Polytechnic. The students of these block-release courses are entirely sponsored by their employers.

(b) Although there is no direct representation of industry in their administration, the technical institutes design and offer courses based on the advice and recommendation of the Hong Kong Training Council whose members are mostly industrialists. In the Polytechnic every department has an advisory committee comprising members from the commercial and industrial sectors. The role of such committees is to act as an interface between the Polytechnic and industries in the community. These committees advise, and from time to time review the course structure and equipment with a view to gearing such resources to fulfil local needs.

Advisory Panels, somewhat similar to the advisory committees of the Polytechnic, exist in the departments of extra-mural studies of the universities.

(c) Institutional training at the universities, the Polytechnic and the technical institutes is provided by means of workshops and laboratories. These are equipped with up-to-date machines, many of which are capable of very advanced work. Most of the equipment in the technical institutes and the Polytechnic is of an industrial type so that students of industry may be taught the operational and theoretical aspects of manufacture. The Polytechnic is considering setting up an industrial training centre to meet the needs of Hong Kong for professional practical training in engineering and technology. Similar facilities are offered by Loughborough University in the U.K.

(d) The training of technical teachers is undertaken by the newly-established Hong Kong Technical Teachers' College. This well-equipped college provides a wide and comprehensive range of training facilities for trainee-teachers in engineering, commerce and other industrial disciplines. The college is also setting up a resource centre to provide teachers and instructors with a wide range of teaching methods and teaching aids. New teaching and training methods are being developed to improve teaching proficiency.

The College is also offering re-training for in-service teachers and instructors on a part-time day-release or evening basis, sponsored by their employers.

(e) The pattern of training follows the training programmes recommended by the Industrial Training Boards of the Hong Kong Training Council. These programmes are designed to meet specific job standards and are carried out jointly by industries and the Technical Education Branch of the Education Department (e.g. placement at Technical Institutes and Technical Teachers' College). Where facilities and other related studies are considered locally inadequate the Government will undertake to send scholars overseas to acquire appropriate training and skill. The public and private sectors organize similar training schemes for their own staff, though on a smaller scale than the Government.

EXAMINATIONS AND AWARDS

Examinations are normally carried out internally. However, prior to the examination, the questions are sent to external examiners who assess their standard and content. Later, when the scripts have been marked by the lecturers concerned, these too are sent to the external examiners for further assessment and evaluation. The final process of certification and awards is administered by the academic committee. The purpose of assessment by external examiners is to ensure that standards are in accordance with those required for recognition by external academic and professional institutions.

TRAINING ESTABLISHMENTS RUN BY IMPORTANT INDUSTRIES

The purpose of this survey would not be properly served if mention were not made of the training centres run by various industries in Hong Kong. One of the best training establishments I have ever seen is that run by the Hong Kong Air Craft Engineering Co. Ltd., a company that undertakes major work for airlines and defence forces throughout the world. In outline, its main functions are:

(a) Line manufacture of transiting aircraft belonging to scheduled airlines;

(b) specialist jobs of air-frame overhaul, major modification and repair;

(c) engine and component overhaul and servicing of major equipment such as propellers, hydraulic equipment and avionics; and

(d) total main base engineering for Cathay Pacific Airways.

Because of the rapid expansion of aviation, there is dearth of aircraft engineers, skilled aircraft fitters, technicians and mechanics in Hong Kong. The H.A.E.C. therefore set up several years ago its own training department which ensures a regular flow of properly-trained and ready-made manpower for its workshops and hangars.

The various types of training given by the H.A.E.C. are:

(a) Apprentice Scheme Suitably qualified school leavers are admitted each year. They are prepared for senior positions in the company.

(b) Mechanic Training Periodically the company recruits technical-school and high-school leavers and trains them as mechanics. Exceptionally well-qualified trainees are nominated for advanced training which enables them to occupy promotional jobs.

(c) Type Training Programme Because new types of aircraft and accessories are being introduced every day, qualified staff are sent overseas to manufacturers and airlines if they cannot be trained further by the company's own experienced staff.

(d) Approved Courses Courses are held continuously to cover various types of aircraft visiting Hong Kong.

(e) Refresher Courses This is a re-training programme run continuously for the Company's own staff to enable them to learn new and modern skills and techniques.

(f) Licence Training Full training is given by specialist instructors to staff opting to obtain or extend their aircraft type licences.

The school is one of the biggest establishments in the South Asia region, and perhaps the only one of its kind.

In Hong Kong half of the population is employed in industry, which is export-oriented and generally sophisticated. The technical education system takes care of the requirements of industry, but the latter does not appear to feel satisfied that courses are so designed as to provide alternative openings and ease of transfer from one stream of industry to another.

The Federation of Industries in Hong Kong is aware of the present requirements of member industries and the general nature and type of future requirements. The Federation has taken the initiative in the matter of specialized training of technicians and engineers. They have instructed six awards for overseas training given in various fields of industry. The Federation also obtains training places abroad, particularly in Japan and West Germany.

The Federation claimed that in 1973 it provided 2,300 apprenticeship seats under the scheme of the Labour Department, mainly in craft training, electronics, textile garments, and the printing and plastics industries. It also arranges engineering craft training in the mechanical, electrical, ship-building and automobile servicing industries.

APPENDIX 1: OFFICIALS MET AND VISITS UNDERTAKEN

Officials

Mr. A. J. Kingwell	Deputy Director of Education, (Technical)
Mr. P. L. Smith	Principal, Technical Teacher Training College
Mr. J. R. Devereux	Principal, Kwun Tong Technical Institute
Mr. Lincoln Lieu	Principal, Morrison Hill Technical Institute
Mr. G. A. V. Ribeiro	Technical Education Officer
Mr. G. A. Larsen	Sr. Education Officer (Technical)
Mr. C. Williams	General Manager, Hong Kong Air Craft Engineering Co
Mr. Stephen Pao	Training Superintendent, Hong Kong Air Craft Engineering Co
Mr. James Wu Manhon	M.L.C. and Proprietor, China Cold Storage Company
Mr. S. O. Chan	Joint Director, Federation of Hong Kong Industry
Mr. J. R. Price	Commissioner for Labour
Mr. H. R. Knight	Assistant Commissioner for Labour (Training)
Dr. S. E. Au	Manpower Development Manager, Hong Kong Productivity Centre
Mr. W. K. Chan	Section Head of Manpower Development Unit, Hong Kong Productivity Centre
Mr. J. Hayes	Training Officer, China Light & Power Co, Ltd
Mr. J. A. Cheetham	Secretary, Employers Federation of Hong Kong
Dr. W. S. Leung	Dean of Engineering and Architecture, University of Hong Kong
Mr. A. J. Linehan	Labour Adviser
Dr. Y. K. Ching	Acting Director, Hong Kong Polytechnic

Some Institutions Visited

Hong Kong Air Craft Engineering Company Ltd; Kwan Tong Vocational Training Centre; Morrison Hill Technical Institute; China Cold Storage and Engineering Company; China Light and Power Co, Ltd.

APPENDIX 2: ESTABLISHMENTS OFFERING ORIENTATION AND TRAINING FACILITIES FOR TECHNICIANS

Ahong Construction Co, (H.K.) Ltd
American Engineering Corporation
Art Key Metal Works Ltd
Au Chow Electrical Co
Candy Novelty Work Ltd
Carter Semiconductor
Chan & Sum Kun Jewellery Co
Cheong Woo Co
Chi Fai Engineering Construction Co
Chiap Hwa Clocks and Watches Ltd
China Cold Storage and Eng. Co, Ltd
China Engineers Ltd
China Light and Power Co, Ltd
Chuag's Cutlery (Holdings) Ltd
Command Secretariat (Civilian Employment and Pay Section)
Cosmopolitan Radio and Elec. Corp
Cox International Ltd
Crown Motors Ltd
Dah Chung Industrial Co, Ltd
Danemann Watch Case Factory Ltd
Dickson Construction Co
R. E. Dietz Co, Ltd
Eton Enterprises Ltd
Far East Motors Ltd
Fook Lee Construction Co, Ltd
Fortuna Food Products Ltd
Fund Tsun Architects
Gammon (H.K.) Ltd
Ge Ling Engineering Co
Gilman & Co, Ltd
Good Years Engineering Co, Ltd
Grandur Electrical Co
Haking Industries (Mechanics & Optics) Ltd
Hanimex (H.K.) Ltd
Henry Engineering & Construction Co, Ltd
Hop Hing (1950) Weaving Factory Ltd
Hong Kong Electric Co, Ltd
Hong Kong L.P. Gas Co, Ltd
Hong Kong Soya Bean Prod. Co, Ltd
Hong Kong Telephone Co, Ltd
Hong Kong United Dockyard Ltd
Honor Industrial Development Co, Ltd
Hsin Chong Construction Co, Ltd
International Engineering Ltd
The Jardine Engineering Corp. Ltd
Jabsen and Co
Jabsen Motors
John Lok & Partners
Karkool Ltd
Lai Lee Machine Factory
Lee Wah Weaving Factory Ltd
Mapco Machined Parts (H.K.) Ltd
Metro-Dodwell Motors Ltd
Oak Electro/netices Corporation (H.K.)
On Hing Cheong Engineering Co
On Lee & Co
Otis Electric Co
Otis Elevator Co
Our Lady of Maryknoll Hospital
Paul Y. Construction Co, Ltd
Perfekta Enterprises Ltd
Pioneer Quarries (H.K.) Ltd
Qualidux Industrial Co, Ltd
Repco Automotive Engineering (H.K.) Ltd
Royal Electrical and Mechanical Engineers
Ryoden Electric Engineering Co, Ltd
Shiu Wing Co, Ltd
Shun Hing Electronic Trading Co, Ltd
Singer Sewing Machine Co
Sonca Industries Ltd

South Sea Textile Mfg. Co, Ltd
Star Industrial Co, Ltd
Sung Foo Kee Ltd
Sunnex Products Ltd
Syvania Far East Ltd
Sze Kee Metal Works
Tat Ming Engineering Works
TMX (H.K.) Ltd
Triangle Motors Ltd
Turin Motors Ltd
United Electrical & Mechanical Co
Variety Plastic Metal Ware Factory
Wallace Harper & Co
A. G. Wilkinson
Wing Yiu Electrical Co
T. S. Wong & Co
World Light Manufactory Ltd
Yau Wing Co, Ltd
Zung Fu Co, Ltd

INDIA

The mere availability of science and technology does not guarantee that economic development will automatically occur. They must be harnessed to productive processes if the desired development is to be brought about. People must be trained to apply science and technology appropriately and effectively on a broad front. Special talents need to be developed. Education and skills must be capable of supporting growth in the economy and giving proper direction to overall development.

Educational planners in India have, therefore, held uppermost in their minds the question of how to equip people with the skills needed to fulfil the needs of different sectors of the economy of a nation. These skills may be in the form of technological services or in construction, design and products requiring appropriate techniques. In India, all-out efforts have been directed, through the various Five Year Plans, to achieving these important objectives by means of technical and vocational education.

All developing nations have time as their greatest enemy. They are required to accomplish in a few decades what the advanced countries of the world have taken centuries to do. Under the conditions that prevail in India it is even more important that technical and vocational education is made relevant to the needs of the various sectors of the economy and the different levels of responsibility. Also, the industrial development should take place in such a fashion that the economy reaches the take-off stage as soon as possible.

During the last quarter of a century the technical education system in India has been developed to take care of these very objectives. At appropriate intervals, care has also been taken to review the whole structure of technical education and to infuse such modifications in the total system as are needed to match scientific, technological and industrial development inside and outside the country. Even so, the lack of proper industrial development and the cycle of natural calamities have created problems which have caused people to ask whether education and training have been sufficiently relevant and adequately reinforced.

A résumé of the facilities for training craftsmen, middle-level technicians and graduates in engineering and technology is given hereunder. Craftsman training is dealt with only summarily as it lies outside the ambit of my survey.

Craftsman training is being looked after by two advisory councils - the National Council for Training in Vocational Trades, and the Central Apprenticeship Council. The former awards National Trade Certificates to those who successfully complete the institutional training and also to apprentices. It is one of the two advisory bodies set up by the Government to ensure that the training imparted in various skills is purposeful and oriented towards the requirements of industries and allied fields. The other advisory body, the Central Apprenticeship Council, advises the Government on all policy matters, standards of training to be attained, course content for theoretical and practical instruction, standardization of tools and equipment required for instruction in the various trades, and details of training to be imparted to the craft instructors.

There are about 355 industrial training institutes spread over the various states and union territories. They provide facilities for the training of more than 155,000 trade trainees. Instruction is imparted in 32 engineering trades and 22 non-engineering trades. The period of training in some of the engineering trades is two years, and one year for the remaining engineering trades and all non-engineering trades. The standard of admission to most of the trades is eight years of school education, while for the remaining trades it is matriculation or one class below. As a general policy, admission is given on the basis of aptitude tests which are conducted in respect of 15 out of 54 trades covering a maximum of 74,000 boys.

Instruction has been simplified, and efforts have been made to maintain good standards. For this purpose, instruction manuals have been prepared for the guidance of instructors, and extensive arrangements have been made for their training and re-training.

Apprenticeship training is arranged according to the provisions of the Apprenticeship Act of 1961. It is obligatory on the part of all employers in specified industries to provide facilities for practical training to the products of the industrial training institutes. The apprenticeship training consists of basic training followed by shop-floor on-the-job training. On the basis of surveys conducted throughout the country, 83,000 training places have been located as against the 45,390 apprentice places in which trainees are actually undergoing training in 4,113 establishments. New trades have also been designated for the purpose of the apprenticeship programme to make a total of 56 designated trades. The new establishments are in the field of printing, catering and chemicals. The period of apprenticeship training varies between six months and four years depending upon the requirements and scope of training in the particular trades. During apprenticeship training, stipends are provided to trainees.

The Government has set up central training institutes at Bombay, Hyderabad, Kanpur, Calcutta, Madras and Ludhiana for the training of 1,098 instructors required annually in the industrial training institutes for 21 trades. Another central training institute has been started in New Delhi for the training of women instructors for cutting, tailoring and embroidery. The duration of training is one year, covering modern methods of instruction. An advanced training institute at Madras has also been started to take care of specific programmes for a higher order of technical and supervisory skills. With a seating capacity of 162, this institute provides facilities for training highly skilled craftsmen. It is also intended to serve as a model for other centres to be established later, and to evolve improved techniques of training which can be followed by institutes engaged in similar activities.

A Centre for Foremanship Training has been started in Bangalore with a view to offering systematic training in foremanship. It imparts technical and managerial skills to foremanship trainees sponsored by industry and other training organizations, and it prepares highly skilled craftsmen. Constant efforts have been made to develop the techniques of trade training to improve technical skills, and also to promote research. For this purpose a Central Staff Training and Research Institute has started functioning at Calcutta. This Institute conducts special training courses and seminars for the guidance and training of principals of industrial training institutes, training officers of the industries, and officers of the Directorate-General of Employment and Training. It also imparts training to enable them to plan, develop and control vocational training programmes to meet the skill requirements of the jobs.

These facilities have enabled the country to build up over the years a force of highly skilled craftsmen, training officers and foremen to organize first-rate shop-floor practice, and highly trained instructors equipped with modern techniques and skills in various engineering and non-engineering fields.

India

In India there are 284 polytechnics offering a variety of courses for the preparation of middle-level technicians and operatives required for various duties in industry, construction work, design and overall development. The sanctioned annual admission capacity of these polytechnics is about 49,000, but this was reduced to 28,000 in 1968 due to economic recession and the high rate of unemployment of trained engineering graduates and diploma holders. The duration of courses ranges from two to four years, depending on the scope of the profession concerned. The functions expected of a technician in a changing environment make it imperative for educational planners to cross-fertilize the theoretical instruction given in the institutions with practical training in industry and other engineering professions and vocations. To this end, specific job-oriented courses have come into being in a number of polytechnics. A keen observer would find high quality and utility in the output of this new system which ensures the availability of broad-based theoretical knowledge in addition to practical training in all relevant fields. In effect this means that none of the theory in the diploma courses of the old pattern is lost for the sake of the envisaged practical training. The aim of the technician education is, therefore, to relate theory with practice, to relate teaching to industrial experience and to highlight the need of co-ordination between the technical institutions and industry. It is strongly felt that industry should not be required to invest huge funds on re-training new entrants so as to fit them for specific jobs, or to divert funds and energy away from the normal development process of which the research and design aspect is the most important.

The technical education system of any country is not an inflexible academic formulation. Rather, it grows out of the social, economic and environmental situation of that country. It must take into account the continually developing occupational needs of the people, and their aspirations for a better standard of living. Time and again it has been impressed upon the people of India that the country's economic emancipation depends on proper industrial development which, again, must be commensurate with the vast natural resources yet awaiting exploitation. In any case, departure from the broad-based instruction and practical work in the general diploma courses could prove harmful.

All the 284 polytechnics run conventional diploma courses in civil, mechanical, and electrical engineering and other allied fields of engineering and technology. These allied fields include metallurgy, mining engineering, chemical engineering, electronics, textile technology, refrigeration and air-conditioning, automobile engineering, leather technology, agricultural engineering, instrumentation, architecture, printing technology, production engineering, chemical operation and structural engineering. The distribution of polytechnics by states and by annual intake capacity is given in Appendix 1 on pages 42-44.

SANDWICH PROGRAMME

To ensure proper technician education and co-ordinate theory with practical training in industry and allied fields, a sandwich programme has been introduced in 44 of the 284 polytechnics. There is no doubt about the effectiveness of this programme in equipping technicians with the general technician functions expected of them by industry and with the specific and particular functions required by those industries that collaborate with the polytechnic running the sandwich programme.

The programme is sound in that it ensures cross-fertilization of theory with practical training in appropriate industrial undertakings, the creation of appropriate relations between teaching and industry, and the promotion of understanding between the technical institutions and the industries of their complementary functions. There is also a fair possibility of an exchange of experts between the industry and the technical institution which, through the sandwich programme, have come close to each other. Beyond doubt it provides for an integrated educational programme as a joint enterprise of the institution and the industry.

That the system is effective is fully borne out by the number of polytechnics running sandwich programmes in collaboration with industry and engineering undertakings, though there are some polytechnics with no industries in the neighbourhood with which useful collaborative arrangements can be made, and some places where industrial development exists but no polytechnic.

Not only is no part of theory sacrificed in the sandwich programme, but also the vacations are fully utilized for purposes of practical training totalling twelve months in duration. The actual duration of a diploma course thus lasts for $3\frac{1}{2}$ to four years instead of the three-year period of a conventional diploma. For this purpose the practical training is distributed into two periods of three months each in the first and second year and a period of six months after the final year examination. The training is supervised both by the experts and training officers of the industry and the teachers of the technical institutions concerned. The cost of the diploma-level sandwich programme works out to 150 rupees a month per student. Out of this, the student is paid a stipend of 100 rupees and the remainder is utilized for training charges at the industry, travelling allowances for the supervisory staff of the institution, and miscellaneous expenditure on running the programme.

A regular assessment of training is made and due credit given to the students for purposes of final examination leading to the award of Diploma in Engineering.

In the State of Maharashtra all the diploma courses are being run as sandwich programmes. In-plant training for a period of twelve months is an integral part of the course. The entire course is divided into eight semesters. The sixth semester is the first in which the student is deputed for industrial training. It is resumed in the seventh and eighth. This exercise improves the students' employability.

It is interesting to note that out of the 44 polytechnics conducting sandwich programmes in India, 25 are situated in the Western Region (comprising Maharashtra, Gujarat, Madhya Pradesh, Goa, Daman and Dieu). Out of the remaining 19, only three are situated in the Northern Region (comprising U.P., Punjab, Rajasthan, Haryana, and Jammu and Kashmir) which is the most important industrial belt and most densely populated area of the country. A list of polytechnics running sandwich courses is given at Appendix 2 on page 45.

DIVERSIFICATION OF DIPLOMA COURSES

No technical education system worth its name can be developed in isolation from industry and the overall economy of a nation. We are living in a highly dynamic world which has given birth to a number of new technological functions. As a result, industry is required to have the services of technicians trained for their special needs. Also specialized industries have come up which have created demands for specialist technicians. All this has created the need for regular review and up-dating of the curriculum of conventional courses so as to prepare technicians for specialist functions and narrow specialities. The diversification that has taken place has not necessarily meant any appreciable sacrifice of the basic principles of engineering enshrined in the conventional engineering diploma course.

In a number of States in India diversified diploma courses have been started in suitable polytechnics. The courses and their curriculum have been planned so as to keep in view the needs of industry. Industry has been consulted for this purpose. Had this not been done, no meaningful courses could have been formulated or run for the benefit of the community at large.

At present, diversified courses are being run (or are proposed to be run during the Fifth Plan period) in about 125 polytechnics throughout the country. A list of special fields of diversification of diploma courses is given in Appendix 3 on pages 46-50.

India

This survey would not be complete if the special efforts being directed towards diversification and re-organization of diploma courses were not mentioned. Under the Indo-Soviet Credit Agreement, the Government of India initiated measures to identify specialized fields of technician training. This approach was part of massive efforts directed towards a meaningful diversification of diploma courses. High-level teams of Indian and Soviet authorities visited a number of polytechnics and held discussions with major industrial projects in the country. They identified the following main areas of specialization for which technician programmes should be developed: machine building; metallurgy of ferrous metals; oil and gas processing equipment; and electrical machine building. For further specialization and emerging technologies they listed: technology of machine building; mechanical working; welding techniques; metallurgy of ferrous metals; production of castings; production forgings and stampings; oil and gas field equipment; oil and gas processing industry; electrical machine building.

Important technologies have been identified with special reference to the industries and institutions having the requirements. Model technician diploma courses were, therefore, started as shown in this table.

TYPE OF INDUSTRY	TRAINING INSTITUTION	CO-OPERATING INDUSTRIES
Mechanical Metallurgy Ferrous metals Mechanical Metallurgy Non-ferrous metals Process Metallurgy Ferrous metals Process Metallurgy Non-ferrous metals	Government Poly, Durg, Madhya Pradesh	Bhilai Steel Plant, Bhilai Bharat Aluminium Co, Korba
Technology of Mechanical Engineering, Machine Building	Government Poly, Ranchi, Bihar	Heavy Engineering Corporation, Ranchi National Institute of Forge & Foundry, Ranchi
Machine Building Technology Machine Building Design & Drafting	Government Poly, Bhopal, Madhya Pradesh	Bharat Heavy Electricals (I) Ltd, Bhopal
Radio Electronics	Government Poly, Hyderabad	Hindustan Aeronautics, Hyderabad Bharat Heavy Electricals, Hyderabad Electronics Corporation of India, Hyderabad
Technicians for Oil & Gas Industry	Baroda University Polytechnic	Gujarat Refining Oil & Natural Gas Commission Workshop Gujarat Fertilizer Corporation

The programme of Model Technician Diploma courses envisages practical training in important industry in each of the regions in which these courses are being run. The duration of the course is therefore $3\frac{1}{2}$ to four years. During the practical training of students in industry, they are paid a stipend of 150 rupees a month. The number of hours of training during the three-year institutional training is 3,456. Out of this, 1,190 hours, roughly 35% of the total work load, are for theoretical training, and the remaining 65% (2,266 hours) are for practical training. The scheme has been found useful, and it is proposed to extend its scope so as to include in it a number of emerging technologies. A technical assistance agreement exists between the Government of India and the U.S.S.R.

GIRLS' POLYTECHNICS

There are at present 24 polytechnics for women and girls in India, their chief aim being the promotion of proper technician education. The courses include: Electronics; Medical Lab. Technology; Secretarial Practice and Stenography; Architecture; Architectural Draughtsmanship; Library Science; Pharmacy; Commercial Arts; Costume Design and Dress-Making; Radio Servicing and Operation; Civil Engineering; Interior Decoration and Display; Tele-communications; Electrical Communication Engineering; Catering and Food Technology. Their duration varies between two and three years. Intake capacity of all the women's polytechnics is 2,370. Students who have completed their secondary education are eligible for admission.

In the fifth Five-Year Plan (Draft) it is proposed to run separate wings for women instead of opening independent women's polytechnics. It is estimated that about 25 to 30 such wings for women will be started during the Fifth Plan in the existing polytechnics. This proposal will not only ensure additional educational opportunity for women but will also economize in the cost of instructional facilities required for a polytechnic for women.

Appendix 5 on pages 53-54 lists the existing women's polytechnics by location in different states, intake capacity and duration of courses.

PART-TIME DIPLOMA COURSES

The Government has taken keen interest in providing facilities for technician training for workers in industry, engineering undertakings and government departments. The aim of this project is to increase productivity and ensure quality in production on the one hand, and, on the other, to enable workers to improve their qualifications and better their prospects. In order to achieve this aim, part-time diploma facilities have been provided in 33 polytechnics. At least 24 of these polytechnics were started under a centrally-sponsored scheme which envisaged 100% financial assistance from the central government for the part-time courses for a period of five years from the date of their establishment. Instruction is provided in the conventional branches of Civil, Mechanical and Electrical Engineering. Each of the 33 polytechnics is designed for an annual admission capacity of 120 candidates. The duration of the course is four years. Minimum requirements for admission are the same as for full-time diploma course but include two years' experience of active technical service.

In addition to the above polytechnics, facilities have been provided for part-time diploma course in printing technology in four regional schools of printing technology.

Distribution of polytechnics running part-time diploma courses by location may be seen in Appendix 4 on pages 51-52.

FACULTY DEVELOPMENT AND QUALITY IMPROVEMENT PROGRAMMES

To train polytechnic teachers, four regional technical teachers' training institutes have been started, one each in Madras (Southern Region), Bhopal (Western Region), Chandigarh (Northern Region) and Calcutta (Eastern Region). All four run a full-time regular course leading to a Diploma in Technical Teaching. In addition, they organize short-term training programmes, refresher courses, summer school and winter school programmes, and special workshop projects for the preparation of instructional material, teaching aids and work-books on important topics for serving teachers. Some of these institutes are also engaged in programmes of examination reform and evolving evaluation techniques in co-operation with the appropriate State Boards of Technical Education.

A programme of industrial training forms an integral part of the Diploma in Technical Teaching in the technical teachers' training institutes. It lasts from twelve to 15 weeks depending upon the speciality or topic of study concerned. Here again, the idea is to familiarize the teacher trainee with the actual work situations and the live problems which an industry faces in the various processes of production, design, development and maintenance. Through the industrial training there is an effective cross-fertilization of academic study with the industrial environment. Studies have shown that this programme not only considerably increases the teaching effectiveness of the trainees but that it also changes their outlook.

Science and technology are advancing rapidly, and each day opens new vistas of knowledge. These developments have an essential bearing on engineers, technicians and operatives in all walks of life. Under such circumstances, it has not only become imperative to continually revise, remodel and review the curriculum of technician courses but also to ensure that it takes full care of the changing pattern of jobs on the one hand and their application in engineering practices on the other.

The technical teachers' training institutes have therefore been entrusted with the work of curriculum planning, and special curriculum cells have been instituted in each of these institutes for this purpose. The curriculum development cells in the technical teachers' training institutes and the Allahabad Polytechnic, Allahabad (U.P.), have now taken upon themselves the responsibility of conducting surveys of industries and engineering departments and organizations so as to identify and analyse technician functions, find out special functions and operations, and identify the course structures for the different specialities. After this exercise the curriculum development cells engage themselves in the development of appropriate teaching aids and instructional materials. Serving teachers in polytechnics are trained in the use of these instructional materials and teaching aids and are apprised of modern methods of teaching and course planning.

In curriculum planning and the follow-up programmes, full co-operation is extended to the institutes by the Department of Technical Education and the State Boards of Technical Education. This hastens the adoption of the new curricula for purposes of teaching and final examination. The faculties of the technical teachers' training institutes are fully assisted by the faculties of the polytechnics. The whole programme is so designed as to ensure harmonious relations and secure those benefits that are not generally available to programmes run in isolation.

Present diploma-level education is defective in that the course curriculum is inflexible and the instruction is not oriented appropriately towards practice in industry and other fields where the services of technically trained personnel are needed. One of the reasons for this is that the country is not sufficiently developed industrially; another is that there has been an absence of apprenticeship in industry. Also, the outlook of teachers in polytechnics is not sufficiently practice-oriented, with the result that instruction is overloaded with theory unsupported by practical experience. Steps have now been taken to remove these limitations.

Under the Quality Improvement Programme launched during the Fourth Plan period the following programmes have been undertaken with the chief aim of improving the quality and nature of teaching in the polytechnics:

(a) Short-term In-service Courses for Teachers in Polytechnics

Under this programme short courses on important topics relating to pedagogy, teaching methods and appropriate subjects of course curricula are organized in appropriate institutions. The entire expenditure on this programme is borne by the Government of India.

(b) Summer School/Winter School Programmes

Under the aegis of the Indian Society for Technical Education, courses extending up to twelve weeks are organized to provide instruction for serving teachers on different topics. Subjects for these programmes are carefully chosen so as to cover a wide range of requirements.

(c) Short-term Industrial Training Programme

Under this programme, teachers in engineering colleges and polytechnics are deputed for industrial training for a period of three months. For this programme the summer vacations are utilized. Industries and engineering undertakings are selected keeping in view the broad requirements of polytechnic education. The teachers deputed are expected to acquaint themselves with the actual process of production, design and construction work, and to utilize this knowledge in the classroom. During the training period the teacher is paid a monthly stipend of 300 rupees a month in addition to a travel grant of 100 rupees.

It is worth mentioning here that the technical teachers' training institutes at Bhopal, Madras and Chandigarh have benefited from a massive programme of British collaboration. This collaboration has brought new concepts, new teaching practices and new ideology to the field of technical education as a whole. The exchange of experts and teaching personnel between the two countries has also been very effective. British contributions of teaching materials, library books, and equipment needed for education technology laboratories, reprographic centres and other centres and laboratories have also been massive. One of the important ideas introduced in the technical education system through the British collaboration has been programmed learning. Now successfully implemented in almost all the technical institutions, it has received wide acclaim both from teachers and students.

APPRENTICESHIP TRAINING

As there has so far been no first-rate apprenticeship programme, it has been difficult to provide facilities for practical training for all the students during their course. Arrangements have, however, been made on a limited basis for post-qualification training in industry, under the practical training stipend programme. In this programme, the Government provides stipends to the value of 150 rupees a month for a diploma holder and 250 rupees a month for a degree holder for a period of 12 months. The scope of this scheme is limited because there are not enough training places in industry for the diploma/degree holders.

This programme facilitates proper practical training in appropriate industries. The apprentice meets actual work situations of production, manufacture, design and construction work and gets accustomed to the industrial environment.

The scope of the Apprenticeship Act of 1961 was extended by an amendment in 1973. As a result, the training of degree/diploma holders in engineering and technology has been brought within its purview. Classified industries are now required to make provision for a specified number of paid apprenticeship places. They share the cost of stipends with the Boards of Apprenticeship Training up to a value of 150 rupees for diploma holders and 250 rupees for those with degrees. In this connection it may be stated that the Government of India has established Boards of Apprenticeship Training in each of the four regions. The Western Region, consisting of Maharashtra, Gujarat, Madhya Pradesh, Goa, Daman and Dieu, is serviced by the Board of Apprenticeship Training, Western Region, Bombay; and the Southern Region, comprising Andhra Pradesh, Tamilnadu, Kerala and Karnataka, by the Board of Apprenticeship Training, Southern Region, Madras. The Northern Region, with Uttar Pradesh, Punjab, Rajasthan, Haryana, Delhi Pradesh, Chandigarh, Jammu and Kashmir, is looked after by the Board of Apprenticeship Training, Northern Region, Kanpur; and the Eastern Region, comprising West Bengal, Orissa, Bihar, Assam and the Union territories of the region, is taken care by the Board of Apprenticeship Training at Calcutta. These statutory organizations are administered by a duly constituted Board of Governors with a director to manage the affairs of the Board of Apprenticeship Training.

Efforts have thus been successfully directed towards creating first-rate apprenticeship training in engineering and technology. It is an effort towards post-qualification training which conditions and re-orients raw graduates and diploma holders to suit the actual needs of industry. Without doubt it increases the employability of trainees and the effectiveness of their executive powers.

DEGREE COURSES

In India 138 engineering colleges are being run for the professional training of engineers and technologists. These colleges offer courses leading to a bachelors degree in engineering and technology. These engineering colleges are inclusive of the Indian Institutes of Technology at Bombay, Kanpur, Madras, Delhi and Kharagpur, the Institute of Science, Bangalore, the Institute of Sugar Technology, the Institute of Paper Technology, 16 Regional Engineering Colleges and some other national centres of specialized technology. The Indian Institutes of Technology are the apex institutes which also offer postgraduate courses in engineering and technology and first-rate facilities for research work leading to doctoral and post-doctoral degrees.

The regional engineering colleges were set up during the Second and Third Plan periods. They have been developed into centres of excellence and as pace-setters for the engineering colleges run by the state governments and private agencies. Quite a few of these colleges also run postgraduate courses leading to M.E./M.Tech. degrees. Also, they offer excellent facilities for research in science, engineering and technology. Each regional engineering college is run by a registered Society and administered by a duly constituted Board of Governors.

Roorkee University is considered to be the pioneering engineering/technological university having residential status. It is an excellent research centre offering facilities in a variety of subjects. Another technological university, known as the Jawahar Lal Nehru Technological University, has come into being in Hyderabad during the Fourth Plan. This university has three constituent engineering colleges.

The engineering colleges run a B.E. course of five years' duration after higher secondary education and four years' duration after an intermediate or predegree course. Facilities are available in a variety of subjects besides the conventional courses in civil, mechanical and electrical engineering. The sanctioned intake capacity of all the engineering colleges is more than 21,000 (reduced by 33% in 1968 due to economic recession and growing unemployment amongst technically trained graduates and diploma holders).

The Indian Institutes of Technology, the Indian Institute of Science, Bangalore, the Banaras Hindu University and Roorkee University have excellent facilities for teaching, research and educational innovation. These centres are, therefore, being used specially for teacher training programmes and programmes of higher studies leading to M.E./M.Tech., doctoral degree and post-doctoral degree studies for teachers in engineering colleges under the Quality Improvement Programme. All these centres run curriculum development cells to update the curriculum of courses leading to first degrees in engineering and beyond. Also, under the Quality Improvement Programme, these institutes run short-term in-service courses and short-term refresher courses in a variety of specialized topics of interest for the benefit of teachers of engineering colleges. They also run summer school programmes and winter school programmes in collaboration with professional bodies like the Indian Society for Technical Education. Some of these institutes - notably the Institute of Science, Bangalore, and the Indian Institutes of Technology, Bombay and Kanpur - have developed excellent research facilities in such important fields as space research, industrial design and aircraft technology. It is worth mentioning here the unique contribution made by the All-India Institute in Planning and Architecture and the Indian School of Mines, Dhanbad. They run courses in narrow specialities of national importance.

Facilities for part-time courses are offered by twelve engineering colleges for the benefit of industrial workers. Admission capacity of these part-time education centres is 790. These four-year courses are run for diploma holders in engineering. The duration of the course is four years. The facilities of part-time degree courses are available mainly in civil, mechanical and electrical engineering. Minimum qualifications for admission are a diploma in engineering, and minimum experience of two years of active technical service. There is provision to expand facilities of part-time education during the fifth Five-Year Plan. This shows how the Government is anxious to improve the lot of the industrial workers and the labour force.

TEACHER TRAINING PROGRAMME

Faculty development programmes have been initiated by the Indian Government with a view to improving the methodology of teaching and the quality of the teachers. Initially, the Government sponsored a technical teacher training programme to which a large number of teachers were deputed both in India and abroad. These were aimed at improving both the teaching and quality of instruction. During the Fourth Plan a massive programme of teacher training has been mounted. Training of teachers has now been recognized as a continuing programme. Under the Quality Improvement Programme, which is fully financed by the Government, teachers of engineering colleges are deputed for studies leading to M.E./M.Tech. degrees, for post-doctoral research, and for three months' industrial training. Under these schemes it is proposed to cover the entire teaching force of engineering colleges. The academic courses referred to are specially tailored to suit teachers in engineering colleges. Each trainee of a M.E./M.Tech. programme is paid a stipend of 300 rupees a month in addition to a grant of 1,000 rupees for industrial tours and project work. Each trainee in doctoral research is paid a stipend of 400 rupees a month plus an industrial grant of 1,000 rupees. The first of these programmes lasts for two years and the second for three years. For the short-term industrial training programme of three months' duration, the teacher trainee is paid 300 rupees a month plus a travel grant of 100 rupees. In addition, teachers are deputed for short-term in-service training and short-term courses in specialized topics and modern technologies and engineering practices.

ROLE OF GOVERNMENT DEPARTMENTS AND THE PRIVATE SECTOR

Government departments - such as the Ministry of Railways, the Ministry of Food and Agriculture, the Ministry of Defence and public sector undertakings like the

Hindustan Steel Ltd, the Bharat Heavy Electricals (India) Ltd, and the Heavy Engineering Corporation - have their own training departments. They recruit raw engineering graduates, diploma holders and craftsmen and train them for specific requirements. The training schools run by these organizations have their own training arrangements. They are self-sufficient in the matter of training capacity. Private organizations and industries have their own training arrangements. They willingly undertake programmes for training teachers and students of technical institutions, but for their own functions and engineering operations they run their own training programmes which bear relevance to their specialized needs.

Of late, the technical education system is being organized to suit the requirements of industries, not only in the general area of their functions but also in specialized fields. Past experience has shown that harmonious relations between technical institutions and industry are essential for the meaningful development of the economy. Day by day, industry and engineering undertakings are becoming more and more closely involved in the education system.

EXAMINATIONS AND AWARDS

Standards of instructional facilities are prescribed and supervised by the universities in the case of courses at degree level and above, and by the State Boards of Technical Education in the case of diploma/technician and certificate courses. Examinations are conducted by these academic bodies, and awards are made on the successful completion of the final-year classes. Over and above these bodies there is the All-India Council of Technical Education which bears constitutional responsibility for the organization and development of technical education throughout the country. This is the apex body in respect of all matters pertaining to technical education and its development up to the desired level. The Council takes stock of long-range needs including the development envisaged in the Five-Year Plans. It also acts as the highest co-ordinating authority in the matter of course-planning and standards.

Practical training is not an essential ingredient for the award of a degree, diploma or certificate except for the degree and diploma courses run on a sandwich pattern. In the sandwich programme, practical training for a period of twelve months is essential, being an integral part of the syllabus. The main reason why practical training is not compulsory for the award of a degree or diploma is that there are not enough training places for all the students attending institutions (49,000 for diploma courses and 21,000 for degree courses). Only in Maharashtra State is practical training an integral part of the technician course, and due credit is given when diplomas are being awarded.

MANPOWER PLANNING

Unless manpower requirements are forecast ten to 15 years in advance, no meaningful effort can be made to organize technical education. In India, first at the national level and then at regional level, identification of manpower requirements for specialized and general engineering needs, and also for emerging technologies, is attempted on the basis of perspective planning. In this process a study of the institutions which provide the manpower resources is also made.

At the national level, the Institution of Applied Manpower Research (3 Ring Road, Indraprastha Estate, New Delhi) is carrying out manpower planning in a modern scientific manner. At the regional level the State Departments of Technical Education are being encouraged to set up proper manpower cells with a view to giving the planning process a meaningful approach.

The Institute of Applied Manpower Research has recently undertaken an extensive survey of educational and training facilities by functions, vocations and professions on an all-India basis. The results of the survey are being examined and analysed. This survey is expected to give, in precise terms, a picture of those educational facilities that are available, those that are required and those that are utilized. While this study is being processed, an in-depth study of specialized fields has also been undertaken by the Institute of Applied Manpower Research. On the basis of these projections, it has been decided that expansion of technical education, at the degree level or the diploma level, is not required during the Fifth Plan. More and more attention is therefore being paid to the consolidation of the existing facilities and to the improvement of the quality of technical education.

APPENDIX 1: DISTRIBUTION OF POLYTECHNICS BY STATE AND SUBJECTS AND THEIR ADMISSION CAPACITY

	Capacity
NORTHERN REGION	
Delhi (3 polytechnics)	
Civil 150, mechanical 270, electrical 210, electronics 30, auto. 30, architecture and draftsmanship 30, refrigeration and air-conditioning 30	750
Himachal Pradesh (2 polytechnics)	
Civil 90, mechanical 60, electrical 105, auto. 15	270
Jammu & Kashmir (1 polytechnic)	
Civil 30, mechanical 45, electrical 45, auto. (post dipl.) 15	135
Punjab (10 polytechnics)	
Civil 420, mechanical 525, electrical 525, textile technology 30, leather technology 25, mechanical engineering (sandwich) 30, auto. (post dipl.) 30	1585
Chandigarh (1 polytechnic)	
Civil 75, mechanical 90, electrical 45	210
Haryana (7 polytechnics)	
Civil 390, mechanical 465, electrical 345, auto. 30, machine tool 30, oper. weld & steel met. tech. 15, ref. and air-cond. 15, elec. mech. and app. 30, elec. & cont. 15, radio and television 15	1305
Rajasthan (6 polytechnics)	
Civil 300, mechanical 450, electrical 450, mining nil, ind. electronics nil, auto. nil, inst. nil	1200
Uttar Pradesh (36 polytechnics)	
Civil 1580, mechanical 2290, electrical 2260, auto. 150, text. chem./tech. 30, electronics 90, arch. asstship 28, ref. air-conditioning 10, leather technology 60, prtg. technology 80, paper and pulp tech. 90, industrial elec. (post dipl.) 15, chemical 10, auto. (post dipl.) 40, inst. 10	6743
EASTERN REGION	
Assam	
Civil 360, mechanical 150, electrical 120, chemical operator 30	660
Bihar	
Civil 670, mechanical 375, electrical 270, mining 40, text tech. 30, ceram. tech. 15, production technology 30, drawing and design	1445

	Capacity
Orissa (5 polytechnics)	
Civil 45, mechanical 155, electrical 155, mining 20, metal 15, chem. 15, tele-com./electronics 35, drilling tech. 10, surveying 10, ref. & air-conditioning 15, auto. 15, instrument 15	505
Tripura (1 polytechnic)	
Civil 30, mechanical 15, electrical 15	60
Manipur (1 polytechnic)	
Civil 30, mechanical 15, electrical 15	60
Meghalaya (1 polytechnic)	
Civil 60	60
West Bengal (27 polytechnics)	
Civil 1135, mechanical 1780, electrical 735, mechanical & electrical (combined) 370, electronics 30, radio comm. nil, mining 58, auto. 30, printing 100, textile technology 20	4258
WESTERN REGION	
Goa (1 polytechnic)	
Civil 40, mechanical 40, electrical 40	120
Gujarat	
Civil 485, mechanical 870, electrical 790, elec. & radio 30, auto. 70, metallurgy 30, text. tech. 150, text. chem. 45, pharm. 200, sound 20, const. & structure 70, ref. & air-conditioning 120, instru. and central 5, machine handing technology 20, agro. ind. engg. 20, tele-comm. 30, television 20, ceramic 20, printing 30, comm. practice 120, production 60, MC tools, mec. & tools engg. 40, oil and gas tech. 30, production of fertilisers 30, synthetic resins & plastics 30	3355
Madhya Pradesh	
Civil 818, mechanical 758, electrical 734, mining 10, meta. 30, auto. 12, pharm. 30, text. tech. 15, printing 20, structural engg. 15, comm. practice 60, fine arts 25	2527
Maharashtra	
Civil 1290, mechanical 1170, electrical 1100, tele-communication 120, mining 15, meta. 50, auto. 15, text. tech. 70, text. chem. 50, sugar tech. 10, paint 20, arch. 136, chem. 40, parm. 220, leather tech. 15, printing 100, sound & television 21, production 50, ind. electronics. 50	4542

	Capacity
SOUTHERN REGION	
Andhra Pradesh	
Civil 860, mechanical 975, electrical 945, elec. comm. 60, mining 20, auto 60, text. tech. 30, ceram. tech. 25, meta. nil, pharm. nil, chem. 90, commercial practice 40	3105
Kerala	
Civil 820, mechanical 925, electrical 625, tele-comm. 30, auto 60, text. tech. 60, chem. operator 60, printing 30	2610
Tamil Nadu	
Civil 1250, mechanical 1487, electrical 1295, auto 40, text. tech. 100, leather tech. 15, printing 95, chem. operator 60, production engineering nil, fisheries and navigation 30, refrigeration nil, town and country planning nil, meta nil, tool design nil, welding tech. nil, commercial practice nil	4327
Mysore	
Civil 1085, mechanical 1005, electrical 975, tele-comm. 70, mining 60, auto 80, text. tech. 40, printing nil, sound nil, ceram. tech. nil, meta. 30, cinematography nil, commercial practice 110	3455
Pondicherry	
Civil 60, mechanical 40, electrical 40, comm. practice nil	140
SUMMARY	
Northern Region (66 institutions)	12243
Eastern Region (54 institutions)	7048
Western Region (73 institutions)	10544
Southern Region (90 institutions)	13682

APPENDIX 2: POLYTECHNICS CONDUCTING SANDWICH DIPLOMA COURSES

Ramgarhia Polytechnic, Phagwara

Allahabad Polytechnic, Allahabad

Government Polytechnic, Panaji, Goa

K.J. Somaiya Polytechnic, Bombay

Polytechnic Institute, Harda

R.C. Technical Institute, Ahmedabad

Bhagubai Mafatlal Polytechnic, Bombay

S.V. Government Polytechnic, Bhopal

Dharamsinh Desai Institute of Technology, Nadiad

Shri Bhavsinhji Polytechnic, Bhavnagar

Government Polytechnic, Ujjain

Dr. S.& S. Gandhy College of Engineering and Technology, Surat

Government Polytechnic, Bulsar

A.V. Parekh Technical Institute, Rajkot

Vaishnav Polytechnic, Indore

Samrat Ashok Technological Institute, Vidisha

K.V. Polytechnic, Patna

Government Girls Polytechnic, Ahmedabad

L.E. College, Morvi

Government Polytechnic, Rajkot

K.J. Polytechnic, Broach

Government Girls Polytechnic, Surat

Pt. Jawahar Lal Nehru Polytechnic, Sanawad

Bhailal Bhai & Bhikhabhai Polytechnic, Vallabh Vidyanagar

C.T.I. Polytechnic, Gwalior

Government Polytechnic, Dhanbad

Government Polytechnic, Barauni

Orissa School of Engineering, Cuttack

Behrampur Engineering School, Behrampur

Jharsaguda Engineering School, Jharsaguda

Orissa School of Engineering, Keonjhar

Assam Engineering Institute, Gauhati

Birla Institute of Technology, Calcutta

The Calcutta Technical School, Calcutta

State Technological Institute, Rourkela

M.C.M. Polytechnic, Avadi, Madras

A.H. Wadia Institute of Technology, Kalina, Bombay

Angel Junior Technical College (Polytechnic), Bombay

Government Polytechnic, Visakhapatnam

Y.M.C.A. Institute of Engineering, Faridabad

Tamil Nadu Polytechnic, Madurai

Coimbatore Institute of Technology Sandwich Polytechnic, Coimbatore

Central Polytechnic, Madras

Government Polytechnic, Khandwa

APPENDIX 3: EXISTING & PLANNED PROGRAMMES OF DIVERSIFICATION

(Location refers to a Government Polytechnic except where stated)

ANDHRA PRADESH

Degree Courses	
Electronics and Communication Engineering	Nagarjunasagar College, Hyderbad
Diploma Courses	
Chemical Engineering	Visakhapatnam
Automobile Engineering	Anantpur
Commercial Practice	Tirupathi and Vishakhapatnam
Pharmacy	Tirupathi, Vishakhapatnam and Hyderabad
Radio Electronics	Hyderabad (under USSR programme)
Part-time Diploma Courses	
Electrical Communication Engineering	
Civil Engineering	

ASSAM

Diploma Courses	
Automobile Engineering	
Agricultural Engineering	
Tele-Communication Engineering	

BIHAR

Diploma Courses	
Chemical Operators Course	Ranchi
Commercial practice	Ranchi
Mettalurgy	Ranchi
Technology of Mechanical Engineering (under USSR programme)	Ranchi

GOA

Diploma Courses	
Commercial Practice	Goa
Structural Fabrication and Erection	Goa
Electrical Communications	Goa

GUJARAT

Diploma Courses	
Construction and Structural	Ahmedabad, Bhavnagar, Patan & Bulsar
Technical in Chemical Industry	Bulsar
Sound and Television Engineering	Rajkot

Telecommunication Engineering	Rajkot
Ceramics Technology	L. E. College, Morvi
Printing Technology	Ahmedabad
Commercial Practice	Patan, Porbander, Broach and Rajkot
Technical Sales Reprsentatives & Services	L. D. College of Engineering, Ahmedabad
Technicians for Oil and Gas Industry	Baroda University Polytechnic (under USSR programme)
Post-Diploma Courses	
Production Engineering	S. & S. S. Gandhi College, Surat, and Bhavsinhji Polytechnic, Bhavnagar
Instrumentation & Control	A. V. Parekh Technical Institute, Rajkot
Material Handling Technology	Ahmedabad
Air conditioning and refrigeration	L. D. College of Engineering, Ahmedabad
Power Plant Engineering	L. D. College of Engineering, Ahmedabad
Part-time Courses	
Machine Tools Technology	Ahmedabad
Welding Technology	Ahmedabad
Tods Engineering (Jigs, Dies and Fixtures)	Ahmedabad
Short-term Job-oriented Programmes in	
Office Management and Business Correspondence	
Accountancy and Taxation	
Banking	
Instrumental Analysis	
Industrial Engineering and Management	
Computer Programming	
Stenography	
Reception and PBX Operator	
Punch Operator	
Laundrier	
Public Address system-cum-Project Operator	
Electroplater	
Farm Mechanic	
Family Planning Assistant	
Typewriting and Duplicating Machine Repairer	
Truck Driver-cum-Repairer	
Plumber	

India

Foundryman

Hospital Assistant

HARYANA

Diploma in Commercial Practice at Government Polytechnic, Ambala.

KERALA

Degree Course	
Rubber Technology	College of Engineering, Trivandrum
Diploma Courses	
Electronics and Communication Engineering	Central Polytechnic, Trivandrum and S. S. Polytechnic, Trichur
Fisheries Technology	Calicut
Cinematography	Central Polytechnic, Trivandrum
Instruments Technology	Women's Polytechnic, Trivandrum
Pharmacy	Women's Polytechnic, Calicut
Laboratory Technician	Women's Polytechnic, Trichur

MADHYA PRADESH

Diploma Courses	
Electronics	Jabalpur
Town Planning	S. V. Polytechnic, Bhopal
Metallurgy	Durg (under USSR programme)
Technology of Mechanical Engineering	S. V. Polytechnic, Bhopal (under USSR programme)
Post-Diploma Courses	
Irrigation Engineering	

MAHARASHTRA

Diploma Courses	
Wool Technology	V. J. T. I., Bombay
Industrial Electronics	B. M. Polytechnic, Vile-Parle, Bombay
Post-Diploma Courses	
Jigs and Fixtures	Poona

MYSORE

Degree Courses	
Electronics and Communication Engineering	Engineering College at Gulbarga, Bangalore and Davangere
Diploma Courses	
Electronics	M. E. I. Polytechnic, Bangalore; Gulbarga

Automobile Engineering	L. V. Polytechnic, Hassan; Bellary
Leather Technology and Plastics	Chintamani
Public Health Engineering	Chintamani
Agriculture Engineering	D. A. C. F. Polytechnic, Chickmangalur and Krishnarajapet
Construction Technology	Raichur
Chemical Engineering	Karnataka Polytechnic, Mangalore
Post-Diploma Courses	
Refrigeration and Air-Conditioning	S. J. Polytechnic, Bangalore
Production Engineering	S. J. Polytechnic, Bangalore
Metrology and Quality Control	S. J. Polytechnic, Bangalore
Electronics	S. J. Polytechnic, Bangalore
Machine Tool Technology	S. J. Polytechnic, Bangalore and D. R. R. Polytechnic, Davangere
Welding Technology	Tumkur and Belgaum
Erection and Maintenance Engineering	Karnataka Polytechnic, Mangalore
Design Draughtsmanship and Production Development	M. E. I. Polytechnic, Bangalore
Architecture and Town Planning	K. H. K. Institute, Dharwar
Foundry Technology and Heat Treatment Technology	S. J. Polytechnic, Bhadravati
Boring and Drilling and Mine Surveying	School of Mines, Oorgaum
ORISSA	
Diploma Courses	
Automobile Engineering	Orissa School of Engineering, Cuttack
Instrument Technology	Orissa School of Engineering, Cuttack
Electrical Communication Engineering	Berhampore Engineering School, Berhampore
Mines Surveying and Drilling	Orissa School of Mining, Keonjhar
Post-Diploma Courses	
Refrigeration and Air-Conditioning	Jharsuguda Engineering School
PUNJAB	
Post-Diploma Course	
Air-Conditioning and Refrigeration	Amritsar
UTTAR PRADESH	
Diploma Courses	
Electronics	Allahabad, K. L. Polytechnic, Roorkee; D. N. Polytechnic, Meerut; Lucknow, Kanpur
Chemical Engineering	Gorakhpur, Bareilly

India

Automobile Engineering	Bareilly, Meerut, Lucknow, Kanpur, Jhansi, Mirzapur and Gorakhpur
Agriculture Engineering	Barielly and Lucknow
Commercial Practice	Barielly and Lucknow
Post Diploma Courses	
Industrial Electronics	Allahabad, Bareilly, Lucknow and Kanpur
Refrigeration and Air-Conditioning	M. G. Polytechnic, Hathras; Bareilly, Moradabad, Lucknow, Faizabad, Mirzapur, Gorkhpur, D. N. Polytechnic, Meerut; Allahabad
Automobile Engineering	Lucknow, and P. M. V. Polytechnic, Mathura
Foundry Technology	Moradabad
High Altitude Engineering	Nainital
Instrument Technology	Manpur
Design and Drafting	Allahabad and Lucknow

TAMIL NADU

Degree Courses	
Sugar Technology	Institute of Chemical Technology, Madras
Agricultural Technology	Muthai Polytechnic, Annamalainagar
Production Technology	Coimbatore
Design and Drafting Technology	P. S. G. Ploytechnic, Coimbatore
Industrial Engineering	Coimbatore
Electronics	Tamilnadu Polytechnic, and Women's Polytechnic Madurai
Bio-medical Technology	Vellore
Plastics and Petro-Chemical Technology	Institute of Chemical Technology, Madras
Television	Institute of Film Technology, Madras
Library Science	Women's Polytechnic, Madras
Commercial Practice	V. S. V. N. Polytechnic, Virudhunagar, and Women's Polytechnic, Madurai
Post-Diploma Courses	
Welding Technology	Tiruchirapalli
Marine Engineering	Central Polytechnic, Madras
Diesel Locomotion and Traction	Tiruchirapalli

PONDICHERRY

Diploma Course	
Commercial Practice	
Electronics	

APPENDIX 4: PART-TIME DIPLOMA COURSES

Civil/Mechanical/Electrical Engineering

	Admission Capacity
Chandigarh	
Central Polytechnic, Chandigarh	30
Punjab	
Guru Nanak Engineering College, Ludhiana	60
Thapar Polytechnic, Patiala	60
Rajasthan	
Jodhpur Polytechnic, Jodhpur	30
Government Polytechnic, Kota	
Uttar Pradesh	
Government Polytechnic, Kanpur	100
Hewett Polytechnic, Lucknow	120
West Bengal	
Acharya Prafulla Chandra Roy Polytechnic, Calcutta	120
J. C. Ghosh Polytechnic, Calcutta-23	60
Central Calcutta Polytechnic, Calcutta-14	60
Birla Institute of Technology, Calcutta-50	40
Asansol Polytechnic, Asansol	120
Calcutta Technical School, Calcutta-13	120
Bihar	
New Government Polytechnic, Patna-13	100
Gujarat	
Dr S. S. Gandhi College of Eng. & Tech., Surat	45
Government Polytechnic, Ahmedabad	100
Government Polytechnic, Dohad	45
S. B. Polytechnic, Bhavnagar	45
Government Polytechnic, Bulsar	30
Government Polytechnic, Porebander	15
Shri K. L. J. Polytechnic, Broach	30
M. S. University Polytechnic, Baroda	100
Madhya Pradesh	
S. V. Government Polytechnic, Bhopal	120
Shri Vaishnav Polytechnic, Indore	120
Government Polytechnic, Jabalpur	120

India

	Admission Capacity
Government Central Technical Institute (Polytechnic), Gwalior	120
Maharashtra	
Government Polytechnic, Poona	120
Andhra Pradesh	
Government Polytechnic, Hyderabad	80
Kerala	
Kerala Government Polytechnic, Calcutta-5	60
Maharaja's Technological Institute, Trichur	60
Government Polytechnic, Kalamarsery	60
Centre Polytechnic, Trivandrum	
Tamil Nadu	
Central Polytechnic, Madras	120
Government Polytechnic, Tiruchirapalli	
Printing Technology	
Northern Regional School of Printing Technology, Allahabad (U.P.)	20
School of Printing Technology, Calcutta (West Bengal)	40
Government Institute of Printing Technology, Bombay (Maharashtra)	50
Regional School of Printing, Madras	35
Total	2485

APPENDIX 5 : GIRLS' POLYTECHNICS

With Dates of Establishment, Fields of Study, and Admission Capacity

	Capacity
NORTHERN REGION	
Delhi Women's Polytechnic, Kashmere Gate, Delhi 6 (1962)	
Electronics 25, commerical practice 25, interior decoration 25, library science 25, medical laboratory tech. 28, commerical art 25, architectural assistantship 30	185
Chandigarh Government Polytechnic for Women, Chandigarh (1962)	
Commercial practice 30, architectural assistantship 25, pharmacy and dress-making course 30, interior decoration and display 30, radio engineering and electronics 30, library science 30	175
Punjab Government Polytechnic for Women, Jullundur	
Library science 30, commercial practice 30, pharmacy 30	90
Haryana Government Polytechnic for Women, Ambala	
Library science 30, pharmacy and dress-making 30	60
Uttar Pradesh Government Girls' Polytechnic, Lucknow (1963)	
Electronics 30, commercial practice 45, architectural assistantship 10	95
Women's Polytechnic Aligarh Muslim University, Aligarh (1966)	
Electronics 30, commerical practice 20, costume design etc. 20	70
EASTERN REGION	
West Bengal Women's Polytechnic, 21 Convent Road, Calcutta 14 (1963)	
Electrical communication 30, architectural assistantship 30	60
Orissa S. K. D. A. Polytechnic for Women, Roukela 4 (1968)	
Tele-communication 15, library science 30, commerical practice 30	75
Assam Girls' Polytechnic, P. O. Silpakhari, Gauhati 3 (1964)	
Civil engineering/draughtsmanship 15, commerical practice 30	45
WESTERN REGION	
Gujarat Government Polytechnic for Girls, Ahmedabad 15 (1964)	
Costume and dress-making 30, commercial practice 30, electronics radio engineering 30, architectural draughtsmanship and assistantship 30	120
Government Girls' Polytechnic, Surat (1965)	
Commercial practice 30, architectural draughtsmanship and assistantship 30, electronics and radio engineering 30, commercial art 30	120

	Capacity
Madhya Pradesh Government Women's Polytechnic, Bhopal	
Medical laboratory technology 25, costume design and dress-making 15, architectural draughtsmanship 15, commercial practice 25	80
SOUTHERN REGION	
Andhra Pradesh Kamala Nehru Girls' Polytechnic, Hyderabad (1961)	
Civil 30, electrical communication engineering 30, catering and fool technology 30, commercial practice 60, pharmacy 100	250
Government Polytechnic for Girls, Kakinada (1961)	
Civil Engineering 30, communications engineering 30, pharmacy 30, commercial practice 30	120
Government Polytechnic for Women, Guntur 4 (1968)	
Commercial practice 30, communications engineering 30, costume design and dress-making 30	90
Kerala Women's Polytechnic, Trivandrum 18	
Costume design and dress-making 30, commercial practice 30	60
Women's Polytechnic, Trichur 7 (1962)	
Commercial practice 30, costume design and dress-making 30, electronics 30	90
Women's Polytechnic, Calucut 9 (1963)	
Commercial practice 30, costume design and dress-making 30	60
Tamil Nadu Government Polytechnic for Women, Madras 20	
Electronics 30, costume design and dress-making 30, commerical practice 30, civil engineering 30	120
Government Polytechnic for Women, Madurai (1963)	
Civil engineering	30
Government Polytechnic for Women, Coimbatore	
Civil engineering 30, commercial practice 30, electronics 30	90
Karnataka Government Polytechnic for Women, Hubli 21	
Commerical practice 30, costume and dress-making 30, tele-communication 30, civil engineering draughtsmanship 30	120
Government Polytechnic for Women, Bangalore	
Commercial practice 30, costume design and dress-making 30, civil engineering draughtsmanship 30, library science 30	120
Government Polytechnic for Women, Mangalore (1970)	
Commercial practice 30, tele-communication 30, library science 30	90

APPENDIX 6: ENGINEERING COLLEGES

Courses additional to civil, mechanical, and electrical engineering (which are run in all States)	Admission capacity	Actual admissions	Out-turn
NORTHERN REGION			
Chandigarh (4 institutions)			
Agro; Meta; Elec Comm; Arch; Chem; Chem; Pharm; Prodn.	505	350	404
Delhi (3 institutions)			
Chem; Text Tech; Electronics.	610	538	483
Haryana (2 institutions)			
Text Tech; Electronics.	320	315	219
Jammu & Kashmir (1 institution)			
Meta; Chem.	250	65	175
Punjab (3 institutions)			
Agri Engg.	435	302	399
Rajasthan (5 institutions)			
Meta; Electronics; Mining; Chem; Pharm; Agri Engg.	870	496	730
Uttar Pradesh (14 institutions)			
Meta; Agro; Chem; Text Tech; Mining; Electronics; Text Chem; Arch; Pharm; Agri Engg; Sugar Tech; Sugar Engg; Alcohol Tech; Bio-Chem; Food Tech; Oil Tech; Paint Tech; Plastics; Ceramics; Fine Art; Com Art; Sculpure.	2753	2149	2163
EASTERN REGION			
Assam (2 institutions)			
Chem.	240	233	298
Bihar			
Tele-comm; Mining; Petro-Tech; Meta; Chem; Applied Geology and Applied Geop; Prodn.	1039	437	676
Orissa (2 institutions)			
Meta; Chem.	320	334	192

India

Courses additional to civil, mechanical, and electrical engineering (which are run in all States)	Admission capacity	Actual admissions	Out-turn
Tripura (1 institution)	60	15	19
West Bengal (12 institutions) Tele-Comm; Mining; Meta; Text Tech; Arch; Naval Arch; Pharm; Ceram Tech; Leather Tech; Agri; Food Tech; Instrument; Aero; Chem; Plastic & Rubber Tech.	1748	1430	1719
WESTERN REGION			
Gujarat Electronics; Chem; Text Tech; Text Engg; Arch; Meta; Pharm.	1847	1895	1315
Madhya Pradesh (10 institutions) Tele-Comm; Chem; Meta; Mining; Arch; Pharm.	1192	1124	1306
Maharashtra (14 institutions) Tele-Comm; Meta; Chem; Text Tech; Text Chem; Arch; Aero; Instruments; Town Planning; Pharm; Food Tech; Interm & Dyes; Plastics; Pig Paints and Varnish; Oil, Fats and Waxes; Oil and Chem Tech; Pharmaceuticals and Fine Chem; Petroleum.	2404	2504	2448
Goa	60	48	24
SOUTHERN REGION			
Andhra Pradesh (11 institutions) Electronics; Chem; Arch; Mining; Pharm; Meta; Marine Mech.	1450	1145	966
Kerala (6 institutions) Chem; Electronics; Arch.	1120	679	815
Tamil Nadu (15 institutions) Electronics; Chem; Automobile; Meta; Text Tech; Pharm; Leather Tech; Aero; Instrument; Technology; Arch.	1630	2295	1887
Mysore (17 institutions) Text Tech; Tele-Comm; Meta; Chem; Arch.	1470	1843	1985

Summary

REGION	No. of Institutions	Sanctioned strength	Actual admissions	Out-Turn
NORTHERN REGION	32	5744	4215	4573
EASTERN REGION	24	3407	2449	2904
WESTERN REGION	33	5623	5571	5093
SOUTHERN REGION	49	6670	5962	5653
Total	138	21444	18197	18223

MALAYSIA

EXISTING PROGRAMMES

In Malaysia the National Industrial Training and Trade Certification Board (NITTCB), under the Ministry of Labour and Manpower in co-operation with the private sector, has developed national standards at basic, intermediate and advanced levels for 19 industrial trades. To assist training institutions, the NITTCB has prepared national training syllabuses for 18 trades at basic level and work is now in progress to prepare syllabuses for these trades at intermediate and advanced levels. The Board will also undertake the specification of training standards and syllabuses for other industrial trades. The certificates to be awarded by the NITTCB will command acceptance in both public and private sectors. The Directorate of Technical Education is in overall charge of lower-level technical education.

Technician training is provided in three institutions - Ipoh Polytechnic, the National Institute of Technology, and the MARA Institute of Technology.

Engineering degree courses are run by the National Institute of Technology. This Institute also runs diploma courses in engineering, which are mainly broad-based and conventional. The University of Malaya has an engineering degree course of four years' duration.

Ipoh Polytechnic runs diploma courses on a sandwich pattern of two years' duration, so in this institution efforts are made to link technical education with practical training in industry in an effective manner. One more polytechnic, at Kuantan in Pahang, is in process of development. This polytechnic is understood to be designed to run agricultural product processing courses besides sandwich technician courses, and will have an enrolment of over 1,000 students. The Government has given high priority to the development of technical education and training at all levels.

It was heartening to note that the expansion and intensification directed towards strengthening facilities for technical education are being co-ordinated at the highest level by the Economic Development Division of the Prime Minister's Secretariat. Also, through the National Advisory Council on Industrial Training, the various training programmes conducted in the industrial institutes are being effectively monitored so that they are related to actual needs of industry and the economy as a whole. This in the long run will check the haphazard growth of technical institutions, and as a result the labour market will not suffer from fluctuations in supply.

The Technical Teachers' Training College conducts a three-year trade teachers' course for training vocational teachers in the engineering trades. This is one field where shortages of properly trained and qualified teachers at all levels continuously hamper the development effort. The Government has utilized, and is still anxious to make the best use of, training facilities offered by other countries in the Asian region.

OVERSEAS TRAINING

In view of the shortage of high-level manpower, efforts have been made to augment the supply from local institutions through the provision of more scholarships for overseas training. During the period 1971-73, a total of 1,962 scholarships, including the MARA awards, were given in various fields - most of them in science, technology and education. In addition to such Government scholars, there are an estimated 18,000 private students undertaking a variety of courses in foreign institutions.

SALIENT FEATURES OF TECHNICAL EDUCATION PROGRAMMES

Industrial training is being organized in vacations. Facilities offered by industry are utilized by the MARA Institute, the National Institute of Technology and the University of Malaya. Training facilities are offered by most sizeable industries.

The training programme run by the Tele-communications Centre, the National Electricity Board and the Railways Training Institute are by far the most satisfactory both in quality of training and in material resources. The training is meaningful in that it caters for the needs of the Government as well as of the private sector.

In Malaysia they have injected a technical/vocational stream into the education system from the lower secondary level. The result is that the end-product is job-oriented and the basic skills and knowledge are those sought after by employers.

Two-year programmes for ordinary grade technicians are run in the Ipoh Polytechnic. Engineering and commercial subjects are also run at diploma level. It is expected that the Ipoh Polytechnic will have an intake of 1,273 technicians in 1975 compared with an intake of 493 in 1970.

Vocational schools are run to prepare appropriate manpower for employment in accordance with precise requirements. The MARA Institute also runs vocation-oriented courses.

In Malaysia newer and diverse types of industry will require more and more technicians and middle-level personnel trained in specialized fields. During the pre-independence period the emphasis was mainly on the production of raw materials requiring technicians for a few narrow fields. Now that special and technology-intensive industries are coming up, the country will require technicians of a wider range. The technical and engineering personnel required to man and manage the industries will have to be fully equipped so that they can match their capabilities with the changing requirements of modern technological advance.

The country will thus face a shortage of adequately trained engineers and technicians in the various specialized fields and emerging technologies for some time. It will certainly seek effective assistance and technical co-operation from countries that have developed proper expertise and training facilities in the diverse specialities.

Malaysia has in the past utilized training facilities available in the countries of the Asian region for the training of technician teachers. It will certainly want to continue to avail itself of such facilities.

The present demand both for middle (diploma) and professional (degree) technologists is very great for both public and private sectors. An example was shown in a report by the Economic Planning Unit of the Prime Minister's Department entitled "Manpower Requirement in Malaysia in 1955-1970". Malaysia during that period alone needed at least 575 technologists a year at diploma level and 320 at degree level. The shortages are still serious.

Malaysia

MANPOWER NEEDS

The shortage of skilled manpower has in the past few years been one of the constraints on the expansion of industry, and wages for skilled workers have shown an upward trend. The overall constraints however, include not only skill shortages but also shortages of construction materials and, to some extent, administrative bottlenecks.

A Survey of Professional Engineering Needs conducted by the Government in 1973 indicated that the public sector had very high vacancy rates: nearly 25% at professional and sub-professional levels. During 1971-1975, the requirements for professional manpower (in engineering, architecture, surveying, etc.) were estimated at 8,000, and for technician-level manpower at 2,200. These figures pertain only to the public sector needs broadly at university and college and polytechnic levels. The requirements at these levels and at the craftsman level in both the public and the private sector are not known with any degree of certainty.

During the five-year period (1971-75) output of degree graduates from engineering courses has been about 600, and from diploma courses in Engineering, Architecture, Surveying, and Town and Country Planning about 1,750. About 300 to 400 students - including those on scholarships and private students in Engineering, Architecture, Surveying, Town and Country Planning etc. - have been returning to Malaysia during the five years, after training in institutions overseas. Thus, in total, the availability of professional level manpower in the related areas for the five-year period is about 900-1,000.

Training of middle-level manpower is primarily the concern of the MARA Institute of Technology, the Ungku Omar (Ipoh) Polytechnic, Tunku Abdul Rahman College, and similar institutions. Their enthusiasm, clarity of purpose, and wide spectrum of work enable them to be involved in the training of supervisors, clerks-of-works, building technicians and others.

Another institution which should concentrate on the training of middle-level manpower is the former Technical College which, as a result of growing aspirations, has been transformed into the Institute of Technology. Provided that its courses are not too theoretical and its output is not geared entirely to the needs of government technical departments, this Institute could well pioneer a wide variety of courses outside the formal system.

Skilled worker training is currently provided at the Industrial Training Institute in Kuala Lumpur and in Prai which, according to their published information, would have a capacity of about 700. Because they are new, these institutes suffer from inadequate staff, salary and status compared with those with a corresponding responsibility for the manufacturing industry.

In addition to these government programmes, agencies such as PAM (Persatuan Akitek Malaysia), Malaysia Institute of Engineers, MIP (Malaysian Institute of Planners), TAM (Technical Association of Malaysia), while not primarily devoted to education and training, can improve the occupational competence of their membership by means of organized courses, demonstrations of technological improvements, "coaching" technicians, and helping to set up quality training programmes. The Malaysian Institute of Engineers and the Faculty of Engineering at the University of Malaya can, for example, undertake a programme of up-grading technical assistants, while the PAM can independently provide training courses for professional personnel needed in architectural offices. It may be useful also for these organizations, in collaboration with the University of Malaya, Universiti Sains Malaysia in Penang, Institut Teknoloji Kebangsaan and Institut Teknoloji MARA, to organize further training courses for engineers, architects and planners which would enable them to deepen their knowledge of the general and theoretical aspects of their profession.

Since the Malaysian Armed Forces now use highly technical equipment and advanced types of organization they should, like other employing establishments, be required to help train many kinds of qualified personnel. As much of the training is directed toward imparting knowledge, skills and personality traits that apply equally to civilian pursuits, there is much to be gained by accepting their training capabilities for development purposes.

Like any other developing country, Malaysia suffers from shortages of qualified personnel at all levels and in all key posts. However imperfect the available statistics may be, they reveal shortages of professional manpower, middle-level personnel and skilled workers; shortages which exist, paradoxically, side by side with unemployment. Among the measures by which such qualified manpower can be trained and increased, stress is laid on the need for training a new breed of professionals described as graduate technologists, who can combine a broad understanding of physical development processes with specific implementation skills. The main point of emphasis is that universities in this country have an obligation to embrace technology as a discipline. The training of middle-level personnel, on the other hand, is considered to be the proper function of institutes of technology.

At the moment there are four institutions of higher learning providing courses for the professional and management group, namely University of Malaya, Universiti Sains Malaysia, Institut Teknoloji MARA, and Institut Teknoloji Kebangsaan. For the training of technicians, there are three institutions: Politeknik Ungku Omar (Ipoh), Institut Teknoloji MARA, and Institut Teknoloji Kebangsaan.

The Politeknik Ungku Omar is specifically set up to train technicians only, while the Institut Teknoloji MARA and Institut Teknoloji Kebangsaan also provide courses at the professional level. The sources of supply for the other categories of worker are the vocational schools, the Institut Kemahiran MARA and the Industrial Training Institute.

EXPECTED MANPOWER SUPPLY

The four higher institutions listed above should take care of the total supply of the required manpower at professional level. The output of engineers and technicians from the institutions concerned is shown in Appendices 2 and 3, pages 72 and 73. In view of the considerable number of students overseas, the manpower situation is not too bleak. The output of technicians from Ipoh is now getting into its stride. It is optimistically forecast that, even if there are not enough technologists for the building industry by the end of 1975, they will certainly have them by the Third Malaysia Plan period.

SUITABILITY OF TRAINING

Because development in Malaysia has not yet reached a take-off position, the demands for technicians and engineers are not so diverse and specialized as to require extra training facilities. The development and planning of technical education has been monitored and co-ordinated effectively, so that the training imparted is sufficient in academic content and well-oriented to industrial needs.

Malaysia

INDUSTRY, TRAINING AND TECHNICAL INSTITUTIONS

Craftsman Training

This is dealt with by the Manpower Department which was established on 8 May 1969, and provides three services, a training service, an employment service, and a labour market information service. The training service has the task of formulating and implementing industrial training programmes to meet the nation's needs for skilled labour. It provides apprenticeship courses, preparatory trade courses, skill up-grading courses, instructional techniques courses, and trade instructor training courses.

Trade Test Standards

Procedure in developing trade test standards is now well established and, to date, standards for three trades - refrigeration and air-conditioning, gas welding, and earth moving equipment and constructional machinery mechanics - have been drawn up at the Central Trade Standard and Testing Committee level.

In-Plant Training

The in-plant training service is expected to have its full complement of staff by the end of 1975, and the improved staffing position will enable the full range of planned in-plant training activities to be implemented.

Skills Up-grading Courses

In the skills up-grading courses, attention will be devoted to assessing the needs and interests of industry so that the training programmes can produce maximum results.

Employment Service

The object of the employment service is the effective utilization of the nation's manpower resources. It assists job-seekers to be placed in suitable employment and enables employers to obtain suitable workers. This is effected through a network of 20 full-time and 25 part-time employment offices in peninsular Malaysia.

Technician Education

In Malaysia there are three institutions where diploma-level education is imparted. A short summary of each is given hereunder.

1. Ungku Omar Polytechnic, Ipoh

The Polytechnic provides two-year full-time courses in engineering technologies and in business studies, while the course in accountancy is of three years' duration. The Polytechnic's certificate is issued to candidates successfully completing the two-year courses. The three-year course in accountancy leads to the award of the Polytechnic Diploma.

The following courses are provided: Electrical Engineering (Power); Electrical Engineering (Communication and Electronics); Control Engineering (Industrial); Mechanical Engineering (General); Mechanical Engineering (Production); Mechanical Engineering (Automotive and Diesel); Mechanical Engineering (Air-conditioning and Refrigeration); and Mechanical Engineering (Marine).

The pattern of industrial training now in vogue provides the whole of this training in a six-month block, sandwiched between the first and second year, leaving the students free at the end of the second year to move straight into a job. Many industries participate in this sandwich programme.

The Polytechnic treats its industrial training programme very seriously, realizing the importance of it and the prominent part it plays in shaping the otherwise inexperienced student into a responsible technician. The public sector has realized the importance of this training and co-operates whole-heartedly by having well-planned training schedules with gradually increased responsibility for the student.

Some firms, particularly in the public sector, have anticipated the next logical step and have sponsored students. This not only helps the students at one of the most needy times of their life, but gives the firm a potential float of technical manpower and allows for greater flexibility in the prediction of staff requirements over a period of at least two years. It also encourages a sense of loyalty to the firm in the students whom it has helped. To date, approximately 70% of all students at the Polytechnic are sponsored, but as the message continues to get across, the Polytechnic is optimistic and looks forward to the time when there will be 100% sponsorship.

2. MARA Institute of Technology

MARA Institute of Technology promotes the creation of a group of professional and semi-professional Bumiputras who will become equal partners with other ethnic groups in the commercial and industrial enterprises of the nation. In the current academic year, education is being provided to more than 5,000 students on four campuses. The Jalan Othman campus programme offers extension education. The Kuching and Kota Kinabalu campuses presently offer first-year curricula for a number of specialized courses and will in the future offer full curricula for these courses. The Shah Alam campus is the main campus of a fully-equipped $ 44 million complex.

The courses of study available at the Institute are organized under twelve schools: Accountancy; Administration and Law; Applied Sciences; Architecture, Planning and Surveying; Art and Design; Business and Management; Computer Science and Mathematics; Engineering; Hotel and Catering Management; Mass Communication; Library Science; Preparatory Studies.

These schools are assisted in their academic programmes by the Library Services Division, the Language Centre, and the Practical Training and Employment Unit.

One problem facing Malaysia as it embarks on an intensive programme of industrialization and economic development is training a sufficient number of engineers and technicians. The School of Engineering has established engineering and technical assistant courses in Civil, Mechanical and Electrical Engineering. All students admitted since July 1974 follow a two-tier system of engineering education. The first tier is of three years' duration, and after successful completion of the course the candidate is awarded a Diploma. Students who have done well in the first-tier examinations will be considered for admission to the second tier for an engineering course of a maximum of three years' duration. At the end of the second tier, successful students will be awarded the Advanced Diploma in Engineering.

The courses offered by the School for the two-tier system are in Civil Engineering, Mechanical Engineering, Electrical Engineering (Power), Electrical Engineering (Electronics), and (to Diploma level only) Land Surveying.

The main engineering and vocational courses offered are:

(a) Accountancy

Diploma in Accountancy; Institute of Cost and Management Accountants (UK); Association of Certified Accountants (UK).

(b) Administration and Law

Diploma in Administration. Institute of Chartered Secretaries and Administrators (UK); Bachelor of Law (UK); Barrister at Law (UK); Private Secretarial Course. Diplomas in Animal Health and Production, Food Technology, Forestry, Industrial Chemistry, Microbiology, Planting Industry Management, Rubber and Plastic Technology, Fisheries Technology, Textile Technology, and Science.

(c) Architecture, Planning and Surveying

Pre-diploma course. Diplomas in Architecture, Town and Country Planning, Building Economics, Building, and Valuation; and a Certificate for Town Planning Technicians.

(d) Art and Design

Pre-diploma course. Diploma in Art and Design (Fine Art), (Graphic Design), (Industrial Design), (Fine Metalwork), (Pottery and Ceramics), (Textiles), (Fashion Design). Certificate in Photography; Art Teachers' Diploma.

(e) Computer Science and Mathematics

Diploma in Computer Science; Institute of Actuaries (UK); Diploma in Actuarial Science; Diploma in Statistics; Institute of Statisticians (UK).

(f) Engineering

Diplomas in Civil Engineering, Electrical Engineering (Power), Electrical Engineering (Electronics), Mechanical Engineering, and Land Surveying. Advanced Diplomas in Civil Engineering, Electrical Engineering (Power), Electrical Engineering (Electronics), and Mechanical Engineering.

(g) Hotel and Catering Management

Diploma in Hotel and Catering Management; Certificate in Hotel and Restaurant Services.

(h) Practical Training and Employment Services

The objectives of the Practical Training and Employment Unit are fourfold: to provide students with practical experience in their respective courses of study and with insights into their eventual careers; to assist those courses where practical training is required for the award of a diploma or certificate; to equip students with practical experience so that they have improved opportunities for employment on graduation; and to help graduates secure suitable employment. These objectives are achieved by performance of the following functions: maintaining liaison with various business organizations, and with government and quasi-government bodies for the purpose of placing students for practical training and employment; organizing

supervising and controlling practical training programmes for the Institute; evaluating the training undertaken by students; organizing the payment of students' subsistence allowances and other expenses; and informing students of job opportunities and assisting them in securing employment.

Most practical training programmes are conducted during the long vacations of June to July and November to December. When longer training periods are required, students work as trainees during term-time. Although the original intention was to place students for training in their specialized fields, it has only been possible to approximate to such placement.

All students enrolled in courses of three years' or longer duration will be eligible for training upon completion of the first year. All students enrolled in courses in which practical training is required for the award of a diploma or certificate will be eligible for practical training in the first year and after. Preference will be given to students whose courses have practical training as part of the curriculum: placement of other students will be subject to the availability of funds. There is a course tutor unit to arrange and organize practical training. This unit will arrange for course tutors or lecturers to supervise students in this field. Such field supervision will be certified and approved by the unit. All students undergoing practical training will be entitled to $ 2.50 per day as subsistence allowance. Internal travelling claims will be considered after the training period.

By virtue of close and constant contact with firms, business organizations, and other bodies, the Practical Training and Employment Unit is able to assit graduates in securing employment. Organizations are informed of the nature of courses, the number of graduates available for employment and the time of availability. As the number of graduates increases in future, the role of this Unit will become correspondingly more important. Its functions will expand to provide advice on employment opportunities and to supply firms and organizations with suitably qualified graduates. It may even become directly involved in the provision of career guidance to the rapidly increasing student population.

3. National Institute of Technology

The National Institute of Technology was formally established as a university on 14 March 1972 under the National Institute of Technology (incorporation) Order, 1972.

Since its establishment the Institute has had three faculties: the Faculty of Engineering, the Faculty of Architecture (now known as the Faculty of Built Environment), and the Faculty of Surveying. Also there is a centre known as the Centre for Science and Humanities Studies which is of faculty status. Courses offered at the Faculty of Engineering, Architecture and Surveying are at two levels, viz. diploma and degree levels, and are divided into the specializations shown in the table on page 66.

For the degree level courses the entry requirement is unique when compared with the other universities in Malaysia. The qualification required is the Malaysian Certification of Education with a minimum of second grade and with credits in Bahasa Malaysia, Mathematics and a pass in English Language or Special English, as well as credits in at least three of the following subjects: Additional Mathematics, any physical science subject, any technical subject, General Science and Additional General Science.

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A holder of a good diploma from the Institute may be considered for a degree level course.

Candidates for diploma courses must not be more than 25 years old and have passed the Malaysian Certificate of Education examination with at least a Grade Two and with credits in Bahasa Malaysia, a pass in English Language or Special English, and credits in Elementary Mathematics and General Science or any physical science subject.

TABLE 1

COURSES OFFERED BY THE NATIONAL INSTITUTE OF TECHNOLOGY

FACULTY OF ENGINEERING	
Degree Courses	Diploma Courses
Civil Engineering Electrical Engineering Mechanical Engineering	Civil Engineering Electrical Engineering (Communication) Electrical Engineering (Power) Mechanical Engineering
FACULTY OF BUILT ENVIRONMENT	
Degree Courses	Diploma Courses
Architecture Quantity Surveying Urban and Regional Planning	Architecture Quantity Surveying Urban and Regional Planning
FACULTY OF SURVEYING	
Degree Courses	Diploma Courses
Land Surveying Property Management (formerly valuation)	Land Surveying

The University of Malaya Faculty of Engineering runs, alongside the degree courses in engineering, courses leading to a doctor's degree and post-doctoral research.

The Faculty also runs a one-year pre-engineering course. After successfully completing this course, a student is admitted to the first year of the four-year

degree course. The Faculty offers Bachelor of Engineering courses in Civil, Mechanical, Electrical and Chemical Engineering.

The Faculty has a student strength of 470 students with an annual intake of over 160 students. Subjects in the first two years are common to all branches of study. Specializations are allotted in the third and final years to meet the professional requirements of relevant branches of engineering.

The bachelor's degree course in Engineering run by the Faculty of Engineering of the University of Malaya has been recognized by the professional bodies such as the Institute of Engineers.

The Faculty has good workshop and laboratory facilities and excellent facilities for research work. Practical experience is an integral part of the degree course; students being allotted to various undertakings in the first year and third year classes.

During the long vacation, students in their first year are required to undergo practical workshop training at an engineering establishment to supplement their training at the University, and as part of the exercise they are required to submit a report. The contents of the report should cover details of the training the student received personally, observations relating to engineering processes with which he has come in contact during this period, and a brief survey of the organization within the works. The report, which should contain from 1,500 to 2,000 words, should be written from the student's own experience. It should be completed before the student leaves the place of training, and shown to the employer for approval and signature.

In the third-year course, each student must submit a technical report and observations on what he has done, experienced and learnt from his practical experience in industry, an engineering undertaking, or a government department. The report is judged on the student's general appreciation of engineering works, and his ability to learn and report on them and make constructive criticism. The report must have sufficient technical content and details of the jobs handled by the student himself.

The student is advised to avoid writing long essays and use illustrations to help to explain the jobs clearly. He is encouraged to reach his own conclusions and express his views on the works after having obtained the views of more experienced personnel. He is reminded that the ability to present a good engineering report is a valuable asset in his future career, and that it is an opportunity for him to gain experience. The benefits derived from practical experience very much depend on the initiative shown by the student himself. If he thinks it does not afford sufficient opportunities, he is required to discuss his problem with the person in charge at the earliest opportunity.

The National Institute of Technology is at present administered by an Interim Council in which professionals from the private sector are also represented. Students are sponsored by the Government, by statutory bodies, and by the private sector which includes international firms such as Guthrie Group, Shell, Cycle and Carriage, Osborne & Chappel, Sarawak Electric Company, and Tin Mining Co. There are no sandwich, day-release/block-release courses in the Institute: all courses are full-time.

MID-TERM APPRAISAL OF THE TECHNICAL EDUCATION SECTOR

In its document "Mid-term Review of the Second Malaysia Plan 1971-1975" the Government reports the following progress made by technical institutions.

Enrolment at the Ungku Omar Polytechnic increased from 493 in 1970 to 915 in 1973. The intake of students more than doubled and is expected to triple in 1975. A new marine engineering course designed to meet the increasing demand for marine engineers will be introduced. Provision has been made for the establishment of a second Polytechnic at Kuantan during 1974-75. This second polytechnic will have an enrolment of over 1,000 students....

The Institute of Technology, MARA, continued to play a key role in producing professional and sub-professional manpower to meet the nation's need for qualified Malays and other indigenous people. Enrolments in professional and sub-professional courses in accountancy, administration and law, applied science, architecture, business management, engineering, hotel and catering management and library science expanded rapidly from 2,142 in 1970 to 4,434 in 1973. A significant development was the introduction of an extension education programme. The aim of this extension programme is to offer professional and semi-professional courses to qualified Malays and other indigenous people who are not able to pursue courses on a formal and full-time basis. The first intake of students for this programme was 339 in 1973. Subsequent intakes will be on an annual basis. Total enrolments at ITM, excluding those in the extension education programme, will reach 6,000 by 1975....

The National Institute of Technology, formerly known as the Technical College, was raised to University status in 1972, offering a two-tier programme at diploma and degree levels. Enrolments at the Institute increased from 692 in 1970 to 1,516 in 1973. Teaching, workshop and laboratory facilities were expanded to cope with this increase in enrolments. The new degree programme at the Institute offers courses in mechanical, civil and electrical engineering and architecture. While it is intended to re-site the present Institute, a major part of the allocation for the Institute during 1974-75 will be directed towards the expansion of student residential facilities at the present site....

TRAINING ORGANIZATION IN THE NATIONAL ELECTRICITY BOARD OF MALAYSIA

The existing training provision is inadequate for the present and future needs of the National Electricity Board. In spite of the envisaged expansion, no capability exists at present to train workers in all the specific skills and techniques utilized by the NEB or to organize short and long-term courses of training for overcoming deficiencies in certain skills. In relation to its expansion, NEB envisages an annual recruitment by 1980 of 120 apprentices, 130 semi-skilled trainees, 90 technicians and 30 engineers. Moreover, it has a need to provide up-grading refresher and up-dating training for electrical fitters, cable jointers, overhead linesmen, electricians, fault finders, meter mechanicians and power operatives. Additionally, it needs to provide development training aligned to its own activities, in technical, administrative and supervisory subjects for its staff, which totals at present about 10,000 persons and is expected to rise to 16,000 to 19,000 by 1982 depending on the productivity achieved. It is one of the biggest training projects in Malaysia receiving financial assistance under the United Nations Development Programme.

The National Electricity Board is an autonomous body appointed by the Government to generate the supply of electrical energy for the economic development of West Malaysia and to make available such energy to consumers. Important features of the project are:

(a) Engineering graduates of the Board have to undergo a two-year pupillage during which they are attached to the various sections of the Board to gain experience. The National Electricity Board also accepts graduate trainees from outside the Board to undergo two years' attachment training similar to the pupillage. In the past two years especially, quite a number of officers have been sponsored for postgraduate studies abroad.

Scholarships are also awarded each year for diploma courses at the local technical college. Those who graduate are required to undergo cadetship for a period of two years where on-the-job training is being provided by attachments. At the end of this training period they are required to pass the departmental technician examinations before being confirmed as Technical Assistants.

Technician Cadets are usually selected from students graduating from the Ipoh Polytechnic and from within the Board. However, graduates of the Ipoh Polytechnic are appointed as Technicians on obtaining their diplomas. Those who are recruited from the technical schools have to undergo a three-year period of cadetship at the end of which they have to sit an examination. Training is given by attachments to the various sections.

Practical training is also provided from Government and other statutory bodies to qualify them to sit for the Local Electrical Engineer Certificate and Chargeman Certificate.

(b) The Electrical Inspectorate is responsible for the issue of Electrical Engineer and Chargeman Certificates. The Board also provides facilities to enable lecturers and instructors from technical institutions and personnel from other statutory bodies to gain practical experience.

(c) The capacity for training is limited to the electrical and mechanical fields, and the number of trainees at any one time varies according to the existing facilities available.

(d) Usually a five-year forecast is made annually to meet the needs of the Board. By 1980 the NEB envisage an annual recruitment of 120 apprentices, 130 semi-skilled trainees, 90 technicians and junior technicians and 30 engineers. There is also a need to provide up-grading, refresher and up-dating training for electrical fitters, cable jointers, overhead linesmen, electricians, fault finders, meter mechanics and power operators and to provide development training, aligned to the Board's own activities, in technical, adminstrative and supervisory subjects for its staff, which totals at present about 10,000 persons and is expected to rise to between 16,000 and 19,000 by 1982 depending on the productivity achieved.

(e) Scholarships are awarded annually by the Board for full professional diplomas, degrees and postgraduate studies both locally and abroad. Direct control and supervision are maintained by the respective departments under the overall control of the Education and Training Department.

(f) The issue of certificates for Electrical Engineers (Local), Chargemen and Wiremen are issued by the Chief Electrical Inspectorate. Examinations for technicians and special grades are conducted by the Board for employees in the NEB.

(g) Periodically officers attend in-service courses or study tours with manufacturing companies and electricity supply organizations abroad, especially in U.K. and U.S.A. The Board also recruits and trains its own personnel at the lower technical level.

APPENDIX 1: OFFICIALS MET AND VISITS UNDERTAKEN

Officials

Md. Tahir-bin Abdul Majid	Director of Technical Education
Mr. V. Murugesu	Dy. Director of Technical Education, Kuala Lumpur
Mr. M. Rafiq Khan	Senior Organisor, Technical Education, Kuala Lumpur
Mr. T. T. Chian	Dean of Faculty of Engineering, University of Malaysia, Kuala Lumpur
Mr. Nitichingham	In-charge, Training Board, National Electricity Board
Dr. A. Amin	UNESCO Expert on Training and Development Electricity Board
Mr. R. Bell	Project Manager, Industrial Trade Instructor Training
Mr. H. E. Carter	Syllabi and Training Standards Expert
Che Mat Bin Abu Baker	Industrial Training Co-ordinator, Ministry of Labour
Mr. En Malek Nahu	Ministry of Youth Training Division
Mr. Kassim Md. Deni	Scholarship and Placement, Public Services Division
Md. Shaari bin Md. Noor	Telecom Training Centre, Kuala Lumpur
Mr. Arshad Bin Marsidi	National Producting Centre
Mr. C. Ung	Ex-Director of Technical Education (now with MARA)
Mr. Nathan	Ministry of Education and Liaison Officer

Institutions Visited

MARA Institute of Technology; Tele-communication Training Centre; National Productivity Centre; National Institute of Technology; University of Malaysia.

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APPENDIX 2: OUTPUT IN ENGINEERING AREAS

From Degree Courses - 1971-1976

Courses	Actual		Estimated				Total
	1971	1972	1973	1974	1975	1976	
Civil Eng.	16	9	55	15	62	71	228
Electrical Eng.	17	20	23	35	40	45	180
Mechanical Eng.	46	47	27	50	55	60	285
Chemical Eng.	-	-	18	35	44	44	141
Total	79	76	123	135	201	220	834

From Diploma Courses - 1971-1975

Courses	Actual		Estimated			Total
	1971	1972	1973	1974	1975	
Civil Eng.	39	58	58	71	119	345
Mechanical Eng.	44	53	72	125	116	410
Electrical Eng.	62	65	66	108	104	405
Land Surveying	27	10	21	46	87	191
Architecture	24	30	26	34	37	151
Building Economics/ Quantity Surveying	23	21	17	31	39	131
Town and Country Planning	11	24	11	23	52	121
Total	230	261	271	438	554	1,754

APPENDIX 3: OUTPUT OF TECHNICIAN ASSISTANTS AND TECHNICIANS (1973-1976)

Institutions	1973	1974	1975	1976	Total
Technical Assistants					
Kebangsaan I. T.	240	315	350	420	1,544
MARA I. T.	43	67	102	100	364
Total	283	382	452	520	1,908
Technicians					
Ungku Omar Poly	212	386	432	582	1,747

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APPENDIX 4: OUTPUT FROM INSTITUTIONS

Output of Engineers from University of Malaya - 1973-1976

Year	Civil	Mechanical	Electrical	Chemical
1973	38	42	14	-
1974	54	26	22	18
1975	76	22	21	15
1976	85	45	30	10

Output of Engineers from Institut Teknoloji MARA - 1973-1976

Year	Civil	Mechanical	Electrical
1973	-	-	-
1974	-	6	-
1975	4	4	6
1976	6	6	10

Output of Institut Teknoloji Kebangsaan - 1973-1980

	1973	1974	1975	1976	1977	1978	1979	1980
Diploma	259	315	350	420	490	560	655	735
Degree (Engineering)	-	-	-	-	95	160	185	225
Architecture	-	-	-	-	-	10	15	20

APPENDIX 5: ORGANIZATIONS OFFERING PRACTICAL TRAINING

Selangor (Kuala Lumpur)

Anglo-orient (M) Sdn. Bhd.
Azman, Wong, Salleh & Co
Bangkok Bank Ltd
Bangunan Wisma Yakin
Bangunan Yee Seng
Bernama
Cathay Advertising Ltd
Chase Manhattan Bank
Comcod Public Relations
Eric White Associates (M) Pty. Ltd
Esso
FIDA (Federal Industrial Development Authority)
First National City Bank
General Accident Fire & Life Assurance Corporation Ltd
Grant Advertising International Inc.
Harrison & Crossfield (M) Sdn. Bhd.
Hotel Nilton
Ibu Pejabat MARA
Ismail Mahyuddin Enterprise Sdn. Bhd.
Kassi, Chan & Co
Kwong Yik Bank
Lembaga Kemjuan Tanah Persekutuan
Lembaga Letrik Negara
Lembaga Padi dan Beras Negara (LPN)
Leo Burnett Sdn. Bhd.
Lever Brothers
Lintas Ltd
Malaysian Airline System
Malaysian Co-operative Insurance Society Ltd
Marketing Advertising (Pte.) Ltd
Mercantile Bank
Ministry of Culture, Youth & Sports
Ministry of Information, Malaysia
New Straits Times Press Ltd
Ogilvy & Mather (M) Sdn. Bhd.
Pearl & Dean (M) Sdn. Bhd.
Pejabat MARA Negeri Selangor
Pejabat Perhubungan Kerajaan Sabah
Perbandanan Pembangunan Bander (UDA)
Pernas Mining Sdn. Bhd.
Persatuan Kelab-Kelab Belia, Malaysia
Raja Salleh, Lim & Co
Royal Exchange Insurance
Safety Insurance Building
Shell Malaysia Ltd
Turquand, Young, & Co
Universiti Kebangsaaan Malaysia
Utusan Melayu (Bhd.)

Selangor (Petaling Jaya)

Alcan Malaysia Bhd.
Dunlop Malaysia Industries Bhd.
Guiness (M) Bhd.
Kumpulan Wang Simpanan Pekerja (EPF)
Lembaga Bandaran Petaling Jaya
Lembaga Pemasaran Pertanian Persekutuan (FAMA)
Maktab Kerjasama

Selangor (Klang)

Lembaga Pelbuhan
Malayan Banking Bhd.
Pejabat Daerah Klang

Malaysia

Selangor (Shah Alam)

Bahagian Kajian Luar Kampus, ITM
Fatimah Carey Office, ITM
Pejabat Pentaobiran, ITM
Statistical Centre, ITM
Steno Department, ITM
United Motor Works

Selangor

Malayan Banking, Bhd.
Malaysian Banking, Bhd.
Sabak Bernam
Tanjong Karang

Perak

Coopers & Lybrand, Ipoh
Pejabat Setiausaha Kerajaan Perak, Ipoh

Pulau Pinang

Malayan Banking
Suruhanjaya Pelabuhan Pulau Pinang
Universiti Sains Pulau Pinang

Kedahtan

Malayan Banking

Kelantan

Malayan Banking, Kota Bharu
Pejabat MARA Negeri, Kelanta, Kota Bharu

Negeri Sembilan

Pejabat MARA Negeri, Serimban

Johor

Pejabat MARA Negeri, Johor Bharu

Trengganu

Pejabat MARA Negeri, Kuala Trengganu

SINGAPORE

EXISTING PROGRAMMES

Technical education in Singapore is the responsibility of the Department of Technical Education, created within the Ministry of Education in 1968. This, in itself, indicates a realization on the part of the Government of the vital importance of technical education in any country, no matter what its size. The Department of Technical Education also implements the programmes and policies of industrial training. An Industrial Training Board was created on 1 April 1973, superseding the previous National Industrial Training Council.

Technician education is conducted in the Singapore Polytechnic, with the Singapore Technical Institute and the Ngee Ann Technical College also running technician courses. The workshops and laboratories of the Singapore Technical Institute are used for conducting teacher training courses and refresher courses. In my opinion, all three institutions have excellent instructional facilities, and the faculty is very effective. Details of facilities by institutions and level of courses are given under a separate heading.

In Singapore, training facilities are not exactly commensurate with requirements. The curriculum of technician education is generally devoid of practical training, but it is flexible enough to meet the requirements of industry in Singapore.

During my discussions with the authorities in charge of technical education and training I was given to understand that, in the next phase of development, they will take effective steps to up-grade the skills of technicians and craftsmen, and create effective working arrangements with industry so that theory is cross-fertilized with actual processes of production, design and construction.

CRAFTSMAN TRAINING AND INDUSTRIAL TRAINING

Industrial Training Institutes are being set up, administered by the Industrial Training Board, which also runs the Singapore Technical Institute.

The Industrial Training Board (ITB) was established on 1 April 1973 to centralize, co-ordinate and promote all forms of industrial training in Singapore on a national basis. The ITB took over from the Technical Education Department responsibility for the administration of twelve training institutions, comprising the Singapore Technical Institute (a tertiary technical institution), eight vocational institutes (including one government-aided institute) offering training in the metal, woodworking, electricity, electronics and building trades; one vocational institute offering courses in manual and applied arts; the Hotel and Catering Training School; and the School of Printing.

The other major functions of the ITB are the promotion of apprenticeship training, and the establishment of trade testing on a national basis. The ITB's scope of responsibility includes the training of workers already employed in

industry, for example, day-release, block-release and sandwich programmes, off-the-job industrial training (OJIT), group training for small firms, and special programmes to meet the needs of individual firms. The accent in the ITB's programmes is on developing skills geared to increasingly high-level technology for the industrial development of Singapore. Engineering is expected to be its central pre-occupation for some time to come.

ARRANGEMENTS FOR MANPOWER PLANNING AND TECHNICAL EDUCATION

The Development Plan provides for the promotion of technology-intensive industries. Such industries will necessarily need a large number of properly-trained technicians. It is felt that the Government will have to pool all its resources and direct its policies and programmes towards the creation of good facilities for the training of such technicians. The training aspect is very important, and the authorities may be required to seek the help of more developed countries for specialized training, particularly in narrow specialities and emerging technologies. The future needs of manpower are determined through periodical surveys carried out by the government on the one hand and by the institutions on the other. The surveys are comprehensive enough to cover the types of training and the specialized fields of training which industry will find useful in a given period.

Some important recent studies which came to my notice during discussions with officials and which have particular reference to manpower planning are: (i) 150 years of Education in Singapore; (ii) Higher Education and Development in South East Asia (UNESCO); (iii) Interim Report on the Singapore 4 Project, Technical Teacher Education and Vocational Training (ILO Chief Technical Adviser); (iv) Education in Singapore; (v) Ship Building Survey; (vi) Manpower Requirements in New Industries; (vii) Manpower Requirements in the Hotel Industry; (viii) Higher-Level Manpower Study; (ix) Manpower in Singapore's Large Manufacturing Firms; and (x) Technical Education Department - Second Annual Report.

It is gratifying to note that organized manpower studies have been attempted periodically. But the time at my disposal was short and the various study reports were not readily available, so it was not possible to know exactly how many training places would be required in the next few years to provide both for students on courses and for employees on an in-service/post-qualification training programmes and how many places are wanted in other countries.

After the visit to the three technician institutions of Singapore, I concluded that the quality of technical training is well up to the mark especially in that the material resources of all three institutions are well developed and exploited. With its pattern of growth, industry will certainly find the end products of these institutions extremely useful.

IDENTIFICATION OF TRAINING NEEDS

The success of the electronics industry in Singapore during the early part of Phase Two demonstrated to international investment circles that Singapore workers have very high skill potential because of their good educational base. Many training needs were identified when the industry began to integrate both vertically and horizontally. When, subsequently, the precision engineering and machine building industries also took an active interest in Singapore, specific additional skills were required. The result was that training programmes were organized and implemented by the Government or by individual companies, depending on requirements and available organization. Among the Government projects were:

(a) Industrial Training Centre

Initially, to orientate the large numbers of young female workers to factory life, an Industrial Training Centre was set up and financed by the Government. The Centre conducted short residential courses on industrial orientation to inculcate in the workers a sense of team work, quality consciousness, good work attitudes and industrial discipline.

(b) Light Industries Services Unit

The integration of the electronics industry was aided by the establishment of a Light Industries Services Unit with UNDP assistance to provide supporting services and train workers. During the later stages, these services and training programmes were expanded with French, Japanese, and British government assistance.

(c) Technical Education Department

To step up technical and vocational training, a Technical Education Department was organized within the Ministry of Education to concentrate on the long-term development of vocational and technical institutes.

(d) Singapore Institute of Management

To promote management training, the Singapore Institute of Management was set up in 1966 as an independent institute. Some governmental assistance was given during the formative stage.

(e) National Productivity Centre

To promote labour productivity in industries, the National Productivity Centre was established in 1967.

(f) Hotel and Catering Training School

To cater for training requirements associated with the rapid growth of the tourism industry, the Hotel and Catering Training School was set up.

Many projects were spontaneously implemented by private industries. These were invariably related to their own formation or expansion plans. To enable some of them to select the most effective training method, the Government provided some financial assistance. The Government-owned Keppel Shipyard established its own training school with a capacity for training 360 apprentices off-the-job. Jurong Shipyard and Shipbuilders, which now build 90,000 ton dwt tankers, sent large numbers of young Singaporeans to Japan for training in shipbuilding and repair skills. During the implementation of the Rollei project to make cameras and projectors, 450 Singaporeans were sent to Germany for training in precision engineering skills. They have now returned to Singapore to assist in the training of over 5,000 other workers in the manufacture of cameras, projectors and other photographic equipment. On the other hand, Wild, which makes precision survey instruments, trains most of its skilled workers in Singapore and resorts to overseas training only for a few key personnel. Generally, this 'quick start' manpower concept was supported by the Economic Development Board under the Industrial Development Scholarships Scheme. Under this scheme, many other international companies which were setting up plants in Singapore sent their key personnel abroad for in-plant training. Timex, a watch-manufacturing company, on the other hand, implemented an apprenticeship programme for tool and die makers in connection with its project to make precision tools and dies for watch manufacturing. Philips, the Dutch electrical firm, introduced an apprenticeship training programme for machinists in connection with its machine factory project.

Singapore

With the coming of more and more precision engineering and machine building industries to Singapore, a pilot scheme for overseas industrial training was evolved. Under this scheme, apprentices were attached to reputable companies in Germany and Switzerland for long-term training to reach the respective national apprenticeship standards. These return as fully-trained workers to expedite new projects.

To sustain a higher economic growth under near-full employment conditions, policies will have to emphasize the optimal use of manpower. The following measures will improve the quality of manpower:

(a) Greater technical orientation will be given in the schools.

(b) The Industrial Training Board will continue to develop a long-term industrial training programme.

(c) The Singapore Polytechnic and Ngee Ann Technical College will be expanded to meet the projected demand for technicians to sustain the economic growth at its present rate.

(d) The University of Singapore will increase its output of professional engineers and accountants.

(e) The Industrial Development Scholarships Scheme will be expanded to enable top apprentices and technicians to be given opportunities for further training locally and abroad.

(f) A Joint Government-Industry Training Scheme has been introduced for high-skill occupations requiring long apprenticeship training. Under this scheme, specialized courses in tool and die making, precision mechanics and precision metal machining are conducted.

(g) To encourage private industries in the growth sector to train their personnel, preferably in excess of their own requirement, an Industrial Training Grant Scheme has been introduced. Under this scheme, training programmes approved by the Economic Development Board may receive grants up to $ 69,000 per trainee.

(h) The Overseas Training Programme previously run on a pilot basis has been expanded to train more skilled workers in occupations relating to new industrial projects being promoted or under implementation in Singapore.

IMPORTANT STEPS TOWARDS ORGANIZED MANPOWER PLANNING

The development of industries in Singapore will not be quick. Therefore the facilities and type of technician training available at present will be found more than sufficient except for technology-intensive industry which might need technician training in emerging technologies and specialized fields. Neither the present requirements for such technicians nor projections for the next few years were readily available. Projections of manpower requirement by occupations have, however, been attempted to cover five years ending 1978.

SALIENT FEATURES OF TECHNICAL EDUCATION IN SINGAPORE

(a) Technician training is imparted on both a part-time and a full-time basis.

(b) Practical training is not compulsory in the curriculum of all technician education simply because of lack of training facilities in industry.

(c) The Ngee Ann Technical College offers technician programmes in Mechanical Engineering and Electronics Engineering.

(d) The Marine Engineering course run in the Singapore Polytechnic is re-inforced with extensive compulsory practical training which is imparted in ship-yards and ship-building industries and lasts for one year.

(e) Because there are many employment opportunities for technicians, a contribution from industry is not required. The students get on-the-job training in accordance with the requirements of particular industries.

(f) Forty to 50% of the population of Singapore is below 16 years of age. These young people need vocational training of one sort or another. The Ngee Ann Technical College meets some of these needs.

(g) The Department of Technical Education and the Industrial Training Board are both capable of providing good facilities for the basic training required locally. They have, however, also made limited use of facilities available in India, Japan, Philippines and elsewhere, particularly in such skills as tool and die making, precision machinery skills, cane, rattan work, and teacher training programmes.

(h) Technical and vocational education in Singapore is very expensive. The Government is well aware of this and hopes to reduce the per capita cost of technical education. It proposes to encourage private employers to run their own training programmes, and may be ready to provide financial assistance, if need be. This will not only accelerate the supply of technical personnel but also reduce the per capita cost of technical education and influence the quality of the product.

SUITABILITY OF TRAINING

Singapore has limited resources for further industrial development. The facilities available for technician training in three institutions are satisfactory both in quality and quantity for the development needs so far envisaged. The country will need specially-trained personnel in narrow specialities and emerging technologies when it embarks upon its plans for the establishment of technology-intensive industries. For such needs, the existing facilities will be found inadequate. It will be necessary either to import expertise and manpower from other countries or to retrain people already in employment.

INDUSTRY, TRAINING, TECHNICAL INSTITUTIONS

Singapore needs engineers in large numbers. Engineers occupy top positions in industry, Government departments and technical institutions by virtue of their creative ability in design, production and construction. Because the field of an engineer is so vast, one person cannot specialize in all types of work. This is recognized in the courses for the first degree in engineering given by the Faculty of Engineering of the University of Singapore. Courses are offered in Civil Engineering, Mechanical and Production Engineering, Electrical Engineering, Industrial and Systems Engineering. The duration of a degree course is four years divided into eight semesters.

Singapore

During the first two years, all engineering students follow a common two-year course. In the third and fourth years, special subjects pertaining to the relevant branches are taught. The students do practical work in workshops and laboratories. They also attend theory classes for about 30 hours per week. During long vacations full-time practical training in industry is undertaken.

In Singapore, technician courses are conducted at two levels: diploma courses, which are of three years' duration, and certificate courses, which are of two years' duration. The technician diploma courses are designed to prepare engineering technicians particularly in specialized engineering fields and applied technologies. The training is more theoretical than that of the certificate course, since the products are required to assist their senior partners - the professional engineers - in design and production work. Diploma-level courses are run in the Singapore Polytechnic and the Ngee Ann Technical College. The certificate-level technician courses are run at the Singapore Technical Institute. Their aim is to produce shop-floor supervisory personnel, and professional staff for technical schools and industrial training schools. These people are required to have less specialized theoretical knowledge, but a better understanding of the processes and practices of production and manufacture. Such technicians, therefore, attain craftsman skill.

All technician trainees are required to study science, maths, and industrial management in addition to the usual technical subjects relevant to the discipline. Normally, 30 hours' theoretical training per week is given in addition to practical study in workshops and laboratories. The long vacations are used for industrial training. The marine engineering course envisages practical training as an integral part of the syllabus. One year's practical training is organized in shipyards or engineering workshops. The nature of the training and the objectives differ from course to course. Vacation training is imparted in the workshops of the Ngee Ann Technical College.

Craftsman training is provided in eight vocational institutes. The number of engineering trade courses is 34. These vocational institutes also run artisans' courses. The craftsman courses are so designed as to cover extensively the functions envisaged in a particular operation. Generally, the craftsman is required to perform a job either by hand or by a machine. His job may be intricate but it is, nevertheless, of a repetitive nature. He is required to possess manual skill and to receive direction from the technician supervisor.

An artisan is less versatile in his skill attainment than the craftsman, but he is required to acquire basic knowledge and skill for a particular trade.

The survey undertaken in Singapore shows that the demand for craftsmen artisans is steadily increasing. The main employees are in the ship-building, ship-repairing, oil exploitation, petroleum, textile, wood and wood products, metal and metal products industries.

The Singapore Polytechnic Act provides for the constitution of well-formed advisory committees consisting of representatives of the Polytechnic, Government departments, Singapore Academy of Science, professional bodies and major industries relating to the fields of engineering and technology for which the advisory committees have been formed.

In the Ngee Ann Technical College facilities are not provided for part-time courses. Facilities are, however, open for the conduct of day-release courses for persons already employed in industrial establishments. Due importance is given to the industrial training of students. The vacations falling in August/October are utilized for attaching students in their second and final years to various industrial and business organizations. This not only gives them an insight into the actual work process and methodology but also enables them to adjust effectively to future employment. This programme is called the Industrial and Business Orientation Programme. Details of courses in each institution are given in Appendix 2 on pages 87-88.

There is a central agency which looks after this programme. It consists of representatives of the Singapore Chinese Chamber of Commerce, the Singapore Manufacturers' Association, the Science Council of Singapore, the Ministry of Science and Technology, Industrial Training Boards, the Science Faculty of the University of Singapore, Nanyang University, Singapore Polytechnic, and the Ngee Ann Technical College. The programme is effectively and actively supported by leading industries and commercial establishments. This is an excellent method of pooling training places and is of maximum use to the economy.

TRAINING WITHIN INDUSTRY PROGRAMME

The Ministry of Labour has launched the TWI Programme which envisages improvement in the quality of supervisory training because it is universally recognized that good supervision pays rich dividends in any industry. The term "supervisor", in the TWI scheme, covers all persons who direct the work of craftsmen, artisans and other operatives. Thus supervisors occupy a key position in industry in providing a link between management and employees. They communicate with the management in matters of production and management policy, and also keep in touch with employees for the execution of orders and implementation of policies. The training of a supervisor is therefore vital.

Short courses of training are organized for supervisory personnel. The training is guided by definite principles of good supervision, and four training programmes are envisaged in the TWI scheme. These are: (i) job relations; (ii) job instruction; (iii) job methods; and (iv) job safety.

In the scheme, supervisory knowledge and skills have been analysed as follows: (i) knowledge of the work; (ii) knowledge of responsibilities; (iii) skill in leading; (iv) skill in instructing and communicating; (v) skill in improving methods; (vi) skill in preventing accidents.

Keeping this knowledge and these skills in view, the TWI programmes detailed below have been formulated. They are not intended to teach any specific knowledge of the work and the responsibilities since these differ from industry to industry and organization to organization.

(a) A job relations programme aims to develop leadership qualities.

(b) A job instruction and communication programme provides training in the skills of taking instructions and communicating them to the workers.

(c) A job methods programme trains in the use of proper techniques for introducing improvements.

(d) A job safety programme emphasizes the need, quality and type of safety methods to be enforced in a particular organization.

(e) A discussion-leading programme aims at training the supervisor to adopt methods and media for discussions relating to jobs and to muster opinion of the workers in properly organized seminars.

A list of industries offering training places for the students of technical institutions is appended as Appendix 3, pages 89-92.

REGIONAL TRAINING

Singapore has collaborated on an official basis with various international or regional agencies on regional manpower training projects. As a Colombo Plan donor country, Singapore provides more than 300 training places each year to other developing countries including Indonesia, South Korea, Malaysia, Philippines, South Vietnam, Sri Lanka and Thailand. Besides accepting trainees in port administration, library services, low-cost housing programmes and so on, Singapore is now providing host country facilities to the following regional manpower training institutions: the Colombo Plan Staff College for Technician Education, the Regional English Language Centre (RELC), and the Regional Institute of Higher Education (RIHED).

The Colombo Plan Staff College has already started functioning under its first Director, Dr. L. S. Chandrakant. The basis of the establishment of this College and the tasks it is required to accomplish are:

(a) that the countries of the region wish to expand and to improve the quality of their systems of technician education; and

(b) that, in these countries, there is an urgent need to increase the supply of well-trained technician teachers and to improve the quality of the teaching of those already in service.

From these premises, it is evident that the countries of the region face major problems in developing technician education and training. Two, however, are paramount. The first is the problem of increasing the supply of well-trained technician teacher educators and supporting and developing those already in service. The second is the problem of encouraging and assisting senior staff in technician education to play a more active part in in-service training and staff-development programmes. In the longer run, these problems will be best solved by the countries themselves. In the short run, it is believed that the Staff College can greatly assist by undertaking:

(a) To provide, both at the College and in regional member countries, courses of further professional education and training for serving technician teacher educators, key technician teachers, persons responsible for the planning, development, administration and supervision of technician education and training, and persons in key supporting roles such as training officers, librarians and registrars.

(b) To conduct study conferences for directors of technical education, principals, and other key personnel from education and industry, at which problems of technician teacher education and training and technician education and training may be examined.

(c) To assist regional countries and institutions to undertake projects in the field of staff and curriculum development, and projects aimed at the effective utilization of resources for learning and teaching.

(d) To promote, co-ordinate and undertake research into the special problems of technician teacher education and training, and technician education and training in the region.

(e) To advise and assist member countries in developing their technician teacher education and training facilities and in making use of other facilities for technician teacher education and training within and outside the region.

(f) To collect and disseminate information on technician education and training, and on technician teacher education and training.

APPENDIX 1: OFFICIALS MET AND VISITS UNDERTAKEN

Officials

Mr. I. K. McGregor	Director, Colombo Plan Bureau, Colombo
Mr. Gregorio P. Espinosa	Adviser on Intra-Regional Training, Colombo Plan Bureau
Mr. Chan Kai Yau	Deputy Director, Schools
Mr. Harbans Singh	Adviser, Technical Schools
Dr. Cheng Lim	Divisional Director, Personnel and Development, I.T.B.
Mr. Gwee Teck Yew	Divisional Director Training
Mr. V. P. W. Ager	Principal, Singapore Polytechnic
Mr. Tan Soo Yang	Co-ordinator of Diploma Course, Singapore Polytechnic
Mr. Khoo Kay Chai	Co-ordinator, Certificate Course, Singapore Polytechnic
Mr. I. W. K. Murch (and Staff)	Head of Production Engineering, Polytechnic
Dr. F. A. Varley	UNESCO Chief Technical Adviser, Polytechnic
Professor Lewis Au	Dean, Faculty of Engineering, University of Singapore
Mr. Allan Philips	Visiting Professor, Mech. Eng., Ngee Ann Technical College
Mr. Thomas Riley	Department of Electrical Engineering, Ngee Ann Technical College
Mrs. Teo Wong Mee Lin	Executive Officer, Ngee Ann Technical College
Mr. Chua Soo Tian	Chief Economic Development Board, Singapore Manpower Development Division
Mr. R. T. Tambyah	Principal, Singapore Technical Institute
Mr. Hee	Principal, Technical Teacher Training College
Mr. Kesavan Yoo Weng	Senior Officer, Industrial Training, E.D.B.
Mr. Lee Fong Seng	Interim Chief Adviser, Colombo Staff College
Mr. J. L. Cabot	Temp. Organizing Tutor, Colombo Plan Staff College
Mr. R. Baum	Executive Director, Singapore Employers Federation
Mr. L. W. Fook	Chief Inspector of Factories, Ministry of Labour
Mr. S. T. Tee	Public Relations Officer

Singapore

Some Institutions Visited

MoNair Centralized Workshop; Kim Seng Technical School; Jurong Vocational Institute, Tata Precision Training Centre; Singapore Polytechnic; Ngee Ann Technical College; Singapore Technical College; Rollei Training Centre

APPENDIX 2: EDUCATIONAL FACILITIES AT ENGINEER AND TECHNICIAN LEVELS

ENGINEER LEVEL

University of Singapore, Bukit Timah Road, Singapore 10

Degrees (4 years) in:

Civil Engineering; Electrical Engineering; Mechanical and Production Engineering; Industrial and Systems Engineering

Minimum admission qualifications: two Higher School Certificate passes at principal level in: (a) Mathematics or Pure Mathematics or Applied Mathematics; (b) Physics or Physical Science. Preference is given to candidates who have in addition obtained a pass in any of the following subjects either at principal or subsidiary level: Mathematics, Pure Mathematics, Applied Mathematics, Chemistry, Geometrical and Mechanical Drawing, Geometrical and Building Drawing, Metalwork/Metalwork (Engineering), Woodwork

TECHNICIAN LEVEL

Singapore Polytechnic, Prince Edward Road, Singapore 2

Diplomas (3 years) in:

Civil Engineering*; Electrical Engineering*; Mechanical Engineering*; Production Engineering*; Electronics and Telecommunications Engineering*; Building*; Chemical Process Technology

Other diplomas: Marine Engineering (4 years)*; Aeronautical Maintenance Engineering (1 year)*; and Architectural Draughtsmanship, Land Surveying, Ship Construction, and Structural Engineering (part-time only)

Certificates (2 years full-time only) in:

Draughtsmanship; Industrial Technician; Marine Radio Officers

Minimum educational qualifications for admission: (a) English Language; (b) Elementary or Additional Mathematics; (c) An appropriate Science Subject (Engineering Science, Physical Science, Physics). Preference is given to candidates who have in addition obtained Grade 7 or 8 in one or more of the following subjects: Geometrical and Mechanical Drawing, Metalwork or Metalwork (Engineering), Electricity and Electronics (for electrical engineering courses), Woodwork (for building and civil engineering courses), Chemistry (for chemical process courses), Geometrical and Building Drawing (for building and civil engineering courses).

Ngee Ann Technical College, 535 Clement Road, Singapore 21

Diplomas (3 years) in:

Mechanical Engineering; Electronics Engineering

Minimum educational qualifications for admission, in the Singapore-Cambridge GCE or equivalent examination, (a) Grade 7 or 8 in English Language, (b) 'O' Level pass in Mathematics, (c) 'O' Level pass in Physics, Science or Additional General Science, or an appropriate technical subject. Preference is given to candidates who have in addition obtained Grade 7 or 8 in one or more of the following subjects:

Singapore

Technical Drawing; Metalwork; Metalwork (Engineering); Electricity and Electronics.

Singapore Technical Institute, Circuit Road, Singapore 13

Certificates in:

Electronic Engineering[x] and Electrical Engineering[x] (1 year); Mechanical Engineering Drawing and Design, Mechanical Engineering, and Air-conditioning and Refrigeration (2 years)

Minimum educational qualifications for admission, in the Singapore-Cambridge GCE examinations, (a) Grade 7 or 8 in English Language, (b) 'O' Level pass in Mathematics, (c) Grade 7 or 8 in either Physics, Physical Science, Engineering Science or Additional General Science. Preference is given to bilingual candidates who have obtained Grade 7 or 8 in the appropriate technical subjects.

Technical stream candidates with Grade 7 or 8 in Metalwork and Technical Drawing qualify for admission to the last three courses above.

Day release courses are also available to applicants in relevant employment.

* Part-time courses are available to applicants in relevant employment.

[x]Only selected graduates of relevant trade courses will be admitted to these two courses as from 1975.

Singapore

Neptune Orient Lines Ltd
OTJ Architects
Office Equipment Manufacturers (S) Pte. Ltd
Ong & Ong Architects & Town Planners
Orchard Motors (S) Pte. Ltd
P. N. Electronics (Pte.) Ltd
Pan Malaysian Group Architects
Paterson Simons Workshop & Service Division
Philips Telecom
Philips Machine Factory
Phoenix Building Enterprise
Prima Ltd (Flour Mills)
R. E. Morris (Electrical Engineers)
Rheem Hume Pte. Ltd
Rediffusion (S) Pte. Ltd
Robin Shipyard (Pte.) Ltd
Rollei Singapore (Pte.) Ltd
Roxy Electric Industries (S) Pte. Ltd
Sanyo Industries (S) Pte. Ltd
Sembawang Shipyard (Pte.) Ltd
Shell Companies in Singapore
Shell Eastern Petroleum (Pte.) Ltd
Shanghai Kor Tong Furniture & Co
Setron Co, Ltd
Sing Oxygen Ltd
Singa Plastics Pte. Ltd
Singapore Airlines Ltd
Singapore Building Society Ltd
Singapore Cement Manufacturing Co, Pte. Ltd
Singapore Electronic & Engineering (Pte.) Ltd
Singapore Glass Manufacturers Pte. Ltd
Singapore Motors Pte. Ltd
Singapore Nissan Motors (Pte.) Ltd
Singapore Nylon Corporation Pte. Ltd
Singapore Offset Printing (Pte.) Ltd
Singapore Oxygen Pte. Ltd
Singapore Polymer Corporation Pte. Ltd
Singapore Semiconductor (Pte.) Ltd
Singapore Textile Industries Ltd
Singapore United Estates Pte. Ltd
Sperry Han(s) Pte. Ltd
Stten Sehested & Partners
Straits Times Press (M) Bhd
Suckling McDonald & Mohd. Isahak
Survey Services (S) Pte. Ltd
Swan & Maclaren
Swiss Associated Ind. (Pte.) Ltd
T. Y. Lin S. E. Asia Pte. Ltd
Tan Ee Ping & Associates
Tancho Plastic Containers Pte. Ltd
Tamco Electrical Engineering (S) Pte. Ltd
Taylor Woodrow-Dillingham Joint Venture
Texas Instruments Singapore (Pte.) Ltd
Thiess-Petrosea International Pte. Ltd
Times Press
Tropical Timber Industries Ltd
Union Carbide (S) Pte. Ltd
United Engineers (S) Pte. Ltd
United Surveyors
Victory Industrial Co, Pte. Ltd
Wah Eng Construction
Wang Coo-Kien & Co, Pte. Ltd
William Jacks (Electronic Supplies)
Willyn (Pte.) Ltd
Wood Working Industries Development Centre
Zuelling (Gold Coin) Mills Ltd

Public Establishments

Anti Pollution Unit
Broadcasting Department
Department of Civil Aviation
Economic Development Board
Engineering Industries Development Agency
Housing and Development Board
Jurong Town Corporation
Metrication Board
Ministry of Defence
Planning Department
Port of Singapore Authority
Public Utilities Board
Public Works Department
Science Centre Board
Singapore Institute of Standards and Industrial Research
Singapore Telephone Board
Survey Department
Telecommunication Authority of Singapore

Establishments and Shipping Companies Offering Training to Marine Engineering Students

Vocation Training

Jurong Shipyard Ltd
Keppel Shipyard (Pte.) Ltd
Public Utilities Board
Sembawang Shipyard (Pte.) Ltd
Singapore Slipway and Engineering Co, Pte. Ltd
Vosper Thronyard Pte. Ltd
Weng Chan Engineering Co, (Pte.) Ltd
Westbank Shipyard Pte. Ltd
Watt and Akkermans Sdn. Bhd.

Sea Training

Esso Asia Service Inc.
Interocean Lines (SEA) Ltd
Island Navigation Corporation Bhd.
Malaysian International Shipping Corporation Bhd.
Neptune Orient Lines Ltd
Ocean Fleets Ltd
Shell Eastern Petroleum Ltd
Straits Steamship Co, Ltd
Thome & Co, Ltd
Ocean Shipping and Enterprises (M) Pte. Ltd
Guan Guan Shipping (Pte.) Ltd

Workshop Training

Jurong Shipyard Ltd
Keppel Shipyard (Pte.) Ltd
Public Utilities Board
Sembawang Shipyard (Pte.) Ltd
Singapore Slipway and Engineering Co, (Pte.) Ltd
Watt and Akkermans Sdn. Bhd.

Shipping Companies Providing Sea Training for Deck Cadets and Apprentices

Austasia Line Pte. Ltd
Chip Hwa Shipping and Trading Co, Ltd
Neptune Orient Lines Ltd
Ocean Fleets Ltd
Ocean Shipping and Enterprises (M) Ltd

Singapore

East Asiatic Co, Ltd
Esso Asia Services Inc.
Guan Guan Shipping Pte. Ltd
Islan Navigation Corp. (SEA) Ltd
Shell Eastern Petroleum (Pte.) Ltd
H. C. Sleigh Ltd
Straits Steamship Co
Worldwide (Shipping) Ltd

Organizations Providing Practical Training for Marine Radio Officers

The Telecommunications Authority of Singapore
Neptune Orient Lines Ltd
The Singapore Association Shipping
The Singapore Shipowners Association

SRI LANKA

PROGRAMMES OF TECHNICAL AND TECHNICIAN EDUCATION

Engineering degree courses are run in two engineering colleges with an annual admission capacity of 350 students. A technicians' diploma course of three years' duration is at present run in the Ceylon College of Technology, Katubedde, within the campus of the University of Sri Lanka. Similarly, three-year diploma courses in engineering are run at the Hardy Senior Technical Institute, Anparai, which has excellent laboratory and workshop facilities. Technician education is treated as a part of university education.

The Directorate of Technical Education looks after technician training and education with the care it deserves. The Directorate has at its disposal the services of a full-time training officer who keeps in touch with the various training establishments spread far and wide in the country. There are facilities in Sri Lanka for the education and training of skilled workers.

TECHNICAL EDUCATION AND THE ECONOMY

A National Apprenticeship Board was established by the Government in 1971. It is responsible mainly for the organization of practical and industrial training for technical institutions of all denominations. Its address is 36 Wijerama Mawatha, Colombo 7.

The training centres run by the Government lack adequate facilities, with the result that training is not of the desired standard. In contrast, the training centre run in the private sector has well-developed facilities for all levels of technical education.

Technician courses are also run on a part-time basis for those who are employed. However, there is hardly any programme for training teachers for engineering colleges and polytechnics. Experts drawn from industry do the teaching work. Thus, industry acts as a responsible partner in education in that it extends full co-operation in the training of students and, to some extent, teachers as well.

Up-to-date projections of technical/skilled manpower have hardly been attempted, so there is no firm idea of the future needs of industry and related sectors of the economy. In fact, prospects of industrial development are bleak since the country depends excessively on imported raw materials to run its industries. There has been a sharp rise in prices throughout the world during the last few years, and imports are becoming costlier day by day.

Manpower requirements at the technician level are easily met from the country's own resources. Overseas facilities for the training of technicians are neither needed nor utilized. Instead they are needed for postgraduate studies and specialized technical training. Technician courses are so designed as to make

education and training flexible and broad-based so as to suit the changing pattern of industry. During discussions I was told there is less need for basic technician training than for specialized training in narrow specialities, and that, too, for a very small number.

What is puzzling is that there is a strong trade union of craftsmen which vehemently resists the recruitment of technicians in any industry. They fear that their chances of promotion would be bleak if technicians were posted to positions where craftsmen could work effectively if they had a little more experience. I am constrained to remark that this situation is bound to affect adversely all programmes for training technicians in a planned manner.

SUITABILITY OF TRAINING

The Government has established a National Council of Technical Education to co-ordinate training schemes with a view to avoiding duplication of effort and overlapping, and to ensuring better utilization of existing resources of the country. However, training is handicapped more in Sri Lanka than in other developing countries of the region because the unfavourable balance of trade has led to a dearth of equipment, spare parts, plant and machinery in technical institutions. Unless this situation is improved and the country's resources appropriately mobilized, the quality of training will deteriorate, particularly at this stage when vast developments are taking place.

It was emphasized that agriculture and agro-industry are most important, but petro-chemicals are becoming important, and rubber-based synthetic, chemical, textile, metal manufacturing and production industries need more specialist workers. These and allied industries need specialist manpower for their development. Specialist servicing and maintenance technicians are urgently required and will be required in greater numbers with higher-level technological knowledge, practical know-how and skill as industrial equipment and processes become more sophisticated.

INDUSTRY, TRAINING AND TECHNICAL INSTITUTIONS

Engineering first degree level courses are conducted at the Peradeniya Campus and at the Katubedde Campus of the University of Sri Lanka. At the former, facilities are available for specialization in the civil, mechanical and electrical engineering fields, while Katubedde allows further sub-division of the electrical engineering speciality into electrical power and electronics and telecommunications streams. The courses run in Katubedde Campus were made up, in 1972, of internal education for a period of four academic years in the university plus a training programme of one year in industry. This course is now being compressed into a course of four calendar years by rearranging the teaching schedule and utilizing the vacations for training.

The recognized technician courses conducted by the Hardy Senior Technical Institute at Anparai and the Katubedde Campus of the University of Sri Lanka lead to a National Diploma in Technology. The courses offer specialization in civil, mechanical (automobile), mechanical (production), chemical, electrical power, and electronics and telecommunication engineering. The course consists of a two-year internal teaching programme followed by industrial training for one year at suitable work places.

The curriculum of most of the engineering courses of Sri Lanka are based on the pattern of corresponding courses run in the U.K. and other advanced countries. It has not been sufficiently modified to suit local conditions or, after critical

examination of the requirements of local industry, to business, government and education. Tea, which is the biggest export product of the country, provides an example of this defect.

In recent times the major government and corporate sectors have involved themselves in the education of engineers, and industry has also shown lively interest in the planning of the course curriculum in technical education. Industrial in-plant training has been introduced to reduce the gap in practical knowledge of the end product of technical institutions.

Practical in-plant training of nine months is compulsory for engineering undergraduates of Katubedde, whereas Peradeniya students generally gain knowledge through vacation employment for varying periods. In the overall picture, theoretical and practical work occupy roughly equal proportions in the engineering curriculum.

MAJOR EXAMINATIONS

The holding of major examinations at the end of each academic year is still the most important method of testing engineering students in Sri Lanka. In the final year there is a "project report" on practice-orientated work. Course work is continuously assessed.

Entrance to engineering first degree courses is based on the results of the General Certificate of Education (Advanced Level) examination. For the National Diploma in Technology courses at the Katubedde Campus of the University of Sri Lanka and at the Hardy Senior Technical Institute, Anparai, entry is based on the results of the General Certificate of Education (Ordinary Level) examination.

Technician level courses in relevant fields are available as part-time/evening courses for those employed during the day. These courses are phased over three years of part-time study.

TECHNICAL TEACHER TRAINING

A wing for the training of technical teachers was started at the Junior Technical Institute, Ratmalana, in September, 1971. The first batch of technical teacher trainees underwent training in the fields of automotive mechanics, electrical trades and metal-work. This training wing has now been established as a Technical Teacher Training Institute, being permanently housed on the Katubedde Campus of the University of Sri Lanka. It has started training instructors for industry, in addition to its regular programme for training technical teachers.

PRACTICAL IN-PLANT TRAINING

Students for the National Diploma in Technology who have completed their two year institutional training are placed in various allied state departments, corporations and private sector establishments for a period of one year for in-plant training. They are under the direct control of the Technical Education Division for purposes of training placements, while training schedules and the payments of stipend etc. during training are controlled by the National Apprenticeship Board. During the in-plant training period they are considered as technician apprentices under the National Apprenticeship Board.

Special training schedules for in-plant training have been formulated as standards by the National Apprenticeship Board for the following areas of engineering and technology: (a) Mechanical Engineering - Production, Automobile;

(b) Electrical Engineering - Electronics and Telecommunications (Light Current); (c) Civil Engineering; and (d) Chemical Engineering.

By an enactment of the Legislature (National Apprenticeship Act No. 49 of 1971) the Government introduced appropriate measures for the regulation and systematic training of apprentices in the various trades. The total number of trainees for in-plant training (Engineering Technician) was 393 in the above fields of engineering in 1975. All examinations for technician courses are conducted by the Commissioner of Examinations on behalf of the Director-General of Education of Sri Lanka.

MANPOWER PLANNING

The responsibility for manpower assessment, forecasting and review rests with the Ministry of Planning and Economic Affairs. This Ministry is basically in charge of all planning activity including employment and manpower planning. There is a Division for Employment and Manpower Planning consisting of a Director, Deputy Director, two Assistant Directors, and other staff. It is advised by a senior I.L.O. adviser.

This Division works in close collaboration with the Ministry of Education, the universities, the National Apprenticeship Board and various other agencies engaged in training activities. Besides employment and manpower planning, this Division is involved in educational forecasting, and the co-ordination of education and training, relating it to manpower needs and examining all educational proposals. Thus it works very closely with educational problems and is particularly concerned with technical education and training.

The Division receives economic data from other units of the Ministry of Planning, while educational data are supplied by the Ministry of Education. Thus it has developed a proper framework for projecting manpower demands in respect of important categories. The manpower forecasts prepared and revised from time to time are passed on to the Ministry of Education in the normal course. There is a great deal of informal discussion, consultation and liaison process. Thus most of the manpower business is done in collaboration with the technical education authorities.

MANPOWER SUPPLY

Demands for various categories of skilled and high-level manpower for the implementation of Sri Lanka's development plans and programmes have been estimated, and are shown in Appendix 3, pages 101-103. These estimates denote only orders of magnitude and in this sense are indicative rather than definitive in nature.

Sri Lanka has now a fair degree of self-sufficiency in regard to engineering graduates in civil, mechanical and electrical engineering. Technicians, supervisory personnel and skilled workers are also available to meet current requirements. In the field of engineering, there are shortages of chemical engineers, production engineers and some specialized technical-cum-managerial personnel, but these are likely to be overcome with the return of a significant number of Sri Lankan engineers now studying abroad.

There are some areas of shortage, viz. experienced personnel in management, particularly technical management and consultancy for small industries, engineering personnel in highly specialized fields, and agricultural scientists with special experience. These shortages are presently being met through training arrangements and technical assistance.

The Department of Labour, Employment Division, occupational analysis unit has prepared occupational classifications and analysis used in Appendix 3, pages 101-103.

MAJOR INDUSTRIES

Sri Lanka's major industries are tea, rubber, and coconut growing and processing, but these are really a part of its agricultural sector. In the economy of the country, manufacturing plays a comparatively small role, but it is possible to distinguish three distinct sectors - the public sector, the organized private sector, and the unorganized private small-scale sector.

In the public sector there have been large investments in projects like the oil refinery, steel, tyres, hardware and cement. In the organized private sector the larger manufacturing firms are concerned with machinery and equipment. In the unorganized sector the major share goes to handlooms. The rough share of each sector in terms of value of output and employment is as follows:

SECTOR	VALUE (Million Rupees)	SHARE (%)	EMPLOYMENT
Public	310	8.4	18,700
Private	3,374	91.6	381,300
Organized	1,952	53.0	103,900
Unorganized	1,422	38.6	277,400

On the above, the comments to be made are:

1. Technical education and training facilities at the technician level are adequate to meet the needs of the nation in most fields.

2. Technical education and training has been given high priority in the National Development Plan. The Cabinet of Ministers has approved the setting up of a National Council of Technical Education and Training to co-ordinate all training schemes of the government departments, corporations and the private sector to avoid wasteful duplication and overlapping as well as to ensure better utilization of existing resources in the national interest. A list of industries who have offered training facilities is at Appendix 2, page 100.

FACILITIES FOR TECHNICIAN-LEVEL TRAINING IN ENGINEERING AND INDUSTRY

Institutions	Duration
Ceylon College of Technology, Katubedde Campus of Sri Lanka University	3 years Technician Course
Hardy Senior Technical Institute, Anparai	3 years
Irrigation Department Training Centre	1 year
Institute of Surveying and Mapping, Diyatalawa	1 year

PRACTICAL TRAINING

Both the technicians' and the engineering courses include a whole year of practical training in industry as this is considered helpful in producing better prepared

manpower for technical assignments. Also, and especially regarding the engineering students, it is generally recognized that intermission of practical work is beneficial to theoretical studies of engineers and technicians.

It was anticipated from the very beginning that there would be difficulties in implementing this new scheme of in-plant training in Sri Lanka. There was no tradition to build on, no legislation to support it, and a general absence of extensive or versatile industries to receive the trainees, except in the field of civil engineering. The National Apprentice Board is now taking an active interest in the problem . Although it has been possible to place all the students for practical training, it cannot yet be said that the trainees have enjoyed maximum benefits through this arrangement. This is partly due to the fact that students have been sent in over-large groups to the few industrial or technical establishments, almost exclusively government corporations or technical departments. They have often had to join training courses for apprentices of these institutions rather than being put to actual practical work.

The lack of adequate staff at the college level to plan, follow up and keep alive contact with the supervisors of the trainees at respective work places has also contributed to putting the scheme in jeopardy.

The practical training is nevertheless an essential ingredient of the courses at the College, and the difficulties encountered in the organization of a proper training have not discouraged the authorities; rather, they have encouraged them to improve the scheme. Employers of technicians and engineers who pass out from the College have expressed satisfaction with this part of their training. It is, therefore, hoped that the industrial sector as a whole will be more co-operative in the field of practical training of technical students as soon as they become aware of its advantages.

APPENDIX 1: OFFICIALS MET AND VISITS UNDERTAKEN

Officials

Mr. R. Paskaralingam	Senior Assistant Secretary, Ministry of Education, Colombo
Mr. T. O. P. Fernando	Director of Technical Education
Prof. K. K. Y. W. Perera	President, Katubedde Campus, University of Sri Lanka
Mr. B. A. S. Josephson	Chief Technical Adviser, UNESCO/UNDP, Katubedde Campus
Dr. P. Sivaprakashapillai	Ag. Head of Electrical and Telecommunications Department.
Mr. M. C. T. Fonseka	Training Officer, Directorate of Technical Education, Colombo
Mr. Wijemahne	Dy. Director General Planning
Mr. P. Ramanathan	Chairman and Director, National Apprentice Board
Mr. R. K. Srivastava	Sr. Adviser on Manpower Employment and Human Resources Planning Project, I.L.O.
Mr. D. Munnaweera	Design Engineer-cum-Training Officer, Tyre Corporation, Colombo
Mr. M. J. P. Senarathe	Ag. Registrar, Institute of Engineers, Colombo
Mr. S. Karunaratne	Dean of the Faculty of Engineering, University of Sri Lanka

Institutions and Factories Visited

College of Technology Campus of University of Sri Lanka; Sri Lanka Technical College, Colombo; Junior Technical Institute, Kegalle; Colombo Commercial Company, Colombo; Tyre Corporation (Government undertaking).

APPENDIX 2: ESTABLISHMENTS OFFERING ORIENTATION AND TRAINING FACILITIES FOR TECHNICIANS

Government Departments

Ceylon Government Railway Chief Mechanical Engineer's Dept
Ceylon Government Factory
Department of Buildings
Colombo Port Commission
Posts and Telecommunications Dept
Department of Civil Aviation
Overseas Telecommunications Service
Land Development Department
Ministry of Irrigation, Power and Highways
Water Works Department, Colombo Municipality
Department of Water Supply and Drainage

Government Corporations/Boards

Eastern Paper Mills Corporation
State Engineering Corporation
Sri Lanka Broadcasting Corporation
Mahaveli - Development Board
Ceylon Petroleum Corporation
Ceylon Steel Corporation
Ceylon Transport Board
Air Ceylon Ltd
Ceylon Oils and Fats Corporation
Ceylon Tyre Corporation
Ceylon Cement Corporation
Cement Electricity Board
Ceylon Ceramics Corporation
Paranthan Chemicals Corporation
Sri Lanka Sugar Coporation
National Textile Corporation
State Distilleries Corporation
Industrial Development Board
Ceylon Plywoods Corporation
State Rubber Manufacturing Corporation

Private Sector Establishments

Chemical Industries (Ceylon) Ltd
Lever Brothers (Ceylon) Ltd
Brown & Co, Ltd
Richard Pieris & Co, Ltd
J. B. Textile Industries Ltd
Lambretta (Ceylon) Ltd
Ceylon Oxygen Ltd
Moosagies Ltd
Deekay Electronic Industries Ltd
Union Carbide Ltd
Maharaja Organization Ltd
Walker & Sons Ltd
Ceylon Tobacco Ltd
Bata Shoe Co, of Ceylon Ltd
Colombo Commercial Co, Ltd

APPENDIX 3: MANPOWER UNIT STATISTICS

Estimated Demand for Technicians (Lower Grade), 1968-78

Category	Total Stock Required		
	1968	1972	1978
Building Overseers	280	400	620
Junior Inspectors	550	800	1,225
Junior Foremen	510	730	1,130
Junior Draughtsmen	590	850	1,300
Minor Supervisors	630	900	1,390
Overseers	1,610	2,310	3,550
Supervisors	570	810	1,240
Surveyors	880	1,265	1,940
Total	5,620	8,065	12,385

Estimated Demand for Technicians (Higher Grade) 1968-78

Category	Total Stock Required		
	1968	1972	1978
Clerks of Works	36	51	78
Senior Draughtsmen	1,066	1,532	2,353
Drawing Office Assistants	57	81	125
Foremen	618	888	1,363
Inspectors of Mines	5	8	12
Quantity Surveyors	9	13	20
Senior Inspectors	450	646	992
Technical Assistants	394	566	870
Total	2,635	3,785	5,813

Sri Lanka

Additional Employment by Occupational Groups, 1972-76

Category	Base Year (1971)	1972-76 (Additional Employment)	1976 (Projection)
Professional, Technical and Related Occupations	196,000	55,500	251,500
Administrative, Managerial and Related Occupations	56,700	22,600	79,300
Clerical, Sales and and Service Occupations	744,300	132,700	877,000
Craftsmen and Production Occupations	965,900	255,800	1,221,700
Farmers and Related Agricultural Occupations	1,973,100	343,400	2,316,500
Total	3,936,000	810,000	4,746,000

Demand and Supply of Skilled and High Level Manpower 1969-78

Category	Demand 1969-78	Supply 1969-78
Engineers	1,850	1,850
Architects	50	50
Technicians	9,950	9,000
Skilled Craftsmen	23,000	24,000
Doctors	2,280	2,050
Dentists	305	335
Nurses	4,520	4,520
Agriculture Graduates	585	585
Agriculture Technicians	1,200	1,200
Veterinary Surgeons	205	225
Science Graduates	9,900	4,250
Teachers	33,150	35,300

Demand for Engineers

Category	Total Stock Required		
	1968	1972	1978
Civil	760	970	1,255
Mechanical	300	460	800
Electrical	350	520	910
Marine	15	25	40
Chemical	40	70	150
Agricultural	20	60	110
Aeronautical	10	15	20
Refrigeration	40	60	20
Electronics	40	20	70
Industrial	10	25	40
Production	40	50	60
Other	40	50	60
Total	1,650	2,365	3,660

As this survey was carried out between October 1974 and January 1975, it is realized that some of the information may have been rendered out of date by subsequent developments.

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