

Technical Education in India

By Prof. DV Singh

Evolution of University Education

In Europe, the expression 'Studium Generale' indicated what we today understand as University. A 'Studium Generale' was expected to have an assembly of many teachers and students drawn from many places and also to have many subjects of instruction and discussions. The oldest 'Studium Generale' in Europe date from the beginning of the 12th Century. To name them, Bologna, Reggia, Montpellier, Paris and Oxford.

The Latin word 'Universitas' meant corporation or guild in middle ages. In medieval Europe Universitas indicated the association of businessmen, teachers, students, scholars, etc. The word 'University' is derived from Universitas.

In India the Budhist developed similar Studium Generale or University institutions several hundred years before they appeared in Europe. The Budhist Viharas developed into bigger institutions in which the subjects of instructions were gradually liberalized to include grammar, philosophy, medicine, arts and sciences. The Monasteries with their complex structure and management became a veritable workshop and a school of arts and crafts. Budhist monastic institutions developed as Universities. To name some of them Nalanda, Vallabhi, Vikramshila, Odantapuri, Jagaddala, Mithila, Ranchi, etc. However, these Universities disappeared due to decline of Budhism in India.

Vocational Education in Medieval India

Details of vocational and technical education in medieval India are not available. The excellence of manufactured articles, e.g. fabrics of cotton and silk, embroideries, painted and enameled wares, steel guns, swords, knives and scissors, gold and silver ornaments and white paper, are well known. This excellence could not have been achieved and maintained for centuries without a dependable technical education. Three systems of technical education developed, the hereditary learning, pupilage training and training schools attached to workshops. The manufacturing establishments called Karkhanas, gradually started imparting technical education in their areas of specialization. The Muslim rulers usually maintained Public Work Department called

Shurat-Am, which looked after and assisted the workshops engaged in industrial training activities.

The early Sultans and Mughals supported such Karkhanas and their technical/vocational education. Both Hindus and Muslims took great interest in vocational education as a result of which trained workers of every trade were available in abundance.

The Onset of Industrial Age

The importance of technical education in the new industrial age was realized in the second half of the 19th Century when international competition in manufactured goods emphasized the advantages of educated and technically trained manpower that was capable of innovation.

It however raised several questions – the educational preparation necessary for technical education, contents and levels of technical education, emphasis to science, etc. Experiences of several European countries for nearly half a Century, with endless debates and discussions of many committees and commissions contributed to obtain appropriate answers to such questions and evolution of technical education.

Technical Education in British India: The Beginning

In 1794 the British Government in India made a move to train technical persons in India by establishing the first Survey School in Madras in a building near Fort St. George with eight students from English schools. The Madras Survey School was training only English boys. The British policy at that time was definitely against teaching surveying of any kind to native Indians because of military and political implications of survey work, as a precaution against reliable maps falling into the hands of the French, the Dutch and the Portuguese. The Court of Directors of the East India Company insisted on the secrecy of survey maps and restricted the art and science of surveying to English boys.

However, civil surveying for revenue purposes remained outside the ambit of the restrictions of the East India Company because it was an ancient branch of knowledge in India and a class of people, the ‘Amins’ or ‘Mirdhas’, specialized in preparing land revenue maps.

The Madras Survey School went through several ups and downs, was on the brink of closure in 1810 but was revived in 1819, admitting some apprentices directly called

from England in addition to boys from the local English schools. The Survey School was expanded in 1857 and renamed as the Civil Engineering School.

Developments in Bengal

In 1823, a General Committee of Public Instruction, comprising mostly of English officers, was constituted in Bengal. For about twenty years, it was the only Government agency of Bengal Government concerned with education matters. In 1842, the Committee was replaced by a Council of Education. The Committee and its successor Council in their reports frequently mentioned the branches of study which would be useful to students to earn their livelihood. Apart from reading writing and arithmetic, surveying was strongly recommended for Indians required in judicial and revenue departments and by courts. At that time surveying was taught in Bengal in two colleges, the Mohammedan College (established in 1781) and the Hindu College (1817). The latter was incorporated in the Presidency College in 1857.

The opinion in Bengal crystallized that drawing and surveying should be taught only in colleges and not in schools. From the need to teach these subjects in colleges, the desirability of having colleges of civil engineering was a big step. Engineering was not classified into several subdivisions and it meant engineering for civil purposes as distinct from military.

The importance of civil engineering, as a branch of instruction for Indians, began to attract attention of authorities in about 1843. Construction of roads and canals was in progress or being projected and it was realized that men trained in engineering would be required; surveying skills would not be enough.

In 1843-44, Government sanctioned a professorship of civil engineering in the Hindu College but no suitable candidate was found. Efforts to get a person through the Institution of Civil Engineers, London also did not succeed. Finally a Cambridge man then teaching in Hindu College, was appointed Professor of Civil Engineering. He was, however, not successful.

At this time the idea for having a University was gaining ground. The Council in its report in 1844-45 suggested the establishment of a central university for “granting degrees in arts, science, law, medicine and civil engineering”. However, the Bengal Government took no action until after ten years.

Developments in Bombay and NWP

Elphinstone Institution in Bombay started engineering classes in 1844 to train surveyors and builders. The programme had a short life of just three years. It was closed in 1847 after producing six surveyors and builders four assistant surveyors and builders. It closed because it did not attract students of sufficient merit to qualify as “scientific civil engineers fully groomed in the theory of their art”

In early 19th century, after the conquest of the northern region by the British, the North Western Province (NWP) was created in 1836 with Agra as its headquarters.

In 1843 the subject of education in NWP was transferred from the Bengal Government to the Government in Agra. The renovation work on old Yamuna Canals and construction of some roads were in progress. Thinking had started on a new bold venture – the Ganga Canal. However, the most significant single event, which in retrospect proved vital, was that in the same years James Thomason was appointed the Lieutenant Governor of NWP. While the governors of presidencies, appointed from British aristocracy and political heavy weights, responded slowly through proper channels to the proposals coming from lower levels, Thomason rising from the ranks of civil servants, made the proposal himself, followed them up for acceptance by higher authorities and implemented them vigorously.

Thomason, in his memorandum dated September 23 1847, submitted a detailed proposal for setting up a college to train Indians as Civil Engineers. Probey Cautley, an army engineer whose name is closely associated with the construction of Ganga canal, had envisaged a school for the supply of efficient workmen for the entire line of canal. Thomason went further in his proposal in which he dwelt extensively on the requirements of the whole country, surveying, irrigation, navigation, roads, bridges and railways for all of which it was impossible to provide Europeans. He made a strong case to form a nucleus at Roorkee for training Civil Engineers.

The proposal of Thomason was accepted by the Governor General Hardinge and the Government of NWP issued a notification dated 25 November 1847 establishing the Civil Engineering College at Roorkee. The College started function on January 1, 1848, with Lieutenant Maclagan as the Principal and four teachers, two of whom were Indians.

The College began with three courses, one for engineers, one for upper subordinates (overseers) and the third for lower subordinates (sub-overseers and draughtsman). The engineering class was open to European military officers and English, Anglo-Indians and Indian Civilians. During the first twenty years only a few Indians were admitted. But after 1870 the number of Indians increased and that of Europeans declined.

Thomason compiled several of his previous recommendations in 1852 in one pamphlet strongly recommending to the Government to raise “Roorkee College into a great school for every branch of engineering labour”. The recommendations were only partly accepted and even they were not all implemented. Yet with limited development, the Roorkee College became a model and catalyst for the other engineering colleges in India. Within a few years engineering colleges of Calcutta, Madras and Poona followed. Thomason died untimely in 1853. The Roorkee College was named Thomason College of Civil Engineering in 1854 in honour of its founder. The concept of the engineering education through formal instructions in a school or college was unknown at that time even in England. Therefore, the subjects of engineering, when Roorkee College was established, were not properly classified from the point of view of teaching.

The teachers of Roorkee College, within the first twenty five years of its existence did pioneering work in systemizing the teaching of engineering, formally writing lecture notes, developing examples, making drawings, writing books and manuals and updating them periodically. The Roorkee College Manuals and Treatise on Civil Engineering became standard texts not only in Roorkee but at other colleges in India.

The Thomason College of Civil Engineering was affiliated to Calcutta University in 1864 and to Allahabad University in 1894. These affiliations remained notional as no student ever took a diploma from these Universities. The affiliation with Allahabad University ended in 1905.

Except for starting one industrial school in 1892, the NWP government concentrated all its efforts to reorganize Roorkee College. From the beginning the College was under the administrative control of PWD which was largely manned by royal and other military engineers.

After a rather stagnant period during the decade of 1890, programmes expanded to include mechanical and electrical engineers at one end to motor drivers and linemen on the other.

Machinery and tools were indented from England and a modern workshop was established, including forge and foundry shops run entirely on electricity. Several new courses were added, including a course in telegraphy in 1893. In 1897, the two year engineering course was extended to three years with two branches, civil and electrical, telegraphy was merged with electrical. The mechanical apprentice and the industrial apprentice courses of three years was opened one year earlier to train foremen. The industrial apprentice course covered various trades, printing, photography, metal and

woodwork, electric motors and mechanical engines. During the early decades of the 20th Century, the profile of the college changed from degree-level education to an industrial apprentice level institute. Even an automobile driver's class was started in 1907.

Wood's Dispatch

The question of suitably trained persons for PWD in all the three presidencies was being raised. The famous Wood's Dispatch of July 19, 1854 from the Court of Directors of the East India Company envisaged an enlarged system of education to be pursued in India. In response, the Governor General Lord Dalhousie recommended to the Court for establishment of an engineering class at each of the three presidencies of Calcutta, Madras and Bombay. Unlike that in NWP the progress was slow but things started moving.

In Madras by 1842 it was already recognized that the survey school was inadequate for the needs of PWD and establishment of an engineering college was desirable. The initial reaction of the Court of Directors to the proposal was negative on the ground that the general education in the presidency had not advanced enough to justify such a venture. It took the Court five years to agree with the Supreme Government on the need to upgrade the Survey School. The matter was referred to the Director of Public Instruction (DPI) Madras who recommended the establishment of a college on the pattern of Roorkee College.

Conflict in Madras

A conflict of interest however delayed the opening of Engineering College. Major Maitland, who had opened a school in the Gun Carriage Factory Madras in 1840 for ordinance officers and apprentices, wrote to the Council of Education that Ordinance "Artificers and the pupil of the Manufactory" be induced to study and improve themselves to become "Mechanics and Artisans of a superior order and out of their number might be found intelligent foremen and overseers for the Ordinance Branch of the Services". Maitland emphasized that, to produce capable engineers, every student admitted to an engineering college must have learnt at least one trade. Maitland must have had enough influence to stall the establishment of the engineering college unless his ideas and his school became essential component of it.

At last in 1854, Lord Dalhousie proposed that "whether by the extension of Maitland's school or by its incorporation with a large institution upon the principle of Thomason College at Roorkee, a complete system of instruction should be provided at Madras for every class belonging to PWD-Europeans, East-Indians or natives whether artificers,

foremen, overseers, surveyors or civil engineers”. The Court of Directors conveyed their concurrence in 1855 and the Director of Public Instructions (DPI) was asked to submit a detailed proposal.

DPI Arbuthnot did not accept the wisdom of Gun Carriage Factory School as a basis for the proposed institution and proposed a scheme of an institution at three levels just as at Roorkee College, with provision of military students along with civilians and kept Maitland and his school out of the proposal. The Madras Government, to please both the parties accepted the DPI’s scheme with the provision that every student of the college be required to master some craft or trade and the school at the Gun Carriage Factory be extended to supply the PWD with artificers.

The Supreme Government in 1856 accepted the proposal of Madras Government but insisted that for the purpose of practical training the Maitland School be amalgamated with the proposed college. Major Maitland interpreted this order to mean that he was given the authority to direct the establishment of the college.

After a voluminous correspondence between the DPI, the Chief Engineer PWD and Major Maitland the dispute, taking more than two years, resolved. Finally, the Supreme Government withdrew the order for amalgamation but ordered that Major Maitland be appointed Director of Practical Instruction and the college of practical training should use his workshop.

Fluid State in Bengal

In 1857, pending settlement of the dispute, the Madras Government ordered the expansion of the Survey School, changed its name to Civil Engineering School and appointed Lt. Winscom as the Principal. After some more hiccups the Civil Engineering College came into being in Madras in 1859. It functioned on a very modest scale because Madras Government gave no grants in addition to what was given to Survey School. The College was affiliated to the University of Madras and the first batch received the Bachelor of Civil Engineering (BCE) on 1864. The Madras University added mechanical engineering course in 1894 and the name of the degree was changed from BCE to BE. The Madras College was the first to offer a degree programme in mechanical engineering. In 1920 the college moved to Guindy.

In 1854, the Council of Education Bengal recommended the establishment of a separate engineering department in the proposed Presidency College, which was to function in the following year by incorporating the Hindu College. The Chief Engineer of Bengal,

Col. Goodwyn, on the other hand, recommended the constitution of a separate engineering college for general improvement of Department of Public Works. The Bengal Government concurred with the Chief Engineer, took two years to prepare its detailed scheme to obtain the sanction of the Court of Directors. In November 1856, the Civil Engineering College Calcutta started function with 10 students and two teachers, Capt. Sherwill of the Engineers as Professor of Surveying and Shome as Professor of Mathematics, since no Englishman was available with suitable qualification. The College started in a portion of Writers Building. The Government gave a guarantee of employment in PWD to the students after passing the two year course. The College was affiliated to Calcutta University when it was established in 1857 and the course was raised to three years with one year training at the end of which the candidates got the degree of Licentiate in Civil Engineering (LCE).

The question of merger of engineering college with Presidency College remained alive and in 1862 when the Government of India invited the view of the Bengal Government on the issue, the latter supported merger. In 1865 the Engineering College was closed and instead a department of Civil Engineering at the Presidency College was opened. This step impeded the progress of engineering education in Bengal for the next about fifteen years.

After a gloomy existence the prospects brightened up in 1878 when a practical training institute around a newly established PWD Workshop was under consideration, it was decided that the civil and mechanical engineering students should receive theoretical training in a college and practical training in a workshop. In April 1880 the engineering department in the Presidency College was again given a separate identity as a college and was moved to Sibpur.

It was given the name Government Engineering College Howrah. Later in May 1887 it got another name Civil Engineering College Sibpur. In 1920 it was named as Bengal Engineering College Sibpur and remained so until after independence.

The Poona College

On the basis of the project submitted by the Bombay Government, the Supreme Government in 1855 approved the establishment of a college for the instruction of civil engineers, surveyors, overseers, foremen and artisans. Not much happened on the project except starting an Engineering Class and a Mechanical School at Poona. Later as the matter was taken up by the DPI Howard, who said that the school was too narrow and governmental and that it trained officers for government service but did nothing for the public. Howard's idea got an impetus through the munificence of Sir Cowasjee

Jehangir, who made a magnificent donation of Rs.50,000/-. Consequently the School was converted into Poona Civil Engineering College in 1864 and affiliated to University of Bombay in 1868 for the degree of Licentiate in Civil Engineering.

The scope of instruction of college was expanded in 1879 to include forestry and agriculture by starting a class for forest rangers and a diploma course in agriculture. The name of the College of Engineering was changed to the College of Science. General courses in science were started leading to B.Sc. degree of Bombay University. The most distinguished and famous alumnus of the College Sir Mokshagundam Visvesvaraya, topped the list of L.C.E's in 1884.

In 1886, the course of civil engineering was revised and upgraded and the minimum qualification for admission was raised from matriculation to what was then called Previous Examination. The trend towards opening new courses was reversed. The Rangers Class was closed in 1904. By 1911 all other non-engineering courses were also abolished. The B.Sc. classes were transferred to the Science Institute in Bombay and the College was given back its original name, the Poona College of Engineering.

Hegemony over the Engineering Colleges

The Royal Engineers in the army in British India played a major role influencing the fortunes and also the misfortunes of the four engineering colleges. They were the only type of engineers that came to India with the East India Company. As the Company took more and more responsibility of governance of the country, all technical jobs of engineering and scientific nature were entrusted to these military engineers. PWD was almost entirely officered by them. Engineering education fell naturally in their sphere.

The original proposals for each of the four engineering colleges stipulated that the colleges be placed under the education departments of the respective presidency or province. This was done to ensure the civilian objectives of the colleges to train engineering personnel for civilian work. But many of the Principals, Professors and Instructors appointed to organize and run these colleges were, by force of circumstances, military engineers. These military officers with natural proclivities towards the army, tended to forge close links between the college and the military in two ways. The army became, at least partly, the feeder for admission in the college and it served the needs of the army by running tailor made special courses for officers and other ranks of the engineering corps.

From the beginning, the Roorkee College was placed under PWD and not under the education department as envisaged originally. The Government of India recognized that

the Thomason College had special obligations towards the army and that a certain proportion of seats in the engineering and the upper subordinate classes should be reserved for young men from the army who wanted to change over to services in public works. Also, under the orders of the Military Department of the Government of India, special courses were regularly run for army personnel till the end of the 19th Century. All the Principals, except one, were military officers until 1930.

The other three colleges successfully remained under the control of the department of education. However, in matters of admission and courses, Madras College had similarity with Roorkee College. Its last Royal Engineer Principal retired in 1907. The Calcutta College too showed military bias but its life was short. The engineering classes of the Presidency College and later Sibpur College had no military connection.

The first Principal of Poona College Capt. JBH Close was very keen to make the College serve military needs by providing instruction to European sappers posted in Bombay Presidency. The Education Department did not allow too much importance to training military officers at Poona. Only the first two Principals were from the military. Subsequently, the military connection ceased.

Stanley Engineers

By 1858, it was clear that the ambitious objectives of the Roorkee College envisaged by its founder did not quite fit in with the imperial interests perceived by Her Majesty's Government in England, which had taken the responsibility of directly governing India after the 1857 war of independence. A scheme of directly recruiting young Civil Engineers in England for service in the public works in India was initiated by the Secretary of State Lord Stanley in 1859. Engineers recruited under the scheme were dubbed a Stanley Engineers. From 1859 to 1868, 165 'Stanley Engineers' were appointed against only 45 from Roorkee College.

While the military engineers nurtured all the four engineering colleges in their infancy, within a few years they also initiated policies which adversely affected the growth of the colleges. In 1870, as a modification of the Stanley Scheme, a college of civil engineering, Royal Indian Engineering College, popularly called Cooper's Hill College, on the pattern of Roorkee College, was established in England to train engineers for PWD in India. The entire expenditure of Cooper's Hill College was borne by the Government of India and its purpose overlapped with those of the engineering colleges in India.

Persons recruited and trained in England thus filled the bulk of the posts in India. The products of the engineering colleges in India were deprived of job opportunities, with the result that many went unemployed or were under-employed. The persons behind the Stanley Scheme and the Cooper's Hill College were some military engineers who were intimately associated with the establishment and running of the four colleges in India.

Cooper's Hill College was designed for an intake of 50 students. However, employment in PWD in India was restricted to 40. Nevertheless, with effect from 1876, Roorkee's share was fixed at 8 and from 1885 onwards it was reduced gradually to 5 and then to 4. The remaining number of engineers passing from Roorkee was adrift and there were cases when they had to accept jobs of draftsmen, accountants or school masters. In late 1870's the demand for engineers in PWD started diminishing because of general reduction in government expenditure. In 1878, Principal Bandreth of Roorkee College proposed that appointments in other Government departments similar to PWD be opened for employment to Roorkee engineers but the Government of India did not respond favourably. In 1880, the Secretary of State passed an order denying jobs to Englishmen trained and educated in India. However, this order was practically rescinded in 1883. The annual appointments for each class were: Cooper's Hill 15, Indian Colleges 9 and Royal Engineers 6. Out of appointments from Indian Colleges, 5 and 4 were alternately given to Roorkee, 1 and 2 to Sibpur, 2 to Poona and 1 to Madras. Due to continued fall in demand for engineers in PWD, the recruitment to PWD from Cooper's Hill was reduced from 15 to 10 in 1892 and thereafter to less than 7. The Cooper's Hill College limped on for another 17 years and was finally closed in 1907. The stores and machinery were shipped to India and distributed free among the engineering colleges.

Establishment of Universities

In July 1854, the Court of Directors of the East India Company sent a Dispatch to the Governor General of India in the Council suggesting the establishment of Universities in the three Presidencies. In pursuance of the Dispatch, the Universities of Calcutta, Madras and Bombay were founded in 1857. At that time, they were purely examining bodies concerned mainly with instituting degrees and framing rules and regulations for examinations leading to degrees. Their scope covered all branches of learning involving intellectual efforts worthy of recognition by a University. They established faculties and instituted degrees in traditional areas like arts, science, law, etc. and also in medicine and engineering.

It was left to colleges to enroll students, organize teaching and seek affiliation with the university degrees. For engineering, Calcutta and Bombay Universities aimed higher and instituted Master of Civil Engineering (M.C.E) degree for which a B.A. degree was prerequisite. Madras University more realistically instituted, in addition to M.C.E., a lower degree called Graduate in Civil Engineering (GCE) for which prerequisite qualification was matriculation. The three engineering colleges at Calcutta, Madras and Poona were duly affiliated to the Universities of their Presidencies.

The ground reality of the needs of engineering education and the uncharted waters of academic aspects through which the colleges were required to steer, did not match the expectations of the Universities. The Colleges continued to produce engineering personnel at two levels, officers and subordinates with great efficiency. If the Universities did not consider the engineer officer worthy of university degrees, the college certificates were valuable enough. There were no takers for the MCE degree. Therefore, Calcutta and Bombay Universities like Madras University, instituted a lower degree of L.C.E. From 1864, the graduates of engineering colleges at Calcutta Poona and Madras received university degrees, LCE and BCE.

The University of Allahabad was established in 1887 and the Punjab University in 1892. The Roorkee College was affiliated to Calcutta University in 1864 and to Allahabad University in 1894. These affiliations appear to have remained only notional as there is no record of Roorkee students going for university examination. The affiliation with Allahabad University ended in 1905.

Status of Technical Education (1884-85)

Sir MacDonnell's Memorandum prepared in 1886 on the existing state and future prospects of technical education had nothing much to notice except the four engineering colleges, three schools of industrial art and about forty five lower grade industrial schools. The following enrollment status during 1884-85 was reported:

Name of College	University Level	School Level	Total
Civil Engineering College, Madras	19	106	125
College of Science, Poona	102	77	179
Government Engineering College, Howrah	42	107	149
Thomason College of Civil Engineering, Roorkee	155	-	155
TOTAL	318	290	608

Sir MacDonnell reported that a few more Survey Schools were functioning during the period in Hyderabad (Sind)

Province	Survey Schools		Industrial Schools	
	Number	Enrolment	Name	Enrolment
Madras	-	-	6	249
Bombay	1	21	7	307
Bengal	4	171	5	172
Punjab	-	-	4	93
NW Province	-	-	2	186
Central Province	-	-	19	316
Assam	7	163	1	18
Burma	5	110	1	38
Total	17	465	45	1379

Golden Jubilee of Queen's Rein

The golden jubilee celebration of Queen Victoria's reign in 1887 provided the occasion to collect large sums of money from the public for commemorating the event suitably. In Bombay and Madras opening of technical schools was considered an appropriate way of utilizing the funds. Viceroy Dufferin in a public address in Lucknow in 1888 said "I have always taken the deepest interest in technical education. I have called the attention of all the subordinate governments to the desirability of promoting this branch of instruction by every means in their power. But I must remind you that it is neither within the competence nor the function of the Supreme Government to give practical effect to its views. The latter responsibility devolves on the local government to a certain degree, but still more largely on the Indian community. Even the local governments, unassisted by the liberality and counsels of those who are in a position to support their efforts, can but do little".

The Victoria Jubilee Technical Institute, founded in 1887, proudly claims that the impulses, which led to the formation of Indian National Congress, were also responsible for the origin of the Institute. The great names associated with the Institute include Dadabhai Naoroji, Pherozshah Mehta, Dinsha Wacha, R.D. Ranade, Badruddin Tyabji, K.T. Telang, and Philanthropic members of Jeejabhai, Wadia and Petit families. The public donations collected to commemorate the vicerealty and to celebrate the Golden Jubilee of Victoria's reign provided the funds.

At the End of 19th Century

The facilities of technical education at the end of 19th Century consisted of 4 engineering colleges at degree level, about 20 survey and technical institutions and some 50 industrial schools. The standard of education was very good except that in the industrial schools. The diplomas/degrees of the colleges were recognized by the Institute of Civil Engineers, London. However, there was stagnation in the growth of education. Only 6 engineers passed from Sibpur in 1861 and 9 in 1900, the average of the first forty years being a meager 5.4. Roorkee also operated below par; till 1856 a total of 31 engineers passed out against the sanctioned outturn of 152 during the first 8 years. In the next 12 years (1857-1869), 84 students passed out at an average of 7 per year against the capacity of 25. The reason for non-utilization of the capacity was not the non-availability of suitable candidates but the then prevailing employment policy of the Government.

Government support for the development of technical education came to a standstill by 1875. In the next quarter century, the Engineering Colleges barely continued to exist. The attitude of the Government was at variance with the need of the public. An elaborate system of technical education was being demanded to improve the employability of youth and to reduce the poverty of the people, whereas the Government opinion was that the development of industry was a pre-requisite to the expansion of technical education. The resulting debate helped in creating public awareness of private efforts. VJTI was the first example. The national sentiment for technical education found its greatest expression in the endowment of Rs.30 lakh created by Jamshedji Nusserwanji Tata in 1898 to promote technical institution, which finally led to the creation of IISc. In Bangalore

Emergence of Public Opinion

In 1880s, a new class of educated Indians was growing and making its presence felt. Many of them had exposure to education, literature and political thoughts of the West. This class wanted to emulate the West and progress in respect of technical education and industrial development. This new class began to impress on the Government the need to start and accelerate the pace of such development. It did have the support of some Englishmen but the majority of them were Indians. Englishmen on the official side said that the Indians were trying to move too fast.

The newspapers with national leanings were continually faulting the Government for not making enough provisions for technical education. Unemployment was on the

increase and technical education was viewed not only as the basic need for industrialization but also as a means to ameliorate unemployment.

The Indian National Congress in its third Session held at Madras in 1887 passed a resolution that “--- having regard for poverty of the people, it is desirable that the Government be moved to elaborate a system of technical education”. A mention of the need to have technical education became a regular feature of the Presidential address at Congress sessions and its resolutions. In particular, the subject was emphasized by the Congress Presidents, W.C. Banerjee in 1892, Anand Mohan Bose in 1898, Chandavarkar in 1900 and Madan Mohan Malviya in 1909. Earlier in the 1901 session the Congress passed a resolution expressing its opinion that a Government College of Mining Engineering be established at some suitable place on the model of the Royal School of Mines in England and the mining colleges of Japan and Europe.

Individuals were coming forward with schemes of their own and published pamphlets and newspaper articles emphasizing the need of technical education. At the same time some individual Englishmen and English newspapers derided these ideas. For example, one Englishman bemoaned that Bombay had already voted money for technical education to loosen a further flood of technical education upon this land. The bulk of native educated community approved of the scheme because they did not-understand what it meant. Even the prestigious Pioneer, then a leading Anglo-Indian paper observed “the technical education in Central Provinces being everywhere rampant, and that engineering and agricultural classes have sprung up with the rapidity of mushrooms”

Lord Curzon’s Dispensation

In 1900 Viceroy Lord Curzon appointed Sir Edward Buck to advise him on technical and industrial schools. Buck recommended that technical education be separated from the general education at all levels in terms of separate schools and separate administrative set-ups. His views however, were ignored. In 1901, Curzon appointed a committee under the chairmanship of Col John Clibborn, Principal of Thomason College to examine the subject of technical education. Its report did not appeal to Curzon and was not even published. Curzon did not favour spreading higher level technical education in India. His response to Tata’s scheme of starting a higher level science research institute was lukewarm. Curzon was of the opinion that India did not have the necessary educational base to profit from higher technical education. He was

in favour of beginning at the lowest level. Fresh Government resolutions resulted only in opening a few more technical and industrial schools. There were few industries in India and most of them were owned by Europeans. They preferred to employ Europeans to all technical positions.

In 1902, Indian Universities Commission was appointed, which made the following recommendations on technical education:

“As the College of Engineering train a large number of students for the lower branches of the profession and only a small number for the higher branch of which alone the University takes cognizance, we do not think it desirable that the University should itself undertake instruction in Engineering”

Provinces Invited to Make Suggestions

The Government of India sent out a circular in 1903 to provincial Governments asking for suggestions on utilization of an additional grant for technical education. Punjab replied that it wanted no immediate establishment of technical schools. U.P., as advised by the Upper India Chamber of Commerce, considered technical schools unnecessary and the industrial schools to serve no useful purpose. Madras wanted no grants for expansion. Bombay wanted to reorganize the VJTI and to start three or four new technical schools. Bengal wanted a weaving school at Serampore. These negative replies further convinced Curzon that technical education was not needed.

But the Indian public opinion was different. When Curzon fund exceeding Rs.1.5 crores for setting up a Memorial for the Queen Victoria was collected, the public opinion was strongly in favour of utilizing it to advance the cause of technical education. It was suggested that the fund be added to Tata's gift for a science institute. But Curzon preferred a monument in stone.

The Swadeshi Movement of the first decade of the 20th Century led to the urge of Swadeshi education also. During this period, many national educational institutions, free from the Government control, were established as for example, National Council of Education, Bengal (1906), which later became Jadavpur University and some others. A few of them also imparted technical education. In the decades that followed some more institutions imparting technical and industrial education at various levels and in different disciplines of technology were established.

Post World-War I

After the World War I, the Government became a little more responsive to public demand of technical education. The situation, which was stagnant during the War period, began to improve. Several institutions were established during the War and in the decades thereafter. They include Banaras (then Benares) Hindu University (1916), Harcourt Butler Technology Institute, Kanpur (1920), Calcutta University College of Science and Technology (1920), Bihar Engineering College, Patna (1924), Indian School of Mines, Dhanbad (1926), Maclagan College of Engineering, Lahore (1930), Andhra University, Vizag (1933), University Department of Chemical Technology, Bombay (1934), and Aligarh Muslim University (1935). Some Colleges were started in the Princely States of India in 1937. Many other colleges in the four regions of the country were started in subsequent years.

There was a lack of coordination at the all India level and to some extent at the provincial level on the issues of contents and durations of the educational programmes. The nomenclatures, “Engineering”, ‘Technical’, ‘Technological’, or ‘School’, ‘College’, and ‘Institute’ were arbitrarily used and did not indicate the level of the programmes.

Abbott and Wood report commissioned by the Government of India in 1937 stated that provision for technical education at all levels was too inadequate for a large country like India and that there was no integrated policy and there was no coordinating agency for its proper development. Later for coordination and standardization of courses, the All India Association of Principals of Technical Institution was formed in 1941. Several technical institutions were established in different parts of the country during this period. As recommended by the Abbot-Wood Committee, a Polytechnic was established in Delhi in 1941.

Pre-independence Initiatives (Post World-War II)

In 1944, the Central Advisory Board of Education was asked by the Reconstruction Committee of Viceroy’s Executive Council to give a Report on the post-war education development in India. In the light of the Report, the Council appointed a committee in 1945 under the chairmanship of N.R. Sarkar to consider the development of higher technical institutions in India. In its interim report submitted in 1945, the Sarkar Committee recommended the establishment of not less than four Higher Technical Institutions one each in the North, East, South and the West. The objectives of these institutions were expected to be similar to those pursued by the Massachusetts Institute of Technology, USA. The key features of the proposed programme were non-specialized orientation and integrated curricula supported by institutional processes that would encourage Indian students to think creatively. The products of these institutions

were expected to be “creative scientist-engineers” and technical leaders with a broad human outlook and individuals with “creative initiative in future situations”. All students were expected to have strong core knowledge of basic sciences, engineering sciences, humanities, and technical arts besides the professional courses in chosen disciplines.

On the recommendations of the Sarkar Committee, a national agency, All India Council for Technical Education (AICTE, then not a Statutory body), was established in 1945 for planned and coordinated growth of technical education in India. In 1947 at the time of Independence, Polytechnic education was severely lacking in respect of eligibility, duration, standard and management. At that time, only 53 institutions conducted Diploma courses in the country with an intake capacity of 3670 students. The major task of AICTE was therefore, coordination, standardization and improvement of Polytechnic education. The action on the other recommendations of the Sarkar Committee Report, which led to establishment of IITs, was taken by the Government of India after Independence.

This visionary report gave rise to the birth of the first Indian Institute of Technology at Kharagpur in 1951 followed by four other IITs at Bombay, Madras, Delhi and Kanpur in the late fifties and early sixties. The IIT at Guwahati, Assam started functioning since 1992. The University of Roorkee was converted into an IIT in 2001.

The number of engineering colleges in the year 1946 was 46 with an intake capacity of 2500 students. These colleges catered predominantly to the needs of the various Government departments such as Public Works, Railways, Electricity, Telecommunications, Irrigation, etc. A very small proportion of engineers found opportunities in private sector companies engaged in engineering operations. The intake capacity for Post Graduate education in engineering was a mere 30 students in 1947. Most had to go abroad to obtain postgraduate education in engineering.

Earlier Initiatives in Independent India

The Government of India, after Independence, recognized the importance of quality technical education for the economic and industrial growth of the country, which required the future generation of engineers to be competent, innovative, good designers and excellent product manufacturers.

The Radhakrishnan Commission Report (1949) made several recommendations on technical education emphasizing the need of new types of engineering and technical

institutions in India. As a consequence of these recommendations, several new developments took place in the subsequent years.

The initiatives to conceive a grand design for technical education in India and implement the concept true to its spirit, in the form of Indian Institutes of technology (IITs) is one of the greatest hallmarks of visionary development in independent India. The performance of the IITs during the last four to five decades has provided a sense of fulfillment. Their achievements, in producing high quality engineers and technologists and in undertaking advanced R&D missions, have received worldwide recognition. Though their future directions may depart from the original design, there is every hope that they will continue to maintain their world class reputation and their brand image.

Considering the ambitious economic and social development goals of post independent India, the need for training engineers in much larger numbers and in diverse disciplines was acutely felt. While a number of engineering Colleges were started adopting the conventional pattern of engineering education there was a desire to establish a few technological institutions which would provide World class technical education and would have the dynamic characteristics to adopt themselves to rapid changes in engineering knowledge and its applications.

In 1959, under the chairmanship of M.S. Thacker, a Working Group on Technical and Vocational Training and also a Committee on Postgraduate Education and Research were constituted. Another important step in the development of technical education was the appointment of Kothari Commission (1964). The Kothari Commission Report contained many recommendations, which included the importance of practical training and industry-institute interaction.

During the first two decades after Independence, the expansion in technical education was accompanied by massive investments by the Government in infrastructure in the academic institutions. In the late fifties, faced with a serious shortage of faculty in technical institutions, a Technical teachers Training (TTT) programme was started. Reasonably attractive fellowships were offered to fresh graduates to induce them to study for a post-graduate degree in one of the established institutions in the country and later join the teaching profession. Some teacher trainees were also sent abroad for acquiring higher qualifications.

Growth of Technical Education

On the recommendation of the Engineering Personnel Committee, which was appointed by the Planning Commission in 1955, the Government of India initially decided to

establish eight Regional Engineering Colleges (Rocs). In order to provide each State with a Regional Engineering College, seven more were approved for establishment during the Third Plan period, bringing the total number of RECs to fifteen by 1972. Two more were added later, one in Jullandhar (1985) and the other in Hamirpur (1989).

The Technical Teacher Training (TTT) programme, which was started in the late Fifties, resulted in creation of a large pool of dedicated teachers. After the TTT programme was phased out, the Quality Improvement (QIP) for improving the quality of technical education and developing the faculty of engineering institutions was launched by the Government of India in 1970. This programme is operated in 25 engineering/technical institutions; seven of them are major QIP centres and eighteen are minor centres. This programme provides opportunity for continuous upgrading of knowledge and skills of persons who are already in the teaching profession. Over the years a large number of faculties acquired higher degrees from leading institutions in the country under the programme.

In order to assess the impact of foreign technical assistance on the development of technical education in India and to determine the areas needing to be further developed and supported through the foreign technical assistance programme, the Government of India appointed a Committee under the chairmanship of Y. Nayudamma (1978). Another Committee also under the chairmanship of Nayudamma was constituted at about the same time to review the postgraduate education research in engineering and technology and make recommendations for further development. Whereas, little is known about the outcome of the former, several recommendations of the latter were implemented.

The National Policy on Education (NPE 1986) was a major development in the field of education. NPE came out at a time when the role and impact of private institutions imparting technical education were not known or even perceived. NPE was, therefore silent on this aspect and so was the resulting Programme of Action (POA 1992).

Postgraduate Education in Engineering and Technology

The postgraduate education in engineering and technology in India had a late start. The postgraduate programmes in the country started in a few institutions in early 1950's but the doctoral programmes were not common until early 1960's. The recommendations of the Thacker Committee (1959-61) and of the Nayudamma Committee (1978-79) played a role in the development of the postgraduate education. These Committees were constituted by the then Ministry of Education and their reports were submitted directly to the Ministry for perusal and action.

Later a Review Committee on Postgraduate Education in Engineering was constituted by AICTE in 1995 under the chairmanship of P. Rama Rao, which submitted its Report to AICTE in 1999. The actions on this Report have been slow and sporadic. The postgraduate education in India remains weak and needs urgent attention. With a weak postgraduate education in engineering, the technology base will be weak and India will not be able to become a front runner in the field of technology, industrial productivity and the service sector, which determine the growth and development of the country.

Rama Rao Committee Report

Rama Rao Committee supported the 'GATE' system of admission, recommended the increase of the duration of M.E./M.Tech programme from 18 months to 21 months, and enhancing the scholarship to postgraduate students, with a provision of its periodic review. The duration of the programme was, however increased to 24 months.

The Rama Rao Committee recommended strengthening the one year postgraduate diploma programmes in suitable disciplines with industrial/application orientation (maintenance of thermal power stations, plastics engineering, industrial engineering, VLSI design, CAD, Information Technology, et al). These programmes could be aimed at key industry personnel and the concerned industries should be expected to invest in setting up links with selected institutions. The Diploma programme could be offered both on-campus and in Distance Education mode.

The Rama Rao Committee recommended enrolling foreign students to post graduate programmes, particularly in engineering areas since many countries may not have the facilities in those areas. The Committee emphasized an assured placement through active linkages with potential employers. It recommended that programmes in new areas be started after careful considerations of all aspects and with due care and listed 35 representative areas. The Committee at the same time recommended restructuring or at the same time even phasing out of the outdated programmes.

Expansion of Technical Education and the Private Sector.

The technical education in India has expanded enormously. The quality of education however, is a major concern. The AICTE website gives the following statistics of the approved technical institutions.

Intake in UG Engineering/Diploma Engineering (Source AICTE Website)

Region	Number of States	Engineering/Diploma	
		NOI	Intake
Central	03	112/ 101	37195/ 23741
Eastern	12	114/ 146	34016/ 22905
Northern	03	106/ 117	32298/ 15689
North-West	06+1UT	153/ 130	50645/ 30206
Southern	03	496/ 315	165757/ 79675
South-West	02	207/ 254	70788/ 48600
Western	2+1UT	158/ 181	48990/ 44600
TOTAL		1346/ 1244	439689/ 265414

More IITs are planned, Joshi Committee short-listed seven institutions to be considered for raising them to the level of IITs. The Anandakrishnan Committee did a detailed exercise which included visits to the seven institutions and submitted its report to MHRD in February 2006. Later MHRD constituted another Committee to submit recommendations on the suitability of the sites proposed by three States to establish three new IITs. Time has come for policy makers to look beyond IITs when new institutions requiring huge investments are being planned.

Some issues in Technical Education

The following is a list of issues in technical education, in no particular order, which need attention.

1. The governance structures of engineering institutions
2. Expansion of engineering education and quality issues
3. Systems of regulation and their efficacy to ensure norms and standards of technical education; in what way they have succeeded and in what way they have not?
4. Admission policies and processes
5. Shortage of teaching faculty
6. Availability of good text-books and other learning materials
7. Teaching and learning in electronic environment
8. Laboratory practices
9. Computer and communication skills of students
10. Entrepreneurship training and skills as part of curricula
11. Role and initiatives of industries in engineering education
12. Quality of teaching and research
13. Accreditation of courses/ programmes and mobility of students with credit transfers

14. Actual cost of technical education and how can it be reduced and what should be the price of education which students should pay
15. Collaboration with foreign Universities/Laboratories
 - Exchange of students and faculty
 - Mutual arrangements to utilize sabbatical leaves
 - Mutual arrangements for Credit Transfers
 - Joint R&D programmes with foreign Universities including international bidding for contract research
 - Issues related to regulatory measures of AICTE, UGC and MHRD regarding tie-ups with foreign institutions.