Challenges Facing Engineering Education in India

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Abstract: *With a 1345 million population, India is the largest democracy in the world. With an annual intake of about 15,76,500 graduates and post graduates from 10,949 technical institutions spread all over the country, India possesses a large pool of technical manpower today. According to McKinsey International and NASSCOM,however, only 25% of engineering graduates in India are employable due to quality deficit. Quality of technical education is to be further improved for addressing the severe shortage of faculty and manpower to conduct engineering education, research and consultancy services.Standard of educational, research and consultancy institutions in India plays a significant role in meeting the socio-economic goals set out by the Government of India for the development of the country.*

Keywords: Consultancy, Education, Engineering, Quality, Research

1.0 INTRODUCTION

At the time of Independence, India had only a few engineering colleges engaged in under graduate education in engineering. Since then there has been a phenomenal growth in engineering colleges (Annexure-I), 90% of which belong to private sector. Except a few, most of the private colleges have poor facilities and unqualified faculty and most of them run only under graduate programmes. Private engineering colleges are commercially run with the objective of making profit. There is no doubt that engineers coming out from both public and private institutions have made significant contribution for the nation's growth. But the maintenance of quality has become the victim of this growth phenomenon. Lack of maintenance of standards in institutions and failure to monitor the same by the regulating bodies like AICTE/Universities is the main factor responsible for this scenario. It may be worthwhile to compare here the numbers of students admitted at different levels in India and USA (Sharma, 2014).

	India	USA
At UG level	15,00,000	75,000 (5% of India)
At Master's level	75,000 (5% of UG)	37,500(50% of India)
At PhD level	1,500 (0.1% of UG)	7,500 (500% of India)

Thus, technical education developed in India has a distorted image. According to a December 2008 report from the Indian Institute of Technology (Bombay), IITs and IISc provide only 1 percent graduates of the total number of students at Bachelor's level, 4 percent at Master's level, and 40 percent at PhD level. A direct consequence of this is an enormous but unfortunate growth of private coaching centers in all major cities in India where a large number of students enroll for taking IIT entrance test. It is not desirable to promote private coaching centers which have no social significance, charge huge coaching fees andare responsible for deterioration of our secondary and higher secondary education system.

Objective of writing this paper is to critically examine the current status of engineering education in India, the various challenges being faced by technical institutions and how to improve the quality of engineering education for future development of the country.

2.0 QUALITY OF TECHNICAL EDUCATION

Engineering and Technical education in India is offered at various levels by different categories of institutions, viz.:

(i) Industrial Training Institutes for technicians (ITIs) of 1-2 year duration,

(ii) Polytechnics for diploma level coursesof 3 years duration,

(iii) Engineering colleges mostly for degree level courses of 4 year duration, and

(iv) Universities/IITs/IIMs/IISCs/IIEST/NITs/ Government and Private institutes of higher education for post graduate education of 2 year duration and doctorates of 2/3 years duration.

Today, majority of our engineering graduates prefer IT, software, banking or similar types of jobs where there is very little scope to utilize the technical knowledge and professional training they receive from the technical institutions during their 4-year degree level program. There is a great deal of mismatch between our social requirements and the educational program and what the students learn from the educational institutions and what they actually practice in real life. According to survey reports by McKinsey and the National Association of Software and Services Companies (NASSCOM), only 25% of the 15 lakh Indian engineers are employable mainly due to quality/skill deficiency.

2.1 Undergraduate Engineering Education

Currently, undergraduate program in engineering/technology is overloaded with heavy dose of theory in diverse subjects of stereotyped nature - often unrelated to the discipline of their specializations. The biggest deficiency in most of the teachers/instructors is lack of any industrial experience. In medical institutions, the doctors receive practical experience while completing internship in hospitals attached with the medical institutes under the able guidance of their teachers. In engineering education, however, no such facilities are available to gather practical experience while learning unless the institute hasa compulsory program of industrial training under the supervision of their teachers. It is advisable not to award degree unless an engineering student undergoes compulsory training of one year duration in industries or teaching and research institutes.

Many of the institutes do not have requisite infrastructures and adequate number of faculty and supporting staff. One of the most important factors for deterioration of quality of UG education is the mushroom growth of engineering colleges offering degrees by some nearby universities which have very little say or control in those engineering colleges as they are neither financially nor administratively controlled by the university with which they are affiliated to. It is to be carefully decided whether proliferation of private commercial type engineering colleges in the cities is preferred to technical universities for achieving quality of technical education in India.

UGC organized regional conferences of Vice-Chancellors which culminated in a national conference of Vice-Chancellors (The Statesman, 2007). They have recommended (Annexure-II) private funding in technical education in areas of priority in rural, remote and underprivileged areas.Bhat (2000) narrated some experiences of Public-Private Partnerships in Social Sectors through private funding.

A large chunk of engineers come from the Institution of Engineers and similar other professional bodies recognized by the Government of India as equivalent to degree holders. They are being engaged by many of the private

companies with poor pay and perks compared to graduates/post graduates from IIT/IIM/IISC/IIEST etc. Unlike engineering colleges where students perform workshops, laboratory experiments, tutorials, design classes, industrial training, project works, etc. under the guidance of teachers, there is no such classes for AMIE/AIEEE students, resulting in an inherent draw back in the development of their concept and confidence which are gradually built up in steps in the engineering colleges. It is true that the large requirement of our technical manpower cannot be met by the government alone. However, it is to be kept in mind that substandard institutions, turning out substandard products from public or private institutions, will in the long run damage many of the good things that Government of India is planning and executing for the future socio-economic development of the countryat high costs.

Except IITs/ IIMs/IISCs/IIEST, quality of engineering graduates and post-graduates from majority of the technical institutions in India is not up to the mark. Currently, India has fifteen IITs (eight of which have only recently started) and 30 NITS, though it is still not clear how the newer IITs and NITs will be staffed with qualified faculty as in the existing ones (The Tribune-2014). Most of the institutions do not have sufficient qualified and trained teachers and adequate infrastructures. Under the prevailing circumstances,majority of the bright and meritorious students in engineering and technology leave India for higher education and research abroad due to their better infrastructures, quality teaching and research guidance, higher remuneration and due recognition of their work. Some of the factors responsible for poor quality of engineering education in India are (Ashok, 2007):

- Inadequate and incompetent Faculties,
- Inadequate physical infrastructure, and funds,
- Lack of autonomy,
- Rigid and outdated curriculum,
- Poor quality of training,
- Absence of R & D activities,
- Poor learner quality, and
- Ineffective linkage with industry.

The biggest problem of engineering education in India, however, lies in non-availability of quality faculty for which Master's/Ph.D. degree is made mandatory by AICTE. An Institute can never grow and develop with part time and ad-hoc type old and retired teachers alone. Young post graduates with strong fundamentals and motivation for research and development form the backbone of any technical institution. They should be recruited very carefully and trained under the careful supervision of senior faculty members and paid salaries and perks as enjoyed by their counterparts in Industry. It should never be forgotten that it is the teachers who mould a student to be professionally competent to deliver the goods to our society.

AICTE may consider introducing their previous scheme 'Teachers Training Program' by recruiting young scholars with attractive compensations to undergo MTech/ PhD program along with teaching/research assistantship. It is a common sight in private engineering colleges for a person who passed with BE/ BTech/ BSc (Engg.) degree to start teaching in the following academic year. Table-1 presents faculty shortage in engineering institutes on national basis (Rama Rao, 2013).

Table 1. Severe shortage of Quality Faculty

Annual intake at UG level	15,00,000 per year
Faculty required for running UG Program (@1:15 faculty:student ratio)	1,00,000
Faculty shortage at UG level	80,000
Shortage at Master's level	20,000
Shortage at PhD level	60,000

2.2 Post Graduate Engineering Education

Postgraduate education, research and consultancy in engineering and technology in India are confined to only a few institutions like IITs and NITs and few universities. Despite attractive scholarships, nearly 60 per cent of over 19,000 sanctioned postgraduate seats (in 191 institutions) remained vacant while less than 7,000 completed the PG courses annually (Kakodkar-2011, Subbarao-2013). Very few UG students from IITs and NITs join PG courses there. Majority of their PG students come from private/state run colleges for getting an IIT/NIT stamp. There is no motivation and they are reluctant to do any hard work partly because of their poor UG background but mostly due to want of proper guidance. They utilize the scholarship, libraries and hostel facilities for preparing for IAS and similar examinations for an assured future. Postgraduate students who mainly perform teaching and R&D works join the PG program as a last choice only when they do not qualify in other all India examinations like IAS, IES, IFS, etc. or do not get any appropriate job. Author is convinced that PG education in India is substandard when compared with that in developed countries like USA, Europe, Australia, Canada, etc. Quality of our PG education has been discussed by the author in an earlier paper (Mazumder, 2008). The low out-turn and poor quality of postgraduates, who constitute the supply source of teaching, research and consultancy profession, is a major concern of our technical education system in India.

Under the above circumstances, the quality of our post graduate students is far from satisfactory. The status of our post-graduate education in engineering can be assessed from the fact that against a sanctioned intake of 32,752, actual intake was about 20,000 whereas actual outturn was about 10,000 only (AICTE-1999).

3.0 R&D AND CONSULTANCY

R&D and consultancy works act as a nucleus in all developmental activities. University professors and the young research scholars working under the professors comprise an enormous pool of expertise and resources which must be tapped to solve many a challenging problems faced by the society in the fast changing world with global competition. A major problem being faced by our educational, research, consultancy and industrial institutions today is how to attract and retain qualified and meritorious persons. Most of the research works in India end with publications with little or no application in field (Mazumder-1999, 2014).

Sound knowledge, information, initiative, hard work, perseverance and above all a spirit of creativity are essentially needed for pursuing research and development works leading to innovation and excellence. There is hardly any invention in the large numbers of our universities and technical institutions in the country. Unless the quality of our education and research in science, engineering and technology are upgraded further, we have to pay heavily in future for our neglect and the developed countries will monopolize the jobs related to R&D and consultancy works. The country will be compelled to purchase know-how from abroad and will remain ever dependent on foreign technology and foreign products at an enormous cost.

Universities and research institutes are good in R&D, but poor in delivery of R&D from laboratories to fields. Although efficient in delivery, Indian industries are hesitant to invest in R&D due to an inherent risk involved and a mindset of belittling research and innovation. Most of the industries in India today are reluctant to encourage their employees for academic pursuit as evidenced by lack of any worthy publications from those in industries. There is only a one way flow from academic institutions to industries today. Without a two way flow from educational institutions to industries and vice-versa, engineering education can never flourish.The general trend is to purchase products of superior quality from abroad at exorbitant costs, although there are large numbers of research institutions/universities in the country and there is no dearth of talent.

4.0 Future of Educational Institutions in India

After independence, educational institutions of higher learning were headed by persons of high integrity and character with vision to develop and excel. Today, many of these institutions are being headed by persons of mediocre calibre with political support or favour from top influential persons on cast/community/regional basis, irrespective of their merit. As a result, the topmost and meritorious brains that are really worthy and capable of delivering are leaving the country out of frustration. Out there they make immense contributions towards R&D in the developed countries thereby enriching the standard of the foreign institutions. A mediocre or political person will always like to be surrounded by similar brand of persons resulting in gradual deterioration in the standard and reputation of the educational and research institutions. Present status of research in engineering and technology in a vast country like India can be assessed from the fact that the annual out turn of PhDs in Engineering/Technology has decreased from 506 in 1979 to 374 in1996 (AICTE-1999). Although the PhD intake has recently increased to 1500, the actual out turn of PhD is only about 1000 per year which is far below India's requirement (AICTE, 2011-12).

Most of the bright students of India capable for teaching and research go to developed countries every year. While India imports equipments and products (developed by Indian scientists and engineers abroad), these countries are importing the best brains from India. China has understood this game very well. Most of their reputed scientists and technologists are encouraged/inspired to return to their homeland after successful completion of studies and training abroad. Talented Indians who go abroad for higher education and research continue to stay and settle there, partly because of high pay and perks but mostly due to a congenial academic environment for research & development and also for the recognition of the work done by them. It seems IITs are built to supply requisite manpower for further development of the advanced countries in the world. Unless this trend can be reversed, India will continue to remain dependent on foreign knowhow and continue to import foreign products at an exorbitant cost.

An educational Institute can develop only through hard work and contributions made by the young and energetic faculty and the employee. The current trend in our educational institutions is to draw as much facilities as possible from the institution unmindful of the health of the parent body. Unless everyone in the institution cares and contributes towards the development of the institute, the health of the mother body is bound to deteriorate.

5.0 Conclusion

The growth of engineering education since the last three decades has been phenomenal with the entry of private players in the country. The quality of most of these engineering institutes is, however, questionable given the fact that employability among the pass outs is very low.The premier institutes are producing a very small number of engineering graduates and post-graduates. The majority come from state run and private colleges; they are neither motivated nor hard working. There is an urgent need to address the problems ailing technical education;

otherwise India will miss the opportunity to utilize its demographic dividend of the young work force which it has. In order to ensure standards as per global norms and mechanism to monitor the same, an uncompromising attitude is essential. In this respect, India becoming a permanent member of the Washington Accord(TOI-2014) is a significant step.

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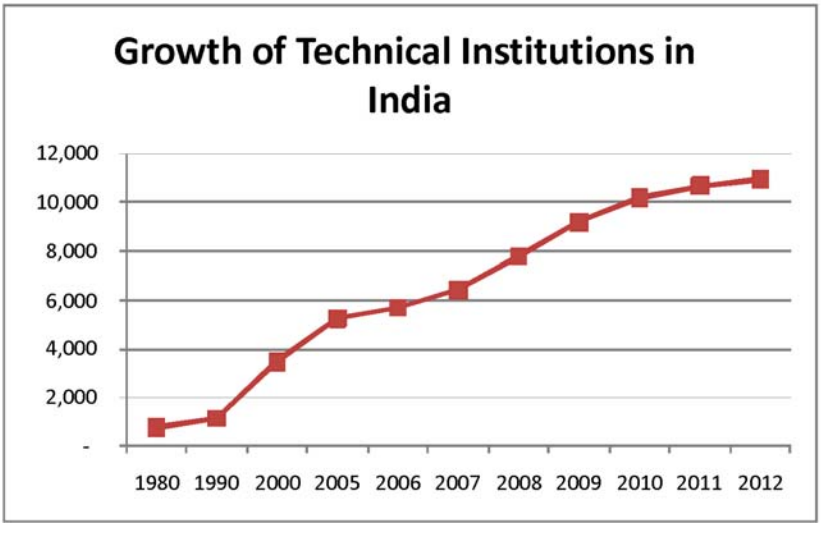
Annexure-I: Growth of Technical Institutions in India

STATE	1980	1990	2000	2005	2006	2007	2008	2009	2010	2011	2012
Andaman and Nicobar Islands	0	0	0	0	0	0	0	1	1	1	1
Andhra Pradesh	83	112	463	852	907	1111	1450	1672	1769	1813	1840
Arunachal Pradesh	2	2	3	4	5	5	5	5	5	5	5
Assam	8	8	23	24	26	28	32	42	44	46	47
Bihar	25	29	44	53	53	55	63	71	76	82	88
Chandigarh	3	3	10	13	13	13	14	14	14	14	14
Chhattisgarh	9	16	31	43	48	57	82	105	109	109	109
Dadra and Nagar Haveli	0	1	1	1	1	2	3	3	3	3	3
Daman and Diu	0	1	1	1	1	1	1	1	1	1	1
Delhi	0	14	59	71	74	79	83	83	86	88	89
Goa	2	4	11	15	15	16	16	16	16	17	18
Gujarat	36	48	121	196	223	244	280	349	399	430	443
Haryana	28	34	87	141	156	213	346	410	453	491	504
Himachal Pradesh	8	10	13	17	21	32	42	63	72	79	80
Jammu and Kashmir	9	12	27	31	34	34	35	38	39	42	47
Jharkhand	15	16	32	41	41	45	49	52	57	61	61
Karnataka	62	137	413	523	537	578	651	731	777	789	798
Kerala	30	37	106	244	250	252	263	291	315	345	358
Madhya Pradesh	36	47	150	278	311	379	432	510	546	563	569
Maharashtra	106	192	556	740	859	926	1087	1286	1461	1550	1598
Manipur	0	0	3	3	3	3	3	3	3	3	3
Meghalaya	1	1	1	3	3	4	4	5	5	5	6
Mizoram	0	1	2	3	3	4	4	4	4	4	4
Nagaland	0	0	0	0	0	3	3	3	3	3	3
Orissa	19	25	98	134	145	164	210	277	293	299	304
Puducherry	5	8	15	18	18	20	23	26	30	31	32
Punjab	21	25	80	178	189	209	262	313	354	386	402
Rajasthan	37	46	103	174	199	232	284	335	467	484	504
Sikkim	0	0	4	4	4	4	4	4	4	4	4
Tamil Nadu	88	160	578	784	817	900	1046	1220	1328	1382	1422
Tripura	4	4	5	7	7	8	8	8	9	9	9
Uttar Pradesh	93	111	287	428	470	537	688	879	1039	1101	1143
Uttarakhand	17	21	49	69	85	93	119	148	165	175	182
West Bengal	37	40	111	167	178	183	201	223	238	247	258
Grand Total	**794**	**1165**	**3487**	**5260**	**5696**	**6434**	**7793**	**9191**	**10185**	**10662**	**10949**



Annexure-II: Recommendations of Regional Conferences of Vice-Chancellors of Indian Universities regarding Private Participation in higher Education

- Non availability of seats in professional and technical higher education in the public institutions has lead to proliferation of private institutes and universities. Though some of them are good but a large majority of them suffer from poor quality leading to production of graduates that are largely unemployable.
- They are run largely on commercial lines even though profit making objectives in educational endeavors are largely prohibited. They charge exorbitant fees which makes higher education exclusivist.
- Public-private partnership and private initiatives and private investment in higher education seem to have become inevitable. They may be encouraged but the following safeguards need to be in place.
- It must be ensured that the quality of higher education is not diluted and commercial considerations do not get preference over the academic factors.
- It must be ensured that the private participation in higher education does not lead to exclusion.
- A strong and effectively regulatory mechanism will be needed to regulate admission and fees to private institutions.
- The government may provide land at subsidized rate for establishment of private colleges and universities in return of which these institutions must agree to provide higher education free of cost to the marginalized social groups and economically backward and poor.
- Community may be encouraged to adopt colleges and provide financial and other support to the adopted institutions.
- The industries should be encouraged to adopt colleges and universities in their neighborhood or those that are engaged in research and development in the areas of their interests. The industries should then sponsor research and make investments in infrastructures and human resources for development of quality and excellence in these institutions.
- The universities should develop technology parks and invite industries to set up units on campus so as to provide training and placement of graduates.
- Universities and colleges should be permitted to establish public limited companies to take up and market their research and patents and revenues generated through these entrepreneurial activities be used for strengthening and updating teaching and research infrastructure.
- It was recommended that there is a need to distinguish between those private institutions that are being run with charitable and philanthropic motives and those that are established with an objective of making profit. While the former category needs to be encouraged and supported, the later will have to be tightly regulated so as to force them perform social objectives of higher education.
- Private investments in higher education should be encouraged in priority areas. Incentives may be offered to private institutions that are established in rural, remote and underprivileged areas that have lower than the national GER due to lack of quality institutions.
- Make it mandatory for the private and deemed universities to offer courses in general higher education in addition to high demand market oriented courses.