PROBLEMS AND PROSPECTS OF DISPENSING QUALITY TECHNICAL EDUCATION FOR ENHANCING EMPLOYABILITY AND CAPABILITY OF TECHNICAL MANPOWER IN INDIA'S PROFESSIONAL LABOUR MARKETS

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ABSTRACT

Technical Education helps in developing technical and professional competencies and specific skills which are required for a broad occupational area. It is the component of education that is most directly concerned with the acquisition of the knowledge and skills required by workers in most manufacturing and service industries. The present study attempts to throw light on the growth of technical education and manpower in India since economic reforms of 1991 and the rampant concern about quality of education being provided by the institutes/colleges. The study discusses the issue of lack of employability of the graduates and factors responsible for declining quality of technical education. It suggests that in order to remove the problem of below par quality technical education and the resultant lack of employability, efforts such as Academia-Industry interface need to be strengthened and keeping in view the demand of the industry, syllabi need to be updated regularly. Emphasis should also be laid on practical orientation of the technical education.

Introduction

Human Capital is semantically the blend of human and capital. Human takes charge of all economic activities like production, consumption,

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transaction, etc., and capital helps to create goods and services (Kwon, 2009). According to human capital theory, expenditures on schooling, health, training, migration, etc. constitute investment in human beings, which enhance the capabilities of the people as producers and consumers in the labour market, in the households and in the society at large. Among all, education and health are considered as the two most important components of human capital (Grossman, 1972).

Accordingly, education has been considered as an important instrument of social change, which is not merely a mechanism for generating manpower, but also provides socially responsible citizenry in our democratic society. As quality of education of the child will determine the quality of life in a nation, therefore, both at the national and international level, efforts are being made to educate more and more people because education contributes to the development of the society consistent with the dignity of the human beings (Singh, 2010). In short, education and knowledge are viewed as great wealth in themselves, besides being sources of increase in wealth (Tilak, 2005).

Technical Education, as per the provisions of the All India Council for Technical Education (AICTE) Act, means programmes of education, research and training in the fields of Engineering and Technology, Architecture, Town Planning and Management, Pharmacy and Applied Arts and Crafts along with such other programmes or areas as the central government may declare in consultation with the council by a gazette notification (Shivani and Khurana, 2012). Technical Education helps in developing technical and professional competencies and specific skills which are required for a broad occupational area. It is the component of education that is most directly concerned with the acquisition of the knowledge and skills required by workers in most manufacturing and service industries.

As discussed earlier, technical education includes all the disciplines under the scope of All India Council for Technical Education (AICTE) that is courses and programmes in engineering and technology, management, architecture, town planning, pharmacy, applied arts and crafts, hotel management and catering technology; diploma level courses at polytechnics to meet training needs of manpower for industry at the supervisory level along with the vocational training imparted through Industrial Training Institutes (ITIs). This is a variation from the institutional framework at the national level where technical education falls under the purview of Ministry of Human Resource Development (MHRD) while vocational training is under the Ministry of Labour and

Employment. Consequently, technical education is imparted at various levels in India such as craftsmanship, diploma, graduate, post-graduate and research in specialised fields, catering to various aspects of technological development and economic progress. Technical education is dynamic in nature as it faces many challenges in responding to societal, technological and economic changes in the local and global environment. Further, it also determines the development and socio-economic conditions. Therefore there is a greater need for high quality technical education to produce skilled manpower in India.

After independence India's development strategy envisaged the attainment of economic self-reliance, which directly depended on the strategy of grooming home-grown technical manpower. Hence, a vast edifice of technical training institutions including Indian Institute of Technology (IITs), National Institute of Technology (NITs), engineering colleges, university departments and so on was erected in the nation. India has become the second largest reservoir of technical manpower which capitalised on the force of globalisation and helped in bringing about IT revolution in India. Globalisation brings a free communication and exchange. So, India could supply incredible technical manpower to support global surge in IT industry. In this context, the present study is an attempt to throw light on the growth of technical education and manpower in India since economic reforms of 1991 and the rampant concern about quality of education being provided by the institutes/colleges.

Database, Scope and Methodology

As per the nature of the study, both types of data i.e. primary and secondary data have been used. For analysing the growth of technical education in India, the secondary data have been collected from various secondary sources like Research and Development Statistics, All India Council for Technical Education (AICTE) Reports, Statistical Abstract of Punjab, National Skill Development Council (NSDC) Reports, etc. The scope of the study is restricted to the Engineering Stream of Technical Education. For analysing growth over the years, compound annual growth rates have been used using the following function:

$$Y_t = ab^t e^{ut}$$

$log Y_t = \log a + t \log b + u_t$

$\log Y_t =$ value of dependent variable,whose growth rate is to be computed.

$t =$ trend/time variable.

$u =$ stochastic disturbance term a & b are constant.

Transforming the equation in linear form:

From the estimated value of regression co-efficient 'b' the compound growth rate 'r' was calculated as follows:

$$r = \text{antilog } (b-1) * 100$$

Where, b is the estimated value of the ordinary least square (OLS).

The paper has used tabular analysis for presenting the data along with the growth rates.

Policy Emphasis and the Resultant Growth of Technical Education in India

Since independence, India's development strategy of attaining economic self-reliance had its moorings in building technological power. It was clearly envisaged by the planners that, to achieve economic self-reliance, technological self-reliance was indispensable. In other words, self-reliance would be unattainable unless based on domestically groomed workforce and skill (Chadha et al., 2013). Unless India grooms its home grown technically skilled and professionally trained manpower to sustain its productive sectors, it would be impossible to sustain rising production and productivity. Therefore, for achieving high rate of economic growth the generation of skilled pool of scientific and technical manpower becomes even more imperative (Choudhary and Chadha, 2015a). Accordingly, India's economic ills were sought to be overcome through a process of industrialisation which required a well-developed system of technical education making it a vital preamble to the country's prosperity. A chain of Indian Institute of Technology (IITs), Indian Institutes of Management (IIMs), universities, research institutes and scientific departments, engineering and medical colleges were set up to train and generate technically skilled manpower. Thus, special emphasis has been laid on the development of institutions providing technical education in India. Currently, India trains about 1.5 million engineers every year which is more than the combined strength of US and China (Gautam, 2013).

1. Growth of Engineering and Technology Colleges in India

Since economic reforms i.e. from 1991, the country has witnessed stupendous growth of recognised educational institutes in India (Choudhary, 2015). On the same grounds, Engineering Education in India has seen tremendous growth over the past decades, both in number of students and number of colleges (Varshney, 2006). Table 1 shows that the number of engineering and technology colleges in India has grown

Table 1: Growth of Engineering and Technology Colleges in India

Year	Engineering and Technology Colleges	Total Colleges
1991	282	7761
1994	341	8441
1997	458	9940
2000	680	11965
2003	1068	16206
2006	1627	19327
2009	2805	25951
2012	3393	35539*
CAGR	**13.94**	**33.06**

Notes: 1. The number of colleges excludes junior colleges and those offering diploma and certificate courses.
2. * denotes Provisional

Sources: 1. Government of Punjab, Statistical Abstract of Punjab, Chandigarh: Economic and Statistical Organisation (various issues)
2. Government of India (2013-14), Approval Process Handbook, New Delhi: AICTE

from just 279 in 1991 to 3,393 in 2012 growing at a rate of 13.94 per cent. This means that the colleges are supplying more and more engineering graduates to meet the growing needs of the economy. However, the recent large scale expansion in engineering education has come at the cost of quality (Choudhary, 2012).

2. Growth of Enrolment in Engineering and Technology Over the Years

In India, one-sixth of all Indian students are enrolled in engineering/ technology degrees (Sarkar and Choudhary, 2015). Table 2 shows the enrolment in engineering and technology institutions over the years for both males and females. It is clear from the table that in 1990-91, the enrolment in the field of engineering and technology was only 216.83 thousand which constituted 4.9 per cent of the total enrolment in higher education. The number has increased to 713.76 thousands in 2002-03 constituting 7.50 per cent of the total enrolment in higher education. Further, the total enrolment has increased from 4425.25 thousands in 1990-91 to 20327.40 in 2011-12 growing at a rate of 6.27 per cent, whereas in the case of engineering and technology, the enrolment has grown at a rate of 12.12 per cent.

Table 2: Enrolment in Engineering and Technology Over the Years

('000)

Year	Total Enrolment	Enrolment in Engineering/ Technology	Percentage of Total
1990-91	4425.25	216.84	4.90
1993-94	5817.20	285.05	4.90
1996-97	6842.62	331.02	4.90
1999-2000	8050.60	104.53	5.00
2002-03	9516.70	713.76	7.50
2005-06	11028.00	795.12	7.21
2008-09	13641.80	1313.70	9.63
2011-12	20327.40	3261.60	16.05
CAGR	**6.27**	**12.12**	**-**

Note: Total enrolment includes enrolment in higher education involving science, technology and other disciplines.

Source: Government of India, Research and Development Statistics, New Delhi: Ministry of Science and Technology (various issues)

3. Enrolment of Women in Engineering and Technology Over the Years

Table 3 divulges the enrolment of women in engineering and technology over the years. The table shows that the enrolment of women in engineering/

Table 3: Enrolment of Women in Engineering and Technology Over the Years

('000)

Year	Total Enrolment	Women Enrolment	Percentage of Total
1990-91	216.84	17.10	7.89
1993-94	285.05	20.00	7.02
1996-97	331.02	27.60	8.34
1999-2000	104.53	63.10	60.37
2002-03	713.76	154.00	21.58
2005-06	795.12	185.90	23.38
2008-09	1313.70	276.80	21.07
2011-12	3261.60	959.10	29.41
CAGR	**12.12**	**20.73**	**-**

Source: Government of India, Research and Development Statistics, New Delhi: Ministry of Science and Technology (various issues)

technology was 17.1 thousand in 1990-91 which rose to 154 thousand in 2002-03 and in 2011-12 the number has risen to 959.1 thousand. In terms of percentage of total enrolment in engineering and technology, the share of women has increased to 29.4. This shows that the enrolment of women in engineering and technology has increased over the years, yet it is around 30 per cent of the total enrolment. Therefore, it is obvious that women enrolment needs to be induced in the field of engineering and technology as well. The total enrolment in engineering/technology has grown from 216.84 thousand in 1991-91 to 3261.60 thousand in 2011-12, growing at a rate of 12.12 per cent. It is clear from the table that although women enrolment is quite less as compared to the total enrolment in engineering/ technology, yet its growth is higher as compared to the total enrolment.

4. Out-turn of Engineering/Technology Personnel in India

The out-turn of engineering/technology personnel in India has risen over the years due to the growing demand of highly skilled Science and Technology (S&T) personnel by the high-tech IT industry and services sector and consequent growth of engineering/technology institutions, in both public as well as private sector. Table 4 shows the growth in out-turn of engineering/technology personnel in India. The table very clearly

Table 4: Growth in Out-turn of Engineering/Technology Personnel in India

('000)

Year	B.E./B.Tech (Engineering)	M.E./M.Tech (Engineering)	Total (S&T + Other Disciplines)
1991	30.03	4.26	233.21
1994	31.69	3.81	235.14
1997	56.06	5.81	329.11
2000	91.78	9.03	469.09
2003	127.49	12.24	609.07
2006	143.22	17.49	695.04
2009	332.44	21.55	1028.94
2012	600.09	39.72	1342.86
CAGR	**15.48**	**12.20**	**9.34**

Source: Government of India, Research and Development Statistics, New Delhi: Ministry of Science and Technology (various issues)

shows that the total Science and Technology (S&T) and other disciplines' out-turn have grown from 2.33 lakh in 1991 to 13.42 lakh in 2012 at a growth rate of 9.34 per cent. Out of the total out-turn in the field of higher education; the share of B.E./B.Tech in Engineering has risen from 30 thousand in 1991 to 60 thousand in 2012 growing at a rate of 15.48 per cent. The share of M.E./M.Tech in Engineering has risen from 4.2 thousand in 1991 to 39.72 thousand in 2012 growing at a rate of 12.20 per cent. It may be noted that as compared to the graduate level of engineering education, out-turn of masters level is quite less. This is basically due to the low inclination of students towards the higher level of engineering and then going into teaching/research. Majority prefers job after completing their graduate level study or prefer to settle abroad.

5. Doctorates in Engineering/Technology

Table 5 shows the number of doctorate degrees awarded in engineering and technology over the years. As can be seen in the table, in the year

Table 5: Growth of Doctorate Degrees awarded in Engineering/ Technology

Year	Engineering/ Technology	Total Degrees Awarded (S&T + Other Disciplines)	Engineering/ Technology (Percentage of Total)
1990-91	629	8383	7.50
1993-94	329	9923	3.32
1996-97	298	10408	2.86
1999-2000	723	11296	6.40
2002-03	779	13733	5.67
2005-06	1058	18730	5.65
2008-09	1292	14591	8.85
2011-12	1915	17709	10.81
CAGR	**8.49**	**3.56**	**-**

Source: Government of India, Research and Development Statistics, New Delhi: Ministry of Science and Technology (various issues)

1990-91 only 629 persons were awarded doctorate degree, the number fell to 298 in 1996-97 and rose again to 1,058 in 2005-06 and 1, 915 in

2011-12. But as compared to the large number of engineers produced in the country, this number is very meagre. It may be noted that the total doctorates awarded in all the faculties of S&T and Other Disciplines has increased from 8,383 in 1990-91 to 17,709 in 2011-12 and out of this huge quantity, the share of engineering and technology is quite less. Further, the data show that out of the total doctorates awarded in the field of S&T and Other disciplines, the share of engineering and technology has risen from 7.50 per cent in 1990-91 to 10.81 per cent in 2011-12. The number of doctorates in engineering/technology has grown at a rate of 8.49 per cent and the total S&T and Other Disciplines at a rate of 3.56 during the period from 1990-91 to 2011-12, respectively. This is a matter of major concern. Therefore, it is necessary to encourage the students to go in for research work.

6. Growth of Expenditure on Technical Education (All Streams) in India

Table 6 shows the expenditure incurred on technical education by Centre and State government for the period of 22 years, i.e. from 1990-91 to 2011-12. The table shows that the combined expenditure of both Centre and state governments on technical education was Rs. 753.01 crore in 1990-91 which rose to Rs. 2820.51 crore in 2002-03. In 2011-12 the expenditure on technical education rose to Rs. 13,850.83 crore. This shows that the expenditure on technical education has increased over the years at a growth rate of 13.57 per cent.

Table 6: Expenditure on Technical Education (all streams) by Centre and State Government

Year	Expenditure (Rs. Crores)
1990-91	753.01
1993-94	1071.70
1996-97	1450.01
1999-2000	2458.96
2002-03	2820.51
2005-06	3657.00
2008-09	7266.46
2011-12*	**13850.83**
CAGR	**13.57**

Note: * Extrapolated value
Source: Government of India, Research and Development Statistics, New Delhi: Ministry of Science and Technology (various issues)

Table 7: Estimated Stock of Engineering Degree Holders by Selected Disciplines

('000)

Discipline	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	CAGR
Civil	146.7	153.6	160.4	166.7	172.8	178.8	184.8	190.7	196.5	200.5	204.5	208.5	212.4	216.4	220.4	224.4	228.4	232.4	236.4	**2.57**
Mechanical	162.8	172.8	184.8	194.8	204.6	214.4	224.2	233.8	243.2	256.5	269.7	282.9	296.2	309.4	322.7	335.9	349.1	362.4	375.6	**4.71**
Electrical	102.9	108	113.8	119.7	125.6	131.9	138.2	144.4	150.5	156	161.5	167	172.5	178	183.5	189	194.5	200	205.5	**3.89**
Chemical	31.9	33.5	35.4	37.5	39.6	41.7	43.8	45.8	47.8	50.9	54	57.1	60.2	63.3	66.4	69.5	72.6	75.7	78.8	**5.24**
Elect. & Tel.	72.1	82.4	93.7	104.8	115.5	132	148.3	164.3	180	190.2	200.4	210.6	220.8	231	241.2	251.4	261.6	271.1	282	**7.64**
Metallurgy	14.3	14.7	15.3	15.9	16.6	17.3	18	18.7	19.3	19.8	20.3	20.8	21.3	21.8	22.4	22.9	23.4	23.9	24.4	**3.01**
Mining	5.7	6.1	6.5	6.9	7.3	7.8	8.2	8.6	9.0	9.3	9.7	10.0	10.3	10.7	11	11.4	11.7	12.1	12.4	**4.26**
Automobile	2.0	2.3	2.7	2.9	3.2	3.4	3.7	3.9	4.1	4.3	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.2	**5.85**
Aeronautical	1.7	1.8	1.9	1.9	2	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.9	3.0	3.1	3.2	**3.48**
Agriculture	3.6	3.8	4.1	4.3	4.4	4.6	4.8	5	5.2	5.5	5.8	6.2	6.5	6.8	7.2	7.5	7.8	8.1	8.5	**4.81**
Production	9.2	11	12.9	14.8	16.6	18.6	20.5	22.3	24.1	26.1	28.1	30	32	34	35.9	37.9	39.8	41.8	43.8	**8.5**
Sugar	1.3	1.4	1.5	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	**1.79**
Oil	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5	**4.06**
Textile	9.1	9.6	10.2	10.7	11.3	11.9	12.4	13	13.6	14.2	14.8	15.3	15.9	16.5	17.1	17.6	18.2	18.8	19.4	**4.22**
Architecture	12.3	13.3	14.4	15.7	16.9	18.1	19.3	20.6	21.8	23	24.3	25.6	26.8	28.1	29.4	30.7	31.9	33.2	34.5	**5.81**
Food	1.0	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.6	2.8	**5.9**
Instrumentation	5.9	7.5	9.4	11.3	13.3	15.1	17	18.8	20.6	22.2	23.8	25.4	27.1	28.7	30.3	31.9	33.5	35.2	36.8	**9.67**
Ceramic	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.6	1.9	2.2	2.5	2.8	3.0	3.3	3.6	3.9	4.2	**9.48**
Leather	0.7	0.7	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	**6.23**
Others	59	71.8	84.4	96.8	109.3	122.3	136.2	149.8	163.2	193.9	224.7	255.4	286.2	316.9	347.7	378.4	409.2	439.9	470.7	**12.2**
Total	**644.7**	**697.9**	**755.9**	**811.1**	**865.7**	**926.9**	**988.6**	**1049**	**1108**	**1183.6**	**1257**	**1331**	**1405**	**1480**	**1554**	**1628**	**1702**	**1777**	**1851**	6.01

Note: 1. Stock is at the beginning of the year., 2. Own Calculations from R&D Statistics data

Source: Government of India (various issues), Research and Development Statistics, New Delhi: Ministry of Science and Technology

7. Stock of Engineering Degree Holders by Selected Disciplines

Table 7 shows the estimated stock of engineering degree holders in the working age group by selected disciplines. It is clear from the table that the total stock of engineering degree holders has increased from 6.5 lakh in 1994 to 18.5 lakh in 2012 growing at a rate of 6.01 per cent. Consistent with the rising demand for electronic and telecommunication engineering as the fast growing sunrise sector, the out-turn of electronic and telecommunication has grown fastest at over 7.6 per cent over the years.

Issues pertaining to Quality of Instructions and Skill Development

In India Engineering education is provided basically in five types of institutions viz., Indian Institutes of Technology (IIT), Technical Universities, National Institutes of Technology (NIT), University Departments of Engineering, Government/Private Engineering Colleges. As depicted in the preceding section, though India has been able to generate a huge stock of technical manpower, yet the skill base of India's workforce is quite dismal and there is a serious mismatch with regards to the existing skill levels of the workers as compared to the requirements in key growth sectors.

Keeping in view the rapid changes taking place in the field of science and technology, it has become even more urgent for the people to acquire the appropriate levels of education and skill. But the quality of education at all levels provides a dismal picture. A number of studies viz., Task Force on Employment Opportunities of the Planning Commission, 2001. The Second National Commission on Labour, 2002, The Approach Paper to the Eleventh Five Year Plan, etc. Have highlighted the skill deficit in the nation which is a major obstacle in the development path of the economy (Government of India, 2011).

The data for the skill gap among 5 states namely Delhi, Jharkhand, Maharashtra, Karnataka, and Tamil Nadu show that there is deficit of both skilled and semi-skilled workers in almost all the mentioned states whereas in the case of unskilled category, the deficit is only there for 2 states i.e. Maharashtra and Tamil Nadu (Table 8). In the case of skilled category, highest deficit is observed in the case of Maharashtra i.e. 3.36 million followed by Tamil Nadu (2.49 million), Karnataka (0.71 million) and Jharkhand (0.18 million) whereas Delhi, the national capital is in surplus of 1.42 million skilled workers. In the case of semi-skilled category, all the given states have shown deficit with Tamil Nadu being at the top i.e. 3.42 million followed by Maharashtra (1.07) million,

Table 8: Skill Gap Forecast for 2012-22 for Select States

(in million)

State	Skilled Workers	Semi-Skilled Workers	Unskilled Workers
Delhi	1.42	-0.17	0.41
Jharkhand	-0.18	-0.40	0.80
Karnataka	-0.71	-0.38	1.18
Maharashtra	-3.36	-1.07	-0.45
Tamil Nadu	-2.49	-3.42	-0.35

Source: FICCI (2013-14), Reaping India's Promised Demographic Dividend- Industry in Driving Seat, p. 8.

Jharkand (0.40 million), Karnataka (0.38 million) and Delhi (0.17 million). The analysis of unskilled category shows that except Maharashtra and Tamil Nadu where there is deficit of 0.45 and 0.35 million, respectively, all other states have shown surplus with Jharkhand at the top (0.80 million) followed by Delhi (0.41 million) and Karnataka (0.18 million).

In India, the demographic dividend, also called demographic bonus or demographic window, which manifests in the population in the age group of 15-64 years is as high as around 60 per cent of population. By 2026, around 64 per cent of the population is expected to be in the age group of 15-59 years and only 13 per cent of the population will be above 60 years (Jagtiani, 2013). Thus, in order to reap the advantages of this vast demographic dividend, much stress has been laid on developing the technical skills and competencies in order to meet the growing needs of the economy in the globalised world. In short, to reap the real dividends, we need to provide the required 'quality' to the quantity of our population.

While Government has set a target to impart the necessary skills to 500 million people by 2022 keeping in view the rising demand of the skilled personnel over the next decade, IAMR analysis (as quoted in FICCI, 2013) states that the total number of people who need to be trained by 2022 ranges between 249 and 290 million across different scenarios of skill requirement. Further, the Twelfth Five Year Plan has set a target to skill only 80 million people by the end of 2017 which means that the rest 420 million will be skilled by the end of 2022. The net enrolment in Indian vocational courses is 5.5 million while comparable figure of China is 90 million and US is 11.3 million. In India, only 2 per cent people are formally skilled whereas the comparable figure of South Korea is 96 per cent, Japan 80 per cent, Germany 75 per cent and UK 68 per cent. The poor levels of skill in India are mainly attributed to the dearth of a formal vocational education framework, high school drop-out rates, inadequate skill training capacity, lack of industry-ready skills even in professional courses (FICCI, 2013).

Issue of Un-employability among Indian Engineers

Basically, employability of technical graduates may be defined as the congruity or consistency between technical education and the requirement of the industry or a person's capability of gaining initial employment, maintaining employment, and obtaining new employment, if required. The idea of employability is ultimately connected to the idea of learning i.e. to become or remain employable requires workers to acquire and update certain skills, notably those that enable flexibility, social competence, taking the initiative and changing competence among others (Jacobsson, 2004). In other words, employability assumes that if employees have the skills needed to be employable, not only will they secure an unproblematic transition from education into employment, but also be able to move onwards and presumably upwards along pre-designed career trajectory (Svensson, 2004). Some writers combine the notion of technical or classroom-learnt skills with other skills, attributes or traits (Cotton, 2001). Employability therefore has disciplinary effects, the subliminal message being that, if you do not update your skills and attributes in a way that the market and the employer wants, then you have to face the consequences (Fleming and Sturdy, 2009). Employability depends on the knowledge, skills and abilities of individuals that they possess, the way they use and present them.

Based on the trends witnessed in productivity and the likely growth potential of the IT and ITES industry, it is expected that the industry would employ about 7.5 million persons directly by 2022. A large portion of this employment is expected to occur in the ITES (BPO/KPO) exports sector, followed by IT exports and then in the domestic market. The projected human resource requirement for the various growth scenarios are given in Table 9. The incremental human resource requirement in IT and ITES sector is expected to be about 5.3 million persons till 2022 (Government of India, 2009).

In Table 10 the talent pool of skilled knowledge workers for India's ICT sectors is presented. It is clear from the table that the total supply of engineering graduates has grown at a rate of 13.42 per cent and that of IT professionals has grown at a rate of 12.86 per cent. Within the engineering graduates, total supply of the degree personnel has grown at a rate of 7.70 per cent, diploma personnel at a rate of 14.98 per cent, and MCA personnel at a rate of 12.12 per cent. Within the IT professionals total supply of degree personnel has increased at a rate of 4.68 per cent and diploma personnel at a rate of 9.21 per cent. Hence, the table very clearly elucidates that over the years the supply of skilled knowledge personnel for India's ICT sectors has increased stupendously.

Table 9: Projected Human Resource Requirement in the IT and ITES Sector

(in million)

Human Resource Requirement Scenarios		FY2008	FY2022	Incremental
Pessimistic	Exports	1.7	4.9	3.2
	IT Exports	0.9	2.0	1.1
	ITES Exports	0.8	2.9	2.2
	Domestic	0.5	1.1	0.6
	Total	**2.2**	**6.1**	**3.8**
Likely	**Exports**	1.7	6.0	4.2
	IT Exports	0.9	2.4	1.5
	ITES Exports	0.8	3.6	2.8
	Domestic	0.5	1.5	1.0
	Total	**2.2**	**7.5**	**5.3**
Optimistic	**Exports**	1.7	8.6	6.9
	IT Exports	0.9	3.5	2.5
	ITES Exports	0.8	5.1	4.3
	Domestic	0.5	2.1	1.6
	Total	**2.2**	**10.7**	**8.5**

Source: Government of India (2009), Human Resource and Skills Requirement in the IT and ITES Industry Sector (2022) – A Report, National Skill Development Council, New Delhi

As far as technical manpower requirement in India's ICT sector is concerned, the scenario is depicted in Table 11. It is evident from the table that in the IT Export Services, the technical manpower requirement has grown at a rate of 18.04 per cent, whereas in the case of ITES sector the manpower requirement has grown at a rate of 38.35 per cent which is more than double when compared to IT Export. Overall, the demand for technical manpower by ICT sector has grown at a rate of 29.15 per cent. Thus, there are high prospects of employment in India's rapidly growing ICT sector.

Table 10: Supply of Skilled Knowledge Workers for India's ICT Sectors

('000)

Technical Qualification	2000-01	2001-02	2003-04	2004-05	2007-08	2008-09	2010-11	2011-12	CAGR
Total Engineering Graduates	**197.3**	**205.6**	**316.0**	**365.0**	**523.0**	**551**	**607**	**635**	**13.42**
(a) Degree	94.7	102.0	139.0	170.0	277.0	290	316	329	7.70
(b) Diploma	102.6	103.6	177.0	195.0	204.0	212	228	236	14.98
(c) MCA	-	-	-	-	42.0	49	60	70	12.12
Total IT Professionals (a+b)	**119.6**	**125.2**	**179.0**	**201.0**	**250.1**	**263.5**	**290.3**	**303.7**	**12.86**
(a) Degree	57.8	64.2	84.0	102.0	158.3	167.3	185.3	194.3	4.68
(b) Diploma	61.8	61.0	95.0	99.0	91.8	96.2	105	109.4	9.21

Source: NASSCOM (various issues), Strategic Review: IT Industry in India, New Delhi

Table 11: Technical Manpower Requirement in India's ICT Sector

(in million)

Type of IT Service	2002	2003	2006	2009	2012	CAGR
IT Export Services (A)						
Consultancy, Integration and Installation	0.01	0.02	0.03	0.09	0.27	36.19
IT Development	0.07	0.08	0.08	0.08	0.11	3.39
Outsourced IT Support	0.09	0.11	0.17	0.28	0.53	18.84
Training and Education	0.00	0.00	0.00	0.02	0.06	44.22
Total (A)	***0.17***	***0.21***	***0.28***	***0.47***	***0.97***	***18.04***
IT Enabled Services (B)						
Customer Care	0.03	0.05	0.15	0.42	1.03	42.04
Finance	0.02	0.03	0.05	0.09	0.21	24.80
Human Resource	0.00	0.00	0.02	0.15	0.69	80.43
Payment Services	0.00	0.01	0.05	0.14	0.45	51.44
Administration	0.02	0.03	0.05	0.15	0.15	23.81
Content Development	0.03	0.04	0.07	0.09	0.20	19.22
Total (B)	***0.10***	***0.16***	***0.39***	***1.04***	***2.73***	***38.35***
Total (A+B)	***0.27***	***0.37***	***0.67***	***1.51***	***3.70***	***29.15***

Source: ITD, NASSCOM, McKinsey (2003), Manpower Profile of India, New Delhi: KPMG International

In the light of the above discussion, it is clear that although demand for technical manpower is very high and to respond to such huge demand, even the supply is equally high; still there is growing unemployment among engineers which is mainly due to their un-employability. Unemployment refers to a situation wherein a person is able to work and willing to work at the existing wage rate, but fails to get employment. The unemployment among engineers in India has been increasing rapidly and the main reason behind it, as stated evidently, is "lack of Employability" of the fresh graduates. Problem with employability arises when individuals have educational eligibility but lack in capability and suitability to execute job related activities despite having the availability of employment opportunities (Choudhary and Chadha, 2015b). The number of entry level engineers hired by the top 20 IT companies in India has also dropped steadily from around 3.5 lakh annually to 1.5 lakh in 2012 (Gautam, 2013). The industry complains about the graduates in terms of their exposure on practical work, lack of versatility with latest equipment, poor communication skills, less awareness of latest techniques and technology along with lack of confidence (Mander, 2015).

Further as per NASSCOM Mckinsey Report (as quoted in Tandon, 2013) while worker's requirement in the IT and BPO industry will increase from 7 lakh to 2.3 Million until 2013, a shortfall of 5 lakh workers will remain not because of dearth of engineering graduates but because of their lack of employability (Tandon, 2013).

Industry like ICT is fast expanding with diversity of activities requiring skill depth and crucially skilled workers. The National Employability Report for Engineering Graduates published recently by Aspiring Minds, a company that tests job seekers' employability, revealed that around 60 per cent of the engineering graduates fail to get jobs because they lack the required level of English (Tandon, 2013). The NASSCOM-Mckinsey study team has analysed three types of skills, which are needed by the industry. These include technical skills, functional skills and life skills. The majority of educational institutes provide technical skills. Some institutes may be able to impart life skills because of quality of inputs and environment (Khanna, 2011).

The employability status of the engineering students in different sectors state that the employability of engineering graduates in different sectors is very low. It is highest in BPO (40.69 per cent) followed by hardware marketing (36.57 per cent) and IT services (17.45 per cent). However in case of IT Product (2.68 per cent) and KPO (9.22 per cent), the employability is very low (Aspiring Minds, 2011).

The educational quality and facilities at higher level are one of the most considered factors for skill gap among the students. Most of the engineering colleges and institutions are not producing the desired results when it comes to these two required parameters. Further to this, universities and educational institutions are unable to produce updated curriculum and syllabi according to current technology trends. As a result, the students who are passed out are not well equipped with required skill sets as per the current industry trends, and therefore, companies are required to incur additional cost to train the fresh graduates and newly hired employees.

The sector- and role-wise employability of graduates, as shown in Table 12, indicates that in the case of business functions, the highest employability is in the case of clerical/secretarial category i.e. 35.95 per cent with only around 15 per cent employability in the case of sales and

Table 12: Employability of Graduates across Sectors and Roles

Sector/Roles	Employability (%)
Business Functions	
• Sales and Business Development	15.88
• Operations and Sales	14.23
• Clerical/Secretarial Roles	35.95
Analytics and Communications	
• Analyst	
• Corporate Communications/ Content Development	
IT and ITES Industry	
• IT Services	12.97
• ITES and BPO	21.37
• IT Operations	15.66
Accounting Roles	
• Accounting	2.59
Teaching	
• Teaching	15.23

Source: Aspiring Minds (2013), "47% Graduates in India are Unemployable for any Job: Aspiring Minds' National Employability Report – Graduates", Press Release, June 23

business development along with operations and sales. The employability statistic is severely low in the case of analytics and communications along with accounting i.e. only around 3 per cent. In the case of teaching the employability is only 15.23 per cent. Further, in the case of IT Services, ITES-BPO and IT Operations the employability has further declined to 12.97 per cent, 21.37 per cent and 15.66 per cent, respectively (Aspiring Minds, 2013).

Although the current demand for workforce is primarily for the lower end of the market (IT, BPO, coding and testing, etc.) which can be supplied by non-engineering graduates along with engineering graduates, sustained success in the global market will require the use of highly skilled and knowledgeable workforce. As per the estimates, 75 per cent of the technical graduates and more than 85 per cent of the general graduates are unemployable by India's high growth global industries (Anand, 2011). Thus, the industry is facing a lot of challenges in hiring skilled workforce who are employable as per requirement. There is a huge employability gap that needs to get reduced for the betterment of the Indian economy because the problem of unemployability is more serious than the problem of unemployment itself.

It is an open secret that a huge majority of the pass-outs of these technical institutes even those giving out professional degrees are unemployable because they neither have good communication abilities nor any skills to enter the highly competitive world of work, be it the corporate or state run (Gill, 2013). Although there is a huge number of non-engineering graduates produced every year in the country, the quality of a major chunk of these graduates is very much questionable. Even the quality of engineering graduates produced by large number of private engineering colleges is not up to the mark. It is to be mentioned here that the southern states of the country have been the hub of engineering education with over-whelming participation of private entrepreneurs. However, in the year 2013 a large number of seats in engineering colleges remained vacant in Andhra Pradesh (1lakh),Tamil Nadu (0.8 lakh), Maharastra (0.5 lakh) and Karnataka (0.15 lakh) (Gautam, 2013).

Table 13: Growth of Total Unemployed Engineers by Select States

State	1999	2003	2007	Compound Annual Growth Rate (%)
Andhra Pradesh	5458	7470	48372	**35.04**
Assam	430	357	274*	**-1.75**
Chandigarh	172	177	196	**-3.19**
Delhi	25	414	1027	**22.08**
Gujarat	1812	4509	17041*	**36.22**
Haryana	243	811	2855	**21.94**
Himachal Pradesh	122	219	291*	**10.14**
Jammu & Kashmir	52	469	1094	**32.97**
Karnataka	6584	9519	17123	**15.8**
Kerala	1542	2211	2799	**6.05**
Madhya Pradesh	1118	2279	6688	**25.08**
Maharashtra	8014	23373	40437*	**17.97**
Orissa	325	2063	5382	**46.77**
Punjab	525	1414	2324	**22.13**
Rajasthan	714	1926	5057*	**23.81**
Tamil Nadu	7080	23184	60320	**30.51**
West Bengal	568	1119	3459	**22.46**

Note: Signifies Extrapolated Values (Using Strata Software Version 10)

Source: Government of India (various issues), Manpower Profile India Yearbook, New Delhi: Institute of Applied Manpower Research

The shortage of suitable engineering graduates is usually attributed to the poor quality of education imparted by many of the engineering institutes. In terms of estimated growth of Indian IT industry, the availability of human resource accompanied with required skill set will be the key factor and India's youth population is going to be one of the prime driving forces for its overall growth. The industry has much more potential in comparison to estimated contribution in economic growth of the country. However, the shortage of skilled workforce which is rising day by day has become a major challenge for the Indian IT industry.

Table 13 shows the growth in the number of total unemployed engineers in the select states of India in three periods of time. It is observed from the table that in 1999, the highest unemployment among engineers was in the State of Maharashtra (8,014) followed by Tamil Nadu and Karnataka with 7,080 and 6,584 engineers respectively. Unemployment has nearly doubled in 2003 as well as in 2007 in both Maharastra and Tamil Nadu states. Further, Orissa followed by Gujarat and Andhra Pradesh recorded highest CAGR with 46.77, 36.22 and 35.04 respectively. In 1999, the lowest number of unemployed engineers was in the states of Delhi and Jammu & Kashmir with 25 and 52 engineers respectively whereas in 2003 and 2007, the lowest number of unemployed engineers was found in the Union Territory of Chandigarh with 177 and 196 unemployed engineers respectively. In the case of Punjab, the unemployment among engineers has increased from 525 in 1999 to 2,324 in 2007. The stream-wise growth of unemployment among engineers is given in Table 14.

Government Measures and Policy Implications

Quality of Education can be realised through many ways viz. more resources and better utilisation, enhancing employability, encouraging private participation, research culture and faculty issues, other initiatives, etc. The Indian Constitution recognised the supreme importance of technical education for the future development of the country. Hence, several working groups, acts, committees, commissions, etc. were set up for the development of Technical education as explained in Table 15.

In the present competitive world, graduates require the skills which are beyond the basics of reading, writing and arithmetic (the '3Rs'). The skills as critical thinking, communication, collaboration and creativity (the '4Cs') are more important in getting jobs. Hence, there is a need to focus on the '4Cs' (Government of India, 2011a). The All India Council for Technical Education (AICTE), the statutory body and a national-level council for technical education under Department of Higher Education, Ministry of Human Resource Development established in November

Table 14: Stream-wise Growth of Unemployed Engineers in Select Disciplines and in Select States from 1999-2007

State	Civil	Chemical	Electrical	Electronics	Mechanical
Andhra Pradesh	6.38	42.64	43.58	19.19	51.07
Assam	-0.94	11.47	13.3	-0.4	-4.26
Chandigarh	-3.6	-4.57	-5.57	-7.12	-4.67
Delhi	-0.03	-3.65	9.64	19.26	-0.76
Gujarat	28.4	58.1	43.26	-9.52	42.56
Haryana	-15.57	-6.72	8.53	22.35	19.24
Himachal Pradesh	-8.25	0	10.27	33.87	-3.38
Jammu & Kashmir	26.11	0	25.68	39.11	33.54
Karnataka	-1.41	18.94	10.3	4.32	9.76
Kerala	-2.27	5.93	0.75	36.94	3.8
Madhya Pradesh	-15.59	25.32	1.87	3.23	23.81
Maharashtra	-17.01	12.22	8.7	18.82	22.57
Orissa	11.07	39.24	39.93	72.03	38.04
Punjab	-17.42	18.12	21.76	26.83	15.28
Rajasthan	10.66	5.49	37.05	44.55	16.01
Tamil Nadu	12.92	27.29	16.48	36.31	18.56
West Bengal	-2.47	5.42	20.37	36.08	13.11

Source: Author's own calculations from the data given in Manpower Profile India Yearbook (various issues), New Delhi: Institute of Applied Manpower Research

1945 first as an advisory body and later in 1987 given statutory status by an Act of Parliament, is responsible for proper planning and coordinated development of the technical education and management education system in India. The AICTE accredits post-graduate and graduate programmes under specific categories at Indian institutions as per its charter and in order to improve the effectiveness of technical education, the council has launched various schemes like Industry Institute Partnership Cell (IIPC), National Facilities in Engineering and Technology with Industrial Collaboration (NAFETIC), Modernization and Removal of Obsolescence (MODROBS), National Programme on Technology Enhanced Learning (NAPTEL), etc. Further, National Board of Accreditation (NBA) was constituted by the AICTE, as an Autonomous Body under section 10(4)

Table 15: Summary of Major Committees and Recommendations

Committee/ Commission	Major Thrust	Year	Recommendations
Sarkar Committee	Higher Technical Institutions for the Post-War Industrial Development	1945-49	Setting up of IITs
Radhakrishnan Commission	University Education Commission	1948-49	Opening of New Technological Institutes
Thacker Committee	Post Graduate Engineering Education and Research	1959-61	Funding for 100 Ph.D annually
Nayudamma Committee	Post Graduate Education in Engineering and Technology	1979-80	Post-Graduation Minimum Qualification for industry, Research and Development
Nayudamma Committee	IIT Review	1986	Greater flexibility in academic programme, focus on engineering research, faculty mobility
P. Rama Rao Committee	Reshaping Post- Graduate Education in Engineering and Technology	1995	21 months M.Tech, increased scholarship amount, assured employment for M.Tech, National Doctoral Programme
R.A. Mashelkar Committee	Strategic Roadmap For Academic Excellence of Future Regional Engineering Colleges (RECs)	1998	Conversion of RECs into NITs with the status of a deemed to be university and structural changes in governance.
U.R. Rao Committee	Revitalising the technical education	2003	Regional inequity to be removed, faculty shortage to be addressed, need for planning and co-ordination in the working of AICTE

(contd.)

P. Ramo Rao Committee	IIT Review	2004	Increased UG output of IITs, fund infrastructure increase, add new IITs but maintain quality
Sampatroda	National Knowledge Commission	2008	Need to establish Independent Regulatory Authority for Higher Education (IRAHE)
Yashpal Committee	To Advise on Renovation and Rejuvenation of higher Education	2009	IITs to be converted into full-fledged universities
Kakodkar Committee	Taking IITs to Excellence and Greater Relevance	2010	Scale up output of Ph.Ds in IITs from current less than 1,000 to 10,000 annually

Sources: 1. Banerjee and Muley (2007), Engineering Education in India, Draft Final Report: IIT Bombay
2. Saha, S.K. and Ghosh S. (2012), "Commissions and Committees on Technical Education in Independent India: An Appraisal", *Indian Journal of History of Science*, Vol. 47, No. 1, pp. 109-138.

of the AICTE Act, 1987 in order to periodically evaluate institutes or functioning of various programmes on the basis of guidelines issued by the body.

In order to improve the quality of technical education, the World Bank assisted the Government of India to launch a Technical Education Quality Improvement Programme (TEQIP) as a long term programme of 10-12 years and in 2-3 phases. Hence, TEQIP is being implemented as a World Bank Assisted Project to improve the quality of technical education system in the country by the Government of India. The first phase of three-phased TEQIP with World Bank support was conducted from 2002-2009 with an investment of Rs. 1,378 crore and covered 127 engineering institutions. The second phase of TEQIP (2009-2014) which extends up to the Twelfth Plan would cover another 180-190 institutions. Under phase third of TEQIP focus would be on the eco-system by supporting State Technical Universities introducing curriculum diversity and scaling up sector-wise programmes. This would ensure that benefit of quality improvement interventions flow to all the segments of technical education. The programme would also leverage synergy with other initiatives like mission for teachers and teaching and mission for use of technology (Government of India, 2012).

In addition, the Indian National Digital Library in Engineering Sciences and Technology (INDEST) Consortium has been set up by MHRD under which the Ministry provides funds required for subscription to electronic resources for 38 institutions including IISc, IITs, NITs, IIMs and a few other centrally-funded Government institutions through the consortium headquarters set up at the IIT Delhi. Further, 44 Government or Government-aided engineering colleges and technical departments in universities have joined the Consortium with financial support from the AICTE (http://library.dce.edu/services/indest).

The Approach Paper to Twelfth Five Year Plan approved by National Development Council in 2011 discusses the concept of Quality of Education under 'Shift of Focus to Quality'. It emphasises the thrust to be laid on consolidating and improving the capacity and quality of the existing institutions. At the same time, a holistic and balanced expansion approach is needed to target the under-represented sections of the society. The twelfth five year plan of India entitled 'Faster, More Inclusive and Sustainable Growth" visualises education as the single-most important instrument for social, political and economic transformation because in this twenty-first century, a well educated population equipped with the relevant knowledge, attitudes and skills is mandatory for sustained economic and social development of a nation.

Thus, in order to solve the problem of below-quality education and the resultant lack of employability among engineers in India, state-of-the-art teaching content as per the market demand, students' involvement in research, innovations and creative activities should be encouraged along with proper training to make them world citizens. There should be harmonious interaction between students and faculty, faculty and management and students and management. Class tests and assignments should be on schedule so that students can gain confidence in decision making, relate theory with practice, realise responsibilities and opportunities to work with modern equipment (Palit, 1998). There should be external monitoring of the educational processes in all the technical institutions and incentives should be given for quality initiatives by the institutions. Further, there is a need to have an independent quality grading of institutions at the state level also for encouraging competition among them and for the knowledge of the public. Benchmarks should be set at the national level for output quality parameters at all levels along with mechanism for periodic review of all institutions. It is also recommended to have a strong industry-institute linkage in the form of regular industrial visits by the students on the one hand and by the industry experts to the institutes on the other hand.

There is a dire need to have broadened and subsidized educational loan facilities by the government and at the same time a synchronized and reduced fee structure so as to enable more students to get admissions in these institutions. Since students have to work in big industries, MNCs and abroad as well, their communication skills need to be improved which can be started at the senior secondary level. A lot needs to be done as far as pay scales of the faculty are concerned, as most of them are not getting salary as per the AICTE norms which serve as a disincentive towards quality work.

Much needs to be done for enhancing the capability of students by conducting seminars, group discussions, educational trips, practical industry experiences etc. Only then the gap between the talent available and desired can be filled. Moreover, government funding is needed to finance the management so that they can further encourage teachers to attend seminars, conferences, symposiums, workshops, etc. which will surely improve the quality of education. Efforts need to be done to groom teachers before entering into this profession e.g. as there is B.Ed at the school level, there must be some teaching course at the college level as well. Most of the colleges directly recruit freshers in the field without any training which leads to decline in quality standards.

Further, many students want to be entrepreneurs, in that context, it is recommended that the government and other funding agencies should provide them with regular financial and technical assistance. In order to have quality technical education, it is necessary that instead of sanctioning more new colleges, emphasis should be laid on strengthening and upgrading the existing ones. Last but not the least, alumni associations should be formed so that they can share their experiences and help the underprivileged students in the form of financial assistance and placement facilities.

Conclusion

In consonance with the country's development strategy of attaining technological self-reliance by growing home-based technical manpower and keeping in view the growing demand for technically skilled personnel in the country, since independence, special emphasis has been laid on the development of institutions providing technical education.. Currently, India trains about 1.5 million engineers every year which is more than the combined strength of US and China. One sixth of all Indian students are enrolled in engineering/technology degrees however the recent large scale expansion in engineering education has come at the cost of quality. The National Employability Report by Aspiring Minds in 2012 stated that

83 per cent of engineering graduates in India are unfit for employment. Similarly, NASSCOM study depicted 75 per cent of IT graduates to be unemployable. The employers are facing severe problems in finding the appropriate skilled and trained personnel for the rapid expanding IT industry and other sectors of the economy competing in the globalised regime. The main reason for this lack of employability of the graduates is the below quality technical education. Therefore, it is imperative to put special emphasis on improving quality of education being provided by the ever-expanding institutions of technical education especially in the private sector. The factors responsible for declining quality of technical education need to be addressed immediately as in the process of the vast quantitative expansion, quality is severely compromised. In order to ensure quality education, Academia-Industry interface needs to be strengthened, and students and teachers need to be encouraged for practical domestic and international experience. Infrastructure, particularly manifesting in libraries and laboratories needs to be braced up. There should be proper check on the rapid expansion of the technical institutions and emphasis should be laid on improving the quality of the existing institutions. Benchmarks should be set at the national level and periodic review of the institutions should be done. Above all, keeping in view the demand of the industry, syllabi need to be updated regularly and emphasis should be laid on practical orientation of the technical education. In short, in order to remove the problem of below par quality technical education and the resultant lack of employability, efforts should be taken immediately otherwise there will be heavy losses in the form of vast unemployment among engineers in the nation.

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