Role of Technical Education in Emerging Indian Society: Opportunities and Challenges

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Prologue

The Indian economy is expected to show one of the highest growth rates globally, financial recession notwithstanding. The role of education, particularly in the technical field, therefore assumes considerable importance.

The Author, who is a leading light in the field of industrial engineering and management, brings out that the technical education system in India has undergone a sea-change due to private investments in technical education, which have increased its access and reach. However, as can be expected, various quality/quantity imbalances have also occurred. This paper identifies the crucial role technical education can play in the emerging Indian society and raises issues that need to be addressed. A SWOT analytic framework and case-oriented discussion on these issues have been brought out in the context of U.P. Technical University (UPTU). The impact of strategic quality initiative of introducing academic excellence awards (in UPTU) and its resultant impact on quality improvements have been discussed. Further, a number of strategic interventions, which need to be taken to effect qualitative reforms in technical education, have also been brought out. The Author opines that all stakeholders should contribute towards the goal of making India a leader of knowledge society with shared perceptions and concerns.

Introduction

India has seen an exponential growth in the number of technical institutions and enrolments over the past 20 years. The participation of private equity in degree level engineering and technology colleges/institutions has changed the scenario drastically and public perception about the engineers, engineering education and quality of technical education. In U.P., in the year 1996, there were 12 engineering
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Colleges, whereas in 2008, the figure rose to 208 with 90 new colleges added in the year 2008 alone. Uttar Pradesh (U.P.) alone is estimated to have attracted about Rs. 15,000 cr. of private investments in technical education. While this may be perceived as a good opportunity, but uncontrolled growth, imbalanced focus, and lack of quality coupled with acute faculty shortages, necessitates introspection and honest soul searching on these trends. This Article attempts to look at the entire subject holistically, and identifies the strengths; also suggesting strategic interventions for the Technical Education if it is to play a meaningful role in the emerging Indian Society.

Role of Technology in Improving Productivity and Quality

Robert M. Solow, a Nobel Laureate from MIT developed a growth model that explained that, ultimately, it is the technological progress that offsets the effects of diminishing marginal returns and thus allows capital to play a role along a steady growth-path. Thus, only technical progress in the long-term can support economic growth and has a pronounced impact on productivity, quality and competitive advantage of any nation. This means that technology can be an important instrument of national development and prosperity. Invariably, the developed economies are technologically very advanced and vice-versa. Hence, in increasing global competitiveness of a country, technology can be a major contributor. By direct implication therefore, technical education can be a major instrument of national development and improvement in the quality of life of Indians.

Technology also plays a vital role in quality assurance by way of reduction in variations and reduction in waste. Thus technology is a vital instrument for enhancing India’s competitive advantage in the current global business environment. Some major revolutionary changes in Indian society, such as ‘green revolution’, ‘communication revolution’ and ‘Railway Reservation system’, were primarily technology driven.

Emerging Indian Society: An overview

India is emerging as a prime resource centre for knowledge society, in which human mind and intelligence are the key engines of development; and computer/microprocessor the physical technology; and network of knowledge workers the key form of organization structure. IT (Information Technology) has been a main thrust of technical education system in the past 15 years or so. While this is a welcome development in terms of creating the right kind of information infrastructure as an enabler in the process of creating a knowledge society, but the imbalance it has created in the overall technological manpower development will have dysfunctional outcomes. Information technology has been treated as a ‘replacement’ technological option rather than ‘enabling’ technological option. As a result, nearly 70% increase in technical institutions and increased intake are confined to IT or its variants. The core technology departments – Civil, Metallurgical, Mechanical, Textile, Agriculture, Chemical, Paper, Sugar, Leather, etc., have hardly seen any growth. In fact, in many cases, there is negative growth in enrolments and institutions. This is a serious issue that needs to be corrected, otherwise its consequences could be disastrous. A recent study by Indian Institute of Metals sponsored by the Ministry of Steel, Govt. of
India, has pointed out acute shortage of technical manpower in disciplines like Metallurgy and Ceramics Engineering at all levels. Similar views can be held for all other core technologies.

India has also witnessed ‘communication revolution’, particularly on the front of mobile (cell) phones, largely due to large private equity participation. Due to convergence of technologies – Information, Communication and Entertainment – we will use the same hardware, cell phone, and all ICE related functions, and many more such as tele-medicine, tele-education, etc., will be performed on the same set.

In order to sustain the development and enable it to play a lead role in emerging knowledge-driven society, India needs to do the following mid-term corrections in its future development agenda:

1. Treat Information & Communication technology as enabling technology to drive all other technologies towards greater productivity and quality instead of ‘replacement’ technology where core technological disciplines are gradually showing decline in enrolments and getting substituted with IT enrolments. Thus, we need to have IT-enabled Mech. Engg., IT-enabled Civil Engg., IT-enabled Chemical Engg., etc. Thus, IT becomes a general base over which various technology verticals should be taught, instead of IT itself becoming a technology vertical–of course except where high end R&D in IT itself is needed.

2. Newer investments in technical education should be in ‘neglected’ areas and any further Public-Private-Partnership should be encouraged for core technologies only, otherwise imbalance will continue to grow as it is less capital-intensive and less risky proposition to start an IT-related teaching department/college. Alternatively, recognizing less enthusiastic investment in Non-IT sectors by private investors, the Govt. funded institutes should go only for IT enabled core technologies and encourage private players to go for balanced development of technical education.

Role of Technical Education in Development

As mentioned earlier, technology is a key lever for growth, development and prosperity of a nation. To generate technological capability, we need to focus on technical education. Technical institutions should be perceived by the industry, government, and society as ‘nursery of future talent pool’ of a nation. In an emerging knowledge-driven society, nurturing this talent pool holistically to make them ‘globally employable’, should be the main objective of the technical education system. Thus any investments (both public and private) in technical education system, if perceived as investments in nation building process for emerging knowledge society will pass the test of cost-benefit analysis. We just need to look at returns from technical education in totality, both tangible and intangible, in life cycle costing perspective.

A Critical Appraisal of Expansion of Technical Education in India

Indian Technical Education System at the degree level has seen enormous expansion since 1987 after AICTE became the statutory regulating authority created
by the Indian Parliament. For past two decades, essentially due to private equity participation, the number of degree level engineering colleges and enrolments in these, have multiplied several fold. This exponential growth, while welcome due to large private investments (Rs. 15000 crore in UP alone) which would have been difficult to come from government sources alone, also had its adverse impact on quality and employability of graduates of these colleges. A statistical analysis of UPTU affiliated B.Tech colleges, based on University based theory examinations, revealed that about 20-30% of these institutions had academic performance, which could be a ‘cause for concern’ or could be called ‘poor’. (See Fig. 1)

Fig. 2 shows a histogram of % of institutions wherein a student could graduate (B.Tech) in minimum 4 years which ranged from 91% (only one college) to 20% (2 colleges) with a University average being around 75%. This reveals a wide fluctuation in the quality standards of these private institutions. This quality paradox is perhaps the outcome of exponential growth associated with ‘acute’ shortage of good and inspiring faculty in many colleges.

The second major problem in the growth of past two decades is the imbalance in the branches of engineering disciplines. Fig. 3 shows the % distribution of enrolments in UPTU in various engineering disciplines and it can be seen that nearly 70% enrolments are confined to only 25% branches which are also minor variants of IT/CSE/EC. Thus, core engineering branches have not attracted attention of private promoters. Surprisingly, not even one college out of 208 engineering colleges in U.P.T.U. has Metallurgy and Mining Engineering. This imbalance will seriously impact on the core sectors of the economy and needs to be urgently corrected. The Regulatory body like AICTE should play a prime and proactive role in it, in addition to CII/FICCI/ASSOCHAM, etc., in sensitizing public as well as promoters to look at technical education from a long-term perspective.

In U.P. alone, in the year 2008, some 90 new engineering colleges were opened. This number was 12 in 1996, 118 in 2007 and 208 in the year 2008. Fig. 4 shows the chart indicating this.

The third major fallout of this is the acute faculty shortages as also their quality, motivation and commitment levels. A preliminary estimate would reflect that nearly 80% of engineering college teachers are simple B.Tech and many of them from their own college and fairly low in their academic performance while they were students. Due to lack of motivation, they are not doing any R&D or pursuing their Ph.D/M.Tech. While number of Ph.Ds in engineering is so low in the country, yet it has not prevented private investors to open new colleges. The age-structure profile of the faculty is also a cause for concern. In most colleges, about 80% faculty are fresh graduates in their early twenties and about 10-15% are past 60 years, mostly retired professors, with an almost missing middle cadre. About 85% colleges will fail to meet the faculty cadre ratios prescribed strictly in terms of Professors, Readers, Lecturers and yet they exist. Even govt. funded colleges suffer from an acute faculty shortage.
Quality Dimension in Technical Education

In the race for quantity, quality seems to have taken a back seat in technical education. The number of NBA (National Board of Accreditation) accredited institutional programmes may be only about 20% of the total AICTE approved programmes. The perceived impact of technical education on emerging Indian society will very substantially depend upon ‘quality’ and ‘employability’ dimensions. NASSCOM estimated the immediate employability of IT graduates in India at about 20-25%. With this degree of quality and employability, India will suffer with a paradox of shortage of talented engineers, while a large pool of unemployable graduate engineers wait for jobs. This could badly hit competitiveness of the Indian industry and also cause social strain due to millions under or unemployed.

Recognizing the importance of ‘quality’ in technical education, UPTU has taken a number of steps for improving quality; and motivating these institutions to initiate quality enhancement strategies. UPTU Academic Excellence Award Model was one such unique initiative, which has generated a healthy sense of positive motivation among technical institutions. Other steps include ranking, on UPTU website, the academic performance of colleges, faculty development initiatives, examination reforms, curriculum reforms and tightening the admission criteria. Interaction with industry through MOU’s and mentoring has also generated awareness. As a result, positive trends in quality improvements have been visible during the past 2-3 years in the University.

Technical Education System in India : A SWOT Framework

A SWOT framework for Indian Technical Education System provides insights and necessitates soul searching. A brief framework is as follows:

Major Strengths

1. Very young demographic profile with more than 55% of population under 25 years of age.
2. Intrinsically intelligent human resources.
3. Large-trainable population.
4. Engg. & Technology still a preferred career option.
5. Parents in India willing to sacrifice their personal comforts for the sake of child’s education.
6. Private equity participation is an attractive proposition.
7. The number of engineering colleges per lakh of population is still way behind that in developed economies.

Major Weaknesses

1. Faculty shortage – both in terms of numbers as well as their quality and commitment.
2. Low concern for quality and high concern for increasing intakes in private colleges.
3. Mushrooming of private colleges.
5. Low focus on practicals, experiments or project work.
6. Very little industrial interaction/collaboration.
7. Low autonomy to academics and academic leadership, irrespective of the source of funding.
8. Little or no research focus, consultancy, publications, R&D, product innovation.
9. Teaching mostly based on rote learning/examination centric.
10. Low immediate employability of graduates.

Major Opportunities
1. Rectify imbalance in location, enrolments, branches and compensation packages in technical education.
2. Integrate Research, postgraduate, UG, diploma and vocational education to have a holistic development of technical education.
3. Regulatory bodies should take pro-active and nurturing role to promote quality and excellence rather than remain inspection driven for approvals only.
4. Holistic development of students as a part of nation building process – improving communication skills, soft-skills, human values, integrity and professional ethics.
5. Faculty development initiatives, creating an enabling and nurturing academic/learning environment.
6. TQM oriented management of technical education with long term rather than myopic perspective in building institutions.
7. Virtualization, e-learning and using IT-enabled engineering education. Focus on IT in B.Tech programmes rather than only having B.Tech in IT.
8. Networking with reputed academic and industrial organizations for a shared goal of creating outstanding quality, globally employable Indian Talent (new form of IT definition).
9. Sensitizing students to show concern towards others, society, environment, elderly, the under-privileged and focus on integrity, positive attitude and discipline among students.
10. Generate healthy sense of competition among colleges by putting their total academic performance, rankings, academic resources/processes on the University website as well as on college websites.

Major Threats
1. Accumulated number of unemployable graduates can cause social upheavals, erode harmony and discipline.
2. Lack of instilling good human values can lead to increased technology driven cyber crimes.
3. Poor quality graduates will negatively impact national competitiveness index and retard progress. Due to talent shortage, Indian industries, and public sector would suffer on productivity, quality and competitiveness front; might even lead to their closures in the wake of global competition.
4. Indian capital may be diverted to foreign universities as parents may decide to get their wards admitted outside India if quality of Indian Technical Institutions is not perceived to be high.

5. Foreign universities may enter Indian markets posing serious challenges to low quality institutes, leading to their closure.

6. Increase in malpractices, corruption in the process of affiliation, admissions, accreditation, and examination processes. This would have a cascading effect and may eventually ruin the social and work environment.

7. Low social esteem for engineering institutions/graduates as an outcome of persistently poor quality turnout.

It is hoped that, as seen in the above mentioned SWOT framework, the policy makers, promoters, regulatory authorities and academicians would make quality and academic excellence as a key centre-stage focus in managing technical education. If that happens, it would transform economic and social environment of this country.

Integration of Human Values and Professional Ethics in Technical Education

A good engineer/technologist has to be a good human being too so that honesty, integrity, concern for others (may include colleagues, neighbours, customers, society, environment, organization and the nation) is high in him/her. Therefore, it is vital that in the design and delivery of engineering education, there is integral focus in technology and human values and professional ethics. In the absence of such a training, engineers in pursuit of their self interest may erode environment – both physical and social. Pollution of water, air, noise, and that of mind is the direct negative consequence of training students without role model teachers and academic leadership and not having adequate concern for practicing good human values in the management of such institutions. Adulteration, corruption, terrorism, cyber-crimes are the negative impacts of technical education sans human values. Technology, if used for negative purposes, can cause untold miseries to the civil society. Recognizing this, the UPTU has initiated a compulsory audit course on “Human Values and Professional Ethics” in all branches of Engineering and Management from July 2009 session.

The Role of Regulatory Bodies

Only inspection-driven, compliance-centric regulatory practices are prone to the influence of corrupt practices. Since the purpose of regulation enshrined in the vision statement of regulatory bodies is to promote quality and nurture excellence, it is high time that there is introspection among all regulatory authorities – UGC, AICTE, affiliating universities and the concerned nodal ministry dealing with technical education to see if current regulatory practices are serving the purpose intended. It is a known fact in the quality assurance literature that inspection (particularly the end of line inspection), is a primitive form of quality control. For effective, proactive, objective, transparent, participative, introspection based total quality management, a fundamental shift in the mindset of regulators is required.
We need to create a nurturing rather than inhibiting environment, which will be excellence driven, holistic, with empowered and role model faculty who will look at education as a process of nation building rather than making profits. UPTU Academic Excellence Award Model framework (Fig. 5) initiated by UPTU in 2007 is one such attempt. It is generating a lot of enthusiasm but needs to be pursued across the country. Table 1 gives a comparison of institutes recognized under this model in 2007 and 2008. This clearly demonstrates the impact of quality award model in motivating technical institutions to pursue the quality enhancement goals. Mandatory disclosures under this model framework would at least sensitize them towards quality.

### UPTU Excellence Award Model

**Fig. 5**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Nature of recognition</th>
<th>In the year 2007</th>
<th>In the year 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>No. of Excellence Awards Given</td>
<td>Nil</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>No. of Star Performer Institutions Recognized</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>3.</td>
<td>No. of Institutions for giving Certificate of Appreciation</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>4.</td>
<td>Total Recognitions</td>
<td>5</td>
<td>21</td>
</tr>
</tbody>
</table>

### Need for Strategic Interventions

Current emerging knowledge driven-economy and Indian core competency having potential in leading the global knowledge society is a great opportunity, provided we at a national level initiate certain strategic interventions to re-engineer technical education system. Some of these are:
1. Redefine the role of regulatory authorities to facilitate, nurture and develop technical education with more focus on faculty development, R&D funding, mentoring, and accreditation or publishing ranking and performance of institutions.

2. Focus on balanced development of technological disciplines with IT, human values, professional communication skills and managerial skills as common component to all technical branches. Also, focus on gap areas and encourage new intake only in the gap areas, while consolidating quality in existing institutions before letting them expand.

3. Create a cell to develop data bases on future requirements of various technical skills and strategies to match these by timely planning of intake capacity.

4. Focus on attracting, motivating and retaining outstanding and role model teachers in adequate numbers and create flexible faculty cadre structure, provide enabling work ambience, facilitating administrative processes and inspirational academic leadership to get the best out of this intellectual capital.

5. Make industry a major stake holder in technical education and a certain fraction of their profits to go to nurture technical education as a part of their Corporate Social Responsibility.

6. Empower universities by ensuring adequate and automatic budgetary support to them by having an MoU on their deliverable outcomes but freeing them from day to day pressures from ‘significant others’ in the environment under which a university functions.

7. Emphasize that teaching, research, innovation, outreach activities are integral parts of a faculty member’s job profile and create a transparent, objective and participative faculty performance appraisal system similar to that which was successfully developed and implemented at IIT Roorkee during its transformation phase.

8. Evolve vertical integration of technical education system from “ITI to IIT” so that there is balanced growth and development at all levels.

9. IT and other emerging electronic technologies will change the quality of life and entire societal environment and entire business, social and educational paradigms. It is very vital to absorb this change very carefully to filter out negative impacts by appropriately sensitizing students and society as well as enhance focus on professional ethics and good human values. UPTU’s initiative to start a compulsory audit course for all branches of engineering & technology and management is one modest step in this direction. These need to be replicated at the national level.

10. Industry should be driving pro-actively the content, quality of course design and facilitate effective delivery by collaborating meaningfully with academia and industry. Technical University to involve industry in academic
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excellence journey in true earnest spirit through BoS, Alumni, Academic council membership and a cadre of adjunct professors from industry with relaxed qualifications of a doctoral degree. Industry should treat academic institutions as ‘nursery of their future talent pool’ and it is in their as well as national interest to nurture this talent well.

Concluding Remarks

In the last 20 years, Technology, particularly information and communication technology, has changed the world and its social, technical, economic, physical and educational environment very significantly and has made the concept of world, as a global village, a reality. As an engine of growth and development, it has led to human prosperity and comforts but concurrently has caused a negative impact on physical, social and business environment. Technology driven or cyber-based crimes have become more visible. Hence, it is the role of technical education system to look at education as a part of a nation-building process and to nurture Indian Talent in a holistic manner. The current scenario is a cause for concern, particularly on quality and employability front. It is opined that all stake holders should contribute towards the goal of making India a leader of knowledge society with shared perception and concern.

Reference

3. UP Technical University, Lucknow – Academic Excellence Award Model (http://www.uptu.ac.in)

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Fig. 1: YTBGYOR. Cumulative Performance Spectrum Control Chart
(Ranking Grouping of Institutions based on Gross Average Intellectual Attainment Per Student (Obtained by various Multidisciplinary Colleges of B.Tech in session 2007-08 including 8 semesters) GAIA:

Basis of Computation: GAIA = (Sum of marks of all the students in all the subjects in theory exam) / Total no of students who took the examination

<table>
<thead>
<tr>
<th>Grade</th>
<th>Marks</th>
</tr>
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<tbody>
<tr>
<td>A+</td>
<td>(90-99)</td>
</tr>
<tr>
<td>A</td>
<td>(80-89)</td>
</tr>
<tr>
<td>A-</td>
<td>(75-79)</td>
</tr>
<tr>
<td>B</td>
<td>(65-74)</td>
</tr>
<tr>
<td>B-</td>
<td>(60-64)</td>
</tr>
<tr>
<td>C</td>
<td>(50-59)</td>
</tr>
<tr>
<td>D</td>
<td>(40-49)</td>
</tr>
<tr>
<td>E</td>
<td>(30-39)</td>
</tr>
</tbody>
</table>

This is complete index of theory exam performance of Colleges. It captures total information (Code Number of Colleges in each colour in decreasing order of GAIA Index)

<table>
<thead>
<tr>
<th>V</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>J</td>
<td>Very Good</td>
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<tr>
<td>K</td>
<td>Poor</td>
</tr>
<tr>
<td>L</td>
<td>Average</td>
</tr>
</tbody>
</table>

A University Average = 41.50%
σ Standard Deviation = 7.36

Fig. 2: Histogram depicting the number of colleges and % of graduates completing their B.Tech degree in minimum period of 4 years in 2006-2007 graduating batch in UPTU
Fig. 4: Growth of Colleges/Institutions and enrolled students in U.P.T.U.