Higher Technical Education in India: Need for New Initiatives

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Introduction

Higher technical Education in India started receiving priority after Independence with the creation of five IITs at Kharagpur, Bombay, Kanpur, Madras and Delhi each with foreign collaboration. Then NITs were created in different regions. Today there are 22 IITs and 31 NITs with an annual intake of 10,000 and 18,000 respectively. There are over 20 Technical Institutions of comparable quality in the private sector. In addition there are a large number of private engineering colleges whose quality has been questioned. The country graduates over a million students per year with a large number of them from these private engineering colleges. There are not enough jobs for these Engineering graduates. There is thus a crisis in engineering education calling for an urgent need to control this growth and also retain quality. We discuss some of these issues now and offer solutions, which to many may seem harsh. All the development schemes of the Govt. starting from 'Clean India' to 'Digital India' to 'Start -up India' depend on good quality S and T manpower. In this task IITs, NITs and private Technical Institutions with a history of quality form a key role.

The IITs

There is a feeling that the country has too many IITs. A close look will reveal that there is nothing wrong with having many IITs, NITs and private institutions of quality for a country of 1.3 billion people. The state of California for example with a population of close to 40 million has 10 public universities in the UC system and in addition has private ones like Stanford, Cal Tech and USC. Each has its own reputation in certain niche areas of S and T. Hence India, which is still in a stage of development in many areas, there is need for many good quality Technical Institutions. Thus having about 75 quality institutions consisting of IITs, NITs and the reputable technical Institutions in the private sector turning around 100,000 undergraduates per year is a reasonable goal. This implies phasing out of poor quality engineering colleges in an orderly manner, a task that the HRD ministry and AICTE must take seriously.

We also need a different metric to judge the quality of our Institutions. The original five IITs, IIT s at Roorkee and BHU along with IISc, are well past the developmental stage and in the opinion of many, they should be producing world-class research and fundamental breakthroughs in S and T. They should aim to get into the top 100 Universities in the world. This is part of the debate that is going on now and a very healthy discussion is needed. The total number of PhDs produced in 2014 was close to 1000 with IITKGP and IITB producing about 250 each and the remaining coming mostly from the other IITs. The newer IITs are also coming up to speed. The total faculty strength in the five original IITs is over 2000. Hence the turn out of PhDs is thus quite comparable to research oriented US universities where the annual output of PhD's is roughly half of the Faculty strength. Hence within a year or two the country will produce a good number of PhDs. This will translate into some significant impact both nationally as well as internationally. It is heartening to note that the newer IITs have a large number of Faculty trained in older IITs. What is critical is that these PhD's be broadly trained in terms of course work in addition to the Thesis part. This is a weakness that needs to be looked at. The newer IITs must ramp up their own PhD programs very quickly. This is necessary to provide a pool of qualified faculty to other IITs as well as NITs and other institutions of good quality. In the long run the objective must be bring the NITs on par with IITs in terms of funding

based on performance and Faculty quality. Looking ahead, about 75 institutions of quality should be the aim.

Controlling the quantity of undergraduates

India produces a large number of graduates in Engineering to the tune of over 1 million per year for a population of 1.3 billion! That this is not matched by job creation is evident. The quality of most of them is not good. In contrast USA produces about 85,000 graduates per year for a population of about 320 million. The number of PhDs produced is about 8,000 with about a third of the students coming from Overseas.

The reform in technical education must start by both central as well as state govts acting together, particularly the latter. Historically the rapid growth of private engineering colleges can be traced to two factors namely the quota system in the Central and State supported Institutions as well as the inability of the IITs to take in more students on merit only. This led to the proliferation of large number of private colleges of dubious quality. Many IITs still regard student to Faculty ratio of 10:1 as important whereas schools such as Berkeley and Univ. of Illinois has it more like 20 plus. Optimum use of faculty and classroom space is critical. Since IITs admit students only in once a year, labs are not utilized in the mornings and lecture halls not occupied in the afternoons. For example IITs can easily admit students at the UG level in both semesters, a practice prevalent in all US universities. The same JEE results can be used for this purpose. Students at UG level need to share rooms all through their stay, a practice prevalent in Chinese universities. If access to these institutions is made easier, private institutions of dubious quality will close down.

Post graduate structure

About the large number of undergraduate students, one could draw a parallel between this and the 3-year liberal arts, science and commerce graduates that India produces. In the sciences many go for the 2-year post-graduate work .One possible hope is that the same thing will happen in engineering too. It is here that the IITs, IISc, NITs and the well run private universities (referred to as Tier I schools)) can play a key role. It is assumed that there will be about 50 tier I schools for discussion purposes. Hence the intake for PG studies must be increased sharply. The Master's program should be of one-year duration consisting of course work plus a small project leading to a M.S degree. Perhaps the two-year M.Tech program may be phased out. This will encourage more students to go for PhD. This is critical for India in future. India has a respectable record in Science Research over the years and it should be the goal to achieve an annual output of about 2000 PhDs in engineering through the Tier I schools in about 5 years. The Govt. must ensure that all Tier I schools must have a teaching staff with a PhD who are available from abroad and the other IITs

Course structure and Faculty teaching loads

A major weakness in the Indian PhD training is the lack of adequate course work. This is reflected in later years when they start doing teaching and research as a Faculty member or even in Industry. Minimum number of 6 courses beyond the proposed one-year of M.S degree is necessary with a good breadth outside the area of specialization, perhaps 2 courses. These courses must be at the graduate level from the sciences and Math depts.

PhD Thesis Evaluation

This is perhaps one area where the postgraduate education has failed in the IIT system and perhaps the country as a whole. Soon after a student finishes his thesis there is an elaborate process of sending it outside the country as well as inside the country. This basically prolongs the student's stay as well as the suspense attached. Anywhere from 6-9 months are wasted and a student does not know what to do. As a first step it is necessary to modify the practice of sending the thesis abroad. By sending a soft copy to examiners within the country and abroad the process can be shortened to a month. A student will be able to look for a faculty position even before he formally gets the degree. If he gets

the degree within a month or two of the Thesis submission, he can join a new institution quickly. It is hoped that he will publish a paper or two before he submits his thesis. The hiring practice must also a change. The IITs must accept applications all through the year. In this way the so-called faculty shortage issue will be solved. It is true in some ways that this resembles the US system. India has adapted to other features of the US system well.

Industry involvement

Except for hiring good Undergraduates, Industry has shown little interest in hiring PhDs. This is one of the reasons students do not go for PG work. There is need for discussion on how to change this situation. The answers are not clear at the moment. The public sector undertakings used to hire PhDs in the 70s. The current picture is not clear since there is too much of reliance on FDI.

Faculty teaching loads

The current practice of faculty handling the tutorials must be replaced by letting the senior PhD students handle them. Same thing goes for the labs except for some light supervision. By bringing down the teaching load, the Faculty in an IIT can devote more time for research. An average of 3 courses per year is enough provided that the faculty member has a sponsored project. Otherwise 4 courses should be the norm.

Conclusions

India can excel in engineering education by adopting many of the features of the US system. A new set of ideas mostly structural has been presented in this article. There is need for quick implementation if the country wants to achieve the goals of a vibrant S and T country.