A STRATEGIC ROAD-MAP TO DEVELOPMENTS IN ENGINEERING EDUCATION IN INDIA

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Abstract *— This paper discusses the current developments in Engineering education in India and also about the newly formed Indo-US e-Learning project wherein lectures given by top visiting U.S Professors are broadcast via an Indian Space Research Organization satellite, EDUSAT, to Engineering Colleges across India. Problems faced due to mushrooming of Engineering Colleges and the efforts of leading educationists to evolve a strategic map for development are also discussed.*

Index Terms*— EDUSAT, e-Learning, Engineering, Innovation*

INTRODUCTION

Engineering education in India has a long tradition, which goes back to 1847, the year in which the Thomason College of Civil Engineering, later to become the Roorkee University, the first Engineering University in the country, was established. The All India Council for Technical Education (AICTE) was established as an apex organization for proper planning and coordinated development of technical education system throughout India. This organization monitors the qualitative growth of technical education in relation to planned quantitative growth and proper maintenance of norms and standards. The National Board of Accreditation (NBA) of AICTE aims to bring standards of some of the programmes offered in technical institutions on par with programmes offered in institutions in USA and Europe by introducing a quality auditing system and establishing a datum for measuring the quality and excellence in Engineering education. The Indian Society for Technical Education (ISTE) is another national, professional, non-profit making society which is a strategic partner of AICTE to assist and contribute in the production and development of top quality professional Engineers and technicians needed by the industries and other organizations.

The pivotal role of education as an instrument of social change by altering the human perspective and transforming the traditional mindset of society is well recognized. The universalisation of education has become the top priority, especially for the developing countries. In India, the shrinking demand for courses not related to Information Technology (IT), non-availability of faculty in IT related branches, poor infrastructure and mushrooming of Institutions have led to crisis in the technical education field [1]. The paper discusses some the far-sighted measures that have been recently adopted to ensure quality and standards in Engineering education.

The extension of quality Technical education to remote and rural regions becomes a Herculean task for a large country like India with multi-lingual and multi-cultural population separated by vast geographical distances and in many instances, inaccessible terrain. In order to meet the multifarious challenge, Indian Space Research Organization (ISRO) has launched a satellite - "EDUSAT" - entirely dedicated to education. EDUSAT supplements curriculum based teaching, provides effective teacher training, greater community participation, strengthens education efforts and provides access to new technologies through a well - thought out ground segment established in Schools, Colleges and other institutions. Satellites can establish the connectivity between urban educational institutions with adequate infrastructure imparting quality education and the large number of rural and semi-urban educational institutions that lack the necessary infrastructure. Thus, in spite of limited trained and skilled teachers, the aspirations of the growing student population can be met through the concept of tele-education. The second section of the paper deals with the efforts to enhance Engineering education in India utilising EDUSAT, through an Inter-University Network under Indo-U.S collaboration. This project aims to build an education system in advanced technology areas for the growth and development of India, taking advantage of the tremendous synergy between the United States and India.

INDIAN TECHNICAL EDUCATION SCENARIO

As the world's largest democracy, India will play a huge role in higher education in this century. In India, technical education is imparted at three different levels:

1. Industrial Training Institutes (ITI), which conduct trade-courses for skilled workers.
2. Polytechnic Institutes, which conduct diplomas to produce middle level technicians.
3. Engineering Colleges, which conduct undergraduate and postgraduate degree, courses in Engineering and Technology.

There are Engineering Institutes and Colleges that are supported by the state and central governments, and also a large number of private Engineering Colleges that provide technical education in India. The number of private institutions, mostly self-financing, is increasing rapidly. A comprehensive account of the student intake and proliferation of Engineering Colleges provided in ISTE handbook [2] and AICTE reports [3] clearly shows a phenomenal growth in the number of Institutions, especially during the last decade. Since more than 60% of these Colleges are concentrated in 4 southern states, (Tamil Nadu, Karnataka, Andhra Pradesh and Maharashtra) this was a lop-sided expansion. In the small southern most state of Kerala alone the increase was from about a dozen to more than seven dozen Engineering Colleges, in a short span of three years. As a result of this proliferation, the country experienced an acute shortage of senior faculty , lack of critical mass of students, (in several institutions) needed for sustainable growth and market access to Engineering education sector, leading to corporate control of curriculum content and economic utililitarianism in the choice of courses and subjects. Table I gives the data on the number of Engineering Colleges in India and their intake, for the past three years.

YEAR	NO: OF ENGINEERING COLLEGES	STUDENT INTAKE
2004	1346	4,39.689
2004-05	1478	5,04,432
2005-06	1310	4,61,125

TABLE I
DATA REGARDING ENGINEERING COLLEGES AND INTAKE

Many educationists have tried to evolve a strategic map for the development of technical education in India, but several factors acted as deterrents. Firstly, in most states, technical institutions are affiliated to the general Universities[4], the structure of which is, as depicted in figure 1. This University affiliating system, which is unique to the Indian sub-continent, does not provide colleges with academic autonomy. The University has to do many administrative activities related to admissions, academics, recruitment, finance and accounts and examinations. At present, all these activities involve lengthy bureaucratic procedures. This contributes to inefficiency and non-reliability to the system. Protracted examinations and large number of scheduled and unscheduled holidays lead to course lagging. Moreover, teaching jobs at entry level are mostly filled up by mediocre graduates, since the bright and the best are grabbed by IT multinationals at lucrative salaries. However, many far-sighted managements and institutions have taken proactive measures as listed below, to ensure quality and standards in Engineering education.

1. Systematic Institutional development starting with Vision and Mission statements, SWOT analysis, long-term and short-term plans etc.
2. Establishing Incubators, Research Parks, Intellectual Property Rights Bureaus and Technology Transfer Centres.
3. Promoting collaborative learning.
4. Trying to introduce web tools in teaching and research.
5. Ensuring guidance and counselling to students as well as stress inoculation to teachers and students.
6. Training and re-training as well as updating subject knowledge of faculty with a motto “Training is Survival”.

In addition to the above steps, since new types of education providers, delivery modes and cross border education initiatives have resulted from changing technology, alternate implementation schemes are also to be considered. In this era of information technology, there is a need to bring in innovative approaches which can complement traditional learning methodologies. e-Learning is one such technique for continuous training and its growth is expected to expand more and more in the coming years[5]. Furthermore, e-Learning enhances self-motivation and independence hence generating active learners

who have acquired the habit to continuously seek new knowledge on their own. The Indian EDUSAT programme has been started as an e-learning facility, with the objective to provide a sustainable distance education service in India using advanced space technology and ground technology of convergence.

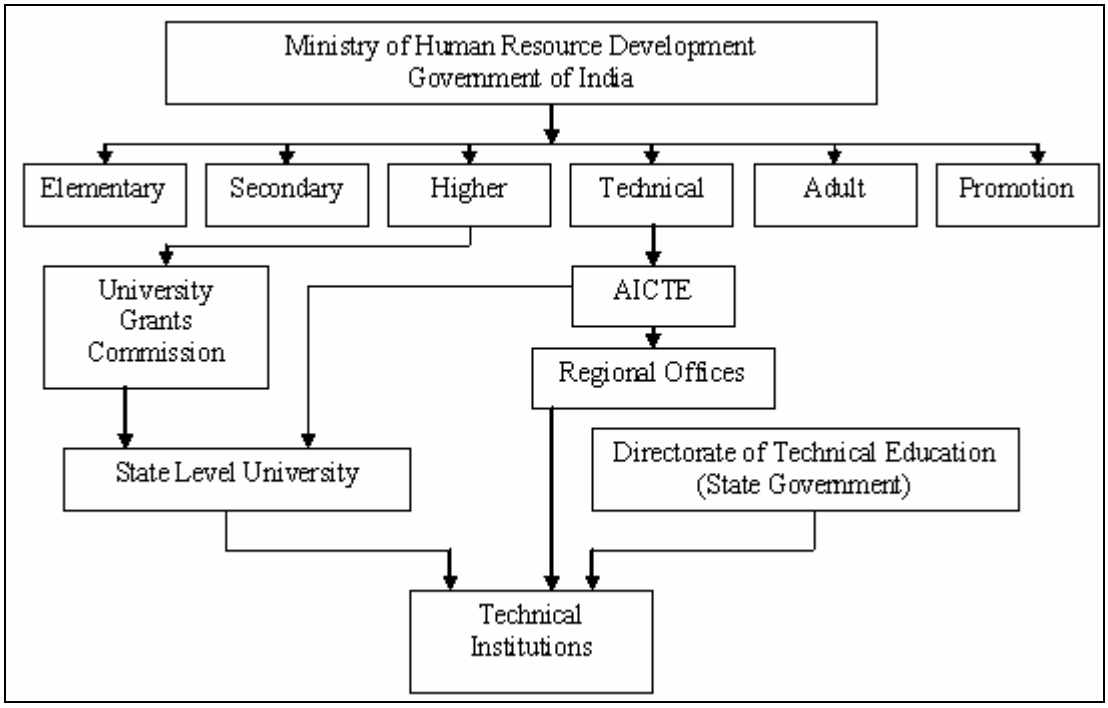

FIGURE 1
STRUCTURE OF TECHNICAL EDUCATION IN INDIA

E-LEARNING THROUGH EDUSAT PROGRAMME

India has an array of achievements in the scientific and technological fields after independence. Nowhere is this more apparent than in the arena of Space Technology. India has effectively applied it for its rapid developments and is presently offering a variety of space services globally. The Space Technology has allowed the nation to move into the world of high technology, a place previously occupied only by more developed nations. The Indian space efforts started in the sixties with the establishment of Thumba Equatorial Rocket Launching Station near Thiruvananthapuram for the scientific investigation of the ionosphere over the Earth's magnetic equator that passes over Thumba. During the formative decade of 1960's space research was conducted by India mainly with the help of sounding rockets. The Indian Space Research Organisation (ISRO) was formed in 1969. Space research activities were provided an additional fillip with the formation of the Space Commission and the Department of Space by the Government in 1972. In the 70's satellite programmes like Aryabhatta, Bhaskara, Rohini and APPLE were conducted. India has come a long way in developing a multi faceted and multi-dimensional space programme-which is indigenous, self-reliant and applications driven. The Indian space programme has the primary objective of developing space technology and application programmes to meet the developmental needs of the country. Towards meeting this objective, two major operational space systems have been established — the Indian National Satellite (INSAT) for telecommunication, television broadcasting and meteorological services and the Indian Remote Sensing Satellite (IRS) for resources monitoring and management. Two satellite launch vehicles, the Polar Satellite Launch Vehicle (PSLV) for launching remote sensing satellites into the required polar orbits and the Geosynchronous Satellite Launch Vehicle (GSLV) for launching communication and meteorological satellites have been operationalised.

The concept of beaming educational programmes through satellites was effectively demonstrated for the first time in India in 1975-76 through the Satellite Instructional Television Experiment (SITE) conducted using the American Application Technology Satellite (ATS-6). During this unique experiment, which is hailed as the largest sociological experiment conducted anywhere in the world, programmes pertaining to health, hygiene and family planning were telecast directly to about 2400 Indian villages spread over six states. Later, with the commissioning of INSAT system in 1983, a variety of educational programmes are being telecast. With the success of the INSAT based educational services, a need was felt to

launch a satellite dedicated for educational service and ISRO conceived the EDUSAT Project in 2002. EDUSAT was launched on board ISRO's Geosynchronous Satellite Launch Vehicle (GSLV) in September 20, 2004. EDUSAT is the first exclusive satellite for serving the educational sector. It is specially configured to meet the growing demand for an interactive satellite based distance education system for the country through audio-visual medium, employing Direct To Home (DTH) quality broadcast. Equipped with 12 transponders, each with a massive bandwidth of approximately 36 megahertz, EDUSAT beams lectures to 10,000 classrooms in technical universities and primary schools across the country. The cost of the satellite and launch vehicle is INR 450 crore. However, adding the cost of content development, the ground segment infrastructure, salaries etc., the project is estimated "conservatively," according to unofficial figures, to have cost between INR 800 crore and INR 900 crore.

A memorandum of understanding for INDO-US Inter-University Collaborative Initiative in Higher Education and Research was signed on July 20, 2005, as per which, six US Universities viz UC Berkeley and UC San Diego, Carnegie Mellon University, Cornell University, the State University of New York at Buffalo, and Case Western Reserve University, deputed eminent faculties to teach full fledged engineering subjects to Engineering Colleges all over India via an e-learning setup and ISRO's EDUSAT [6]. Three international corporations - Microsoft, Qualcomm, and Cadence Design Systems - are also involved in the collaboration. These companies fund the US participation in the programme and pay the salaries and travel expenses of American professors. Initially, around 20 selected Engineering Colleges are participating in the programme. Classes taught by participating faculty are delivered to these colleges throughout India over EDUSAT. This programme supplements curriculum based teaching, provides effective teacher training, greater community participation, strengthens education efforts and provides access to new technologies An e-Learning classroom has been set up in all participating colleges with V-SAT, computer, and projector equipments. The programme will expose U.S. faculty to potential research partnerships in India, and would also promote more Indian students to gain admission into U.S. Engineering schools. These satellite courses also aim to create more top-level Engineers, potentially for Ph.D. programs and businesses in India as well as in the U.S. Three U.S. research centers are partners to the agreement. They are University of California's Center for Information Technology Research in the Interest of Society (CITRIS); the California Institute for Telecommunications and Information Technology (Calit2); and Carnegie Mellon's CyLab. Thus this project is an ambitious e-Learning collaboration to enhance science and Engineering education at Indian Universities and to boost the supply of world-class engineers available for corporate and academic research in both countries.

For over thirty years, a large number of Indians have been teaching in American Universities. An estimated ten thousand academics of Indian origin are teaching at these institutions. There is thus a great deal of synergy and familiarity in the system of higher education between India and US. The networking of universities and institutions through EDUSAT is only the first step towards creating a more effective method to enhance higher education and research in India through a satellite e-Learning network. In fact, during the year 2006, four full fledged courses, five short term courses and numerous lectures were beamed through this programme.

EFFECT OF E-LEARNING ON ENGINEERING EDUCATION

With the sudden proliferation of Engineering Colleges in the country and also with the sudden spurt of employment opportunities in the IT field, those students who would have earlier opted for Law and Commerce are now seeking Engineering careers. Moreover, because of the early job recruitment in pre-final and final year classes, most of the students have two or three job offers, drawing double to triple the salary of their teachers. Hence in a country like India, the taxonomy of new generation students in Engineering Colleges vastly differs from the earlier findings of education experts. Besides, the pernicious University affiliating system denies many advantages enjoyed by autonomous Institutions. The vacuum at the middle level of teaching faculty is also a major issue. Since e-learning can raise the level of education, literacy and economic development, some of these problems can be overcome through this. This is especially true for countries like India, where technical education is expensive and economic disparities exist. However, one of the problems with e-learning in India is the lack of course content, especially outside the mainstream focus areas of IT education, English-language content, and tutorial-like courses. Expectations were naturally pitched high, when EDUSAT was launched, since possibilities for education suddenly seemed infinite. Space technology could now be harnessed to "reach the unreached" and to "bridge the divide" between rural and urban schools and colleges, in India. Virtual classrooms could solve the problem of the low teacher-student ratio as well. But, in an evaluation of the pilot phase of EDUSAT project, conducted by The National Institute of Advanced Studies (NIAS), the percentage use of the e-learning facilities was found to be low, partly because of a top down approach, which did not adequately involve teachers. However, the INDO-US collaborative project, which is mainly addressed in this paper, have on the other hand, been a renewal programme of long standing scientific cooperation between the teachers of the two countries and it is meant to be a win-win situation for both the countries. It has enabled thousands of students who are unable to pursue Engineering studies in United States, to have access to American Professors, while studying in Colleges in

India. It is an innovative concept of an e- learning system which has been established in an attempt to achieve a technology that provides Engineering students with an instructive and affordable framework for learning Engineering-related courses.

Although e-learning has potential in India, adoption has been slow and will need a major awareness building effort, as the demand for education would go up substantially in the next five years. This necessitates alternative modes of delivering Technical education. A hybrid education system in which equal emphasis is paid to the conventional `face-to-face' format and the facets of e-learning using the tools of technology will be the future trend in India.

CONCLUSION

Technical education determines the development and socio-economic condition of a nation. High quality faculty, infrastructural facility, National and International high bandwidth connectivity, and availability of knowledge sources are essential for realizing excellence in education. In addition to this, a good learning environment, collaborative environment, exposure to the International best practices and constant promotion of innovation and creativity are also needed. The higher the research intensity in a University environment better will be the teaching quality. Though the collaborative initiative like the Indo-US networking programme is innovative in nature and offer tremendous advantages and benefits to students, it is quite early to assess the impact of this. However, the country is agog with the excitement of competitive experimentation among the leading Engineering colleges, to exploit the potential of this newly formed "Virtual University".

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