

## 10. TRANSFORMING ENGINEERING EDUCATION GLOBALLY – THE IUCEE WAY

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### *Abstract*

*During the past four years, a unique program, Indo US Collaboration for Engineering Education (IUCEE) has started to make a significant impact on the quality of engineering education in India. More than 100 US engineering faculty are participating in this effort, which is already showing results in over 100 colleges all over India. This paper summarizes these accomplishments. The 124 Faculty Leadership Institutes which have been conducted, have directly impacted more than 3000 Indian faculty and lakhs of students in their classrooms. After initial financial support from donors and in-kind support from industry, IUCEE is now on its way to becoming financially sustainable with the assistance of a consortium of 45 college, all over India. The recent creation of the IUCEE Virtual Academy for delivering Webinar lectures by world class US faculty, directly to classrooms in India, has opened up the possibility of scaling up the program to make an enormous impact on engineering education in India while creating opportunities for unique teaching and research collaborations between Indian and US institutions. This paper analyzes the lessons learnt from the work done so far. Other countries are now showing interest in emulating the IUCEE model.*

### **The Need:**

The world needs good quality engineering talent in order to find solutions to the global challenges facing humanity, such as energy, environment, health and communications. A partnership between the world's largest democracy (India) and the world's most advanced democracy (US) has amazing potential in this regard. India has an enormous amount of raw talent to address these needs.

However, the rapid expansion of engineering educational institutions in India in recent years has created serious problems of maintaining quality engineering education and research to sustain and fuel economic growth in India itself.

In 2011, there were 3241 engineering colleges in India, of which only 1511 are eligible for accreditation i.e. more than 5 years old (from "International Accreditation Perspectives", MacMillan Advanced Research series; Ed. R. Natarajan, 2012). This massive expansion of institutions has resulted in an acute shortage of faculty (estimated in 2008 to be over 30,000 Ph.D. and 24,000 Masters Degree faculty). In some of the important disciplines such as Computer Science and related areas, availability of faculty is dismal. The institutions are not able to attract and retain good faculty due to archaic recruitment and promotion procedures, absence of incentives for quality performance, and non-existent faculty development policies in most

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institutions. Shortage of training opportunities and attention to overall growth of faculty, is adversely affecting impartation of quality knowledge and skills to students; thereby, lowering their employability (estimated at 25% in 2009). The faculty also lacks communication and pedagogical skills. Background information taken from "Project Implementation Plan" TEQIP Phase II, MHRD, GOI, 2009.

In order to address this need, the Indo US Collaboration for Engineering Education (IUCEE) was conceptualized by over 150 leaders of engineering education and businesses from US and India in 2007. It was founded by University of Massachusetts Lowell (UML) with the help of the American Society for Engineering Education (ASEE), Pan IIT (organization of IIT alumni), International Federation for Engineering Education Societies (IFEES) and Indian Society for Technical Education (ISTE).

#### **Our Vision:**

The vision is to improve the quality and global relevance of engineering research and education in India by imbibing of global best practices from the US, with help of best faculty members.

#### **Our Approach:**

We have emphasized four pillars for the quality of engineering education: learning, research, accreditation and entrepreneurship. Initial emphasis is on building capacity to improve the teaching quality of faculty in the large number of engineering colleges by introducing state-of-the-art concepts of problem based and outcomes based approaches to teaching and learning. This is being implemented with the leadership of experienced Indian faculty in collaboration with US faculty experts. Simultaneously, the culture of research and innovation among these colleges is being enhanced via the resulting networks and collaborations between the US and Indian institutions, thereby increasing the capacity of the Indian institutions to engage in world-class research and generate innovative solutions for

addressing crucial problems facing India and world. The corporate and government institutions are playing a key role in this partnering process in order to ensure relevance to societal needs.

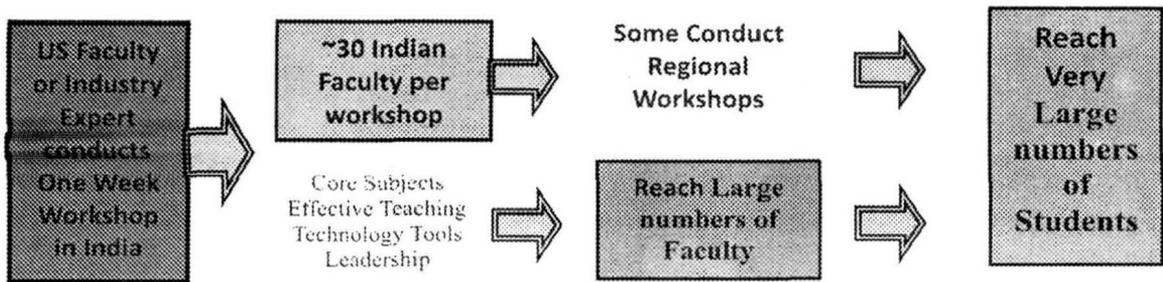
This process is under way during the past four years. During the first two years (2008 and 2009), IUCEE received significant **financial support from philanthropic families** (Deshpande's, Narayana Murthy's and Malhotra's) and in-kind support from the corporate sector (Infosys Technologies). 2010 onwards progress has been made towards partial financial sustainability with the support of colleges in India.

#### **Our Results in Past Four Years:**

##### ***Faculty Leadership Institutes (FLI) initiated in 2008***

Each year, international experts from the US travel to India to discuss global best practices in teaching and research in their field with Indian faculty leaders from public & private colleges in one-week workshops at Faculty Leadership Institutes (FLI). Selected Indian faculty leaders then conduct regional workshops on these topics for faculty in second and third tier colleges in their subjects all over India. Since 2008, 92 US professors and 24 industry experts gave 124 one-week workshops to ~3,065 Indian engineering faculty at Faculty Leadership Institutes (FLIs). Networks for collaborations created between faculty from over 100 Indian colleges and 30 US colleges and more than 200 US faculty members from over 50 US institutions are participating. The large pool of engineering educators and entrepreneurs of Indian origin in the US, has enabled the momentum to be built and sustained.

During the 2008 and 2009, Infosys Technologies in Mysore hosted over 36 professors from US and 10 industry experts who gave 46 workshops to about 1,165 faculty members, at their Global Education Center. Indian faculty participants have followed up by conducting more than 200 regional workshops,



directly impacting more than 6,000 other faculty and 100,000 students. Videotapes and course materials from US experts were used as resources. During 2010, IUCEE built on the success of the first two years by conducting 37 workshops in a regional and semi-sustainable format. An IUCEE Consortium of 22 Colleges hosted 37 workshops by 28 US experts and 5 industry experts for over 1000 Indian faculty at 25 locations all over India. Host colleges provided for 50% of the costs of conducting the workshops at their locations. Some amazing results of radical curriculum revisions resulting from teams of participants at the 2008, 2009 and 2010 FLIs have been documented. During 2011, 37 colleges from all over India have become members of the 2011 IUCEE College Consortium and 42 workshops have been conducted all over India with the Consortium colleges paying all the direct costs of the US experts. Details of the FLIs conducted from 2008 to 2011 are given in tables at end of this paper.

Year	FLIs	Direct Faculty	Faculty Reached	Students reached
2008	23	600	~ 2,000	~ 200,000
2009	23	600	~ 2,000	~ 200,000
2010	37	1,000	~ 3,000	~ 300,000
2011	42	1,000	~ 3,000	~ 300,000

Significant positive outcomes have been demonstrated with over 100 colleges all over India. Dramatic improvements in student motivation and academic achievements, as well as faculty engagement, have been documented. Partnerships have been built with

various agencies which are already engaged in similar efforts, such as NPTEL program of IITs and the TEQIP program of MHRD. As a result of strengthening the first pillar of capacity building by improving teaching quality, networks have been created between Indian and US faculty and institutions which are already resulting in research collaborations. The second pillar of research excellence has been launched in the form of an IUCEE Co-Guide program this year. Resulting research collaborations, enabled by faculty exchanges and distance education technologies, will allow large scale PhD production and research productivity. Simultaneously, IUCEE is beginning to address the other two pillars for improving the quality and global relevance of engineering education, by assisting with the implementation of a globally acceptable accreditation system for engineering education as well as a model innovation and entrepreneurship adapted to the societal needs of Indian and the global economy.

#### Web Portal Launched in 2009

The IUCEE web-portal at <http://iucee.org>, launched in 2009, makes available all the workshops, courses and webinars offered by US faculty. It also provides a forum for interactions and collaborations among the US and Indian engineering education community. Below is a sample of the page on the portal along with the page corresponding to one of the FLIs conducted by Dr. Sartaj Sahni of University of Florida on Data Structures.

The screenshot shows the IUCEE website interface. On the left, a sidebar titled "Program categories" lists:
 

- IUCEE College Consortium
  - Consortium Membership
  - 2010 Consortium Colleges
  - 2011 Consortium Colleges
  - 2012 Priorities of Consortium Colleges
- Faculty Leadership Institutes (FLI)
  - 2008 FLI
  - 2009 FLI
  - 2010 FLI
  - 2011 FLIs
  - Potential 2012 FLIs
  - Confirmed 2012 FLIs

 The main content area features a "List of Introductory Lectures" for the "IUCEE Virtual Academy Learning from the Web". Below this is a section for "Unsolicited testimonials from active participants of IUCEE". To the right, there is a video player showing a group of people in a classroom setting, with a title "Data Structures" and "Baris Erol, University of Florida". Below the video are search and navigation options.

### IUCEE College Consortium Created in 2010

During 2011 and 2012, a consortium of colleges was formed to help IUCEE become financially sustainable. Annual Fees for membership partly help defray overhead expenses of IUCEE. Consortium colleges receive special access to IUCEE programs and US experts.

### On-Line Webinar Series launched in 2011

The search for a lower cost, easily scaleable approach, for interactions between US faculty and Indian faculty led to the use of Go To Meeting Technology. This has been found easy to use, easy to learn and easy to access in remote colleges all over India. As a result, 84 FREE one-hour webinars on teaching and research topics have already been conducted on line by US faculty during 2011 and 2012. Each of these webinars has been attended by an average of 31 faculty and students. An estimated number of more than 10,000 Indian faculty and students have attended these Webinars. A very useful aspect of this technology is the recording feature. IUCEE has converted all the Webinar recording to a UTube format which is very convenient to use and made them available on the Portal.

### Virtual Academy (VA) Piloted in 2012

The success of the individual webinars led to the concept of the IUCEE Virtual Academy. Global faculty experts deliver Mini-Courses of 10 Lectures each, directly to students in classrooms in India. The content is based on Indian curriculum and in consultation with Host colleges. These are delivered LIVE using the on-line Webinar approach and interactivity is facilitated by texting questions during live presentation and later by email questions from students to email account for courses.

Webinars have all been recorded and these are all made available on IUCEE portal. A test is given to the students after the 10 lectures and IUCEE certificates are provided to students after satisfactory completion. This has been an outstanding success in March 2012. The critical aspect of this Virtual Academy is that the MiniCourses can be conducted simultaneously for students and faculty in multiple colleges. This allows scale and results in a more affordable cost of delivery to each college.

### 2012 and Beyond:

Although the work of IUCEE has only recently begun, the real results of the efforts on the ground and the enormous momentum it has generated, make us believe that dramatic results

can be achieved in a reasonable time period. The Faculty Leadership Institutes, the Webinars and the MiniCourses have been demonstrated successfully and can now be scaled to much larger numbers. The response from US, as well as Indian, faculty and institutions to the IUCEE programs, has been overwhelming. IUCEE is seeking Government of India assistance in order to sustain the program and scale it up in order to reach the very large numbers of engineering colleges throughout India. Private support is also being sought in order to make this a truly PPP (Public Private Partnership) model. Within the next five years, the goal is to bring about significant transformations in over 500 institutions all over India, thereby making a difference to the quality and standards of their engineering education. The IUCEE collaboration is expected to raise the standards of engineering education all over India and enable it to get full membership of the Washington Accord.

The success of IUCEE has become visible to engineering education organizations from

other countries around the world, who are members of IFEES (International Federation of Engineering Education Societies). Similar approaches to improving quality of engineering education are being considered by Kazakhstan. Countries in East Africa, as well as Latin America, are exploring possibilities of adapting IUCEE programs.

### **Acknowledgements**

The success of IUCEE is primarily due to the guidance and personal financial support from Jaishree & Desh Deshpande, Sudha & Narayana Murthy, Kiran & Arjun Malhotra and corporate support from Infosys Technologies. Thanks are due to the leadership team of IFEES (International Federation of Engineering Education Societies) which has provided constant encouragement and support.

## Feed back:

**Note:- Feed back from one of the beneficiary  
Engineering Colleges, in India,**

### **Dramatic Results of RIT's association with IUCEE**

Last three years of association with IUCEE brought about major changes in the teaching-learning process at Rajarambapu Institute of Technology. About 50 faculty from the institute have attended the FLI (Faculty Leadership Institute) Programmes and senior faculty members in turn organized the programmes at the institute to benefit the in house faculty along with faculty from neighbouring institutes.

Association with IUCEE as a consortium member has given the opportunity to Webinars from US experts, International exposure & also US faculty organizing workshops at RIT. RIT is in the process of implementing the outcome base teaching- learning, experiential learning and project based learning. Our one student could attend Global Student Forum at Singapore in 2010 because of the help and partial sponsorship from IUCEE and could become a part of global networking of the students. We organized one FLI on "Mechatronics and Product Design" during July 12 to 16, 2010. Dr. Devdas Shetty of University of Hartford was the resource person. Forty participants from various parts of the country got benefited and faculty availed the opportunity to interact with such an eminent personality.

Free webinars organized by IUCEE are excellent in all respect and the fringe benefit to students, faculties, HOD's and Deans. Our second year electrical students are such captivated with the Virtual Academy Course that they are demanding this methodology of teaching for all courses.

In a nutshell, with the association of IUCEE RIT is able to bring about noticeable improvement in students learning and strongly believe in the Mantra of IUCEE. ***We are teaching, Are they learning, prove it and improve it.***

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