

SEPTEMBER 2017

VIEWPOINT

OFFICIAL QUARTERLY MAGAZINE OF CEAI

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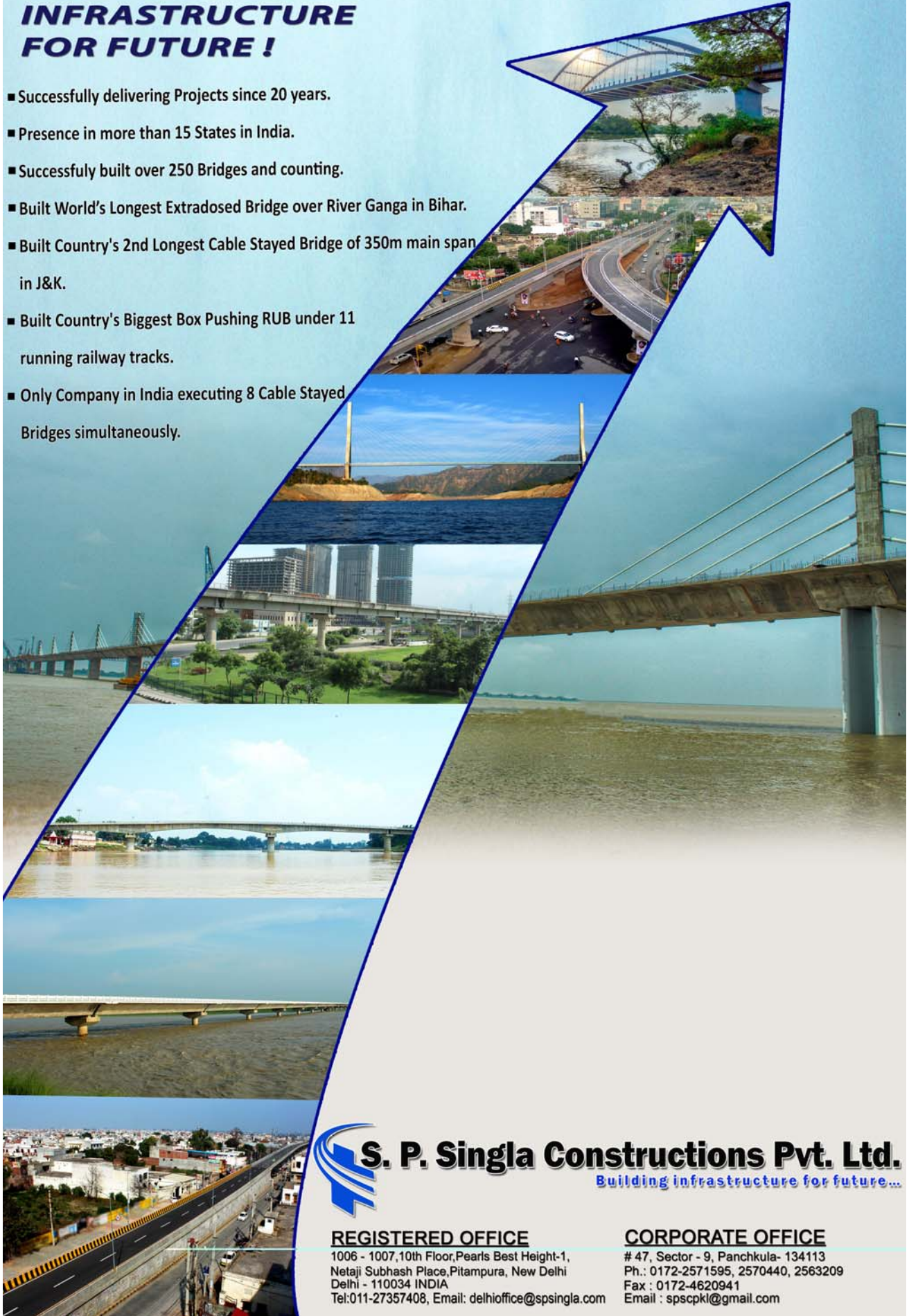


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MESSAGE FROM CHIEF EDITOR

Dear Fellow Consulting Engineers,

The country has had a good monsoon which is ambrosia for the agrarian economy. The flip side of it were the storms and consequent inundation - a setback to development, growth and the overall economy of the country.

Some of the questions that can arise on account of the latter are:

Can we not control and obviate or reduce the impact of the storms and the consequent floods?

Cannot the rivers be trained or interconnected to utilize the precious rain water rather than let the banks overflow and the greater part become unusable or drain into the sea?

Is not the flooding in urban areas like Mumbai, Bangaluru, etc. a known phenomenon or predictable since most of it is man-made and hence measures be taken to prevent it?

Does not the country have persons capable of providing feasible and sustainable solutions?

There can be many more such questions.

However, let's look at them from an overall perspective. Which professions can provide the solutions? It's the engineers and the scientists. India has capable and experienced engineers and the scientists who can provide feasible solutions. However, those solutions need to be implemented in toto and not piece meal or half heartedly. Since many of the solutions would require a long term commitment it is essential that the stream of capable and experienced engineers is always available to the country. That in itself is a tall requirement. To fulfill that the country must ensure that the engineers and scientist that it develops by its education systems and research are capable of taking over the reins and continue to deliver albeit with the objective support of the governmental departments, the authorities and agencies entrusted with the execution.

Let's see how the education system has transformed over the past 5-6 decades. The difference is apparent and is startling. Although one also had to memorise a lot then but there was an equal emphasis on application of the mind. Physical education also received due attention. There were no guide books with readymade answers or tuition classes to attend. The evenings were free to learn from play and later do the homework. The science and engineering courses were also different, with emphasis on understanding the how and why of it together with the technology involved and not merely its application as engineering. It's that grounding together with the rational logical thinking algorithm that was instilled in one which made one capable and confident of taking up a challenge and successfully solve matters that came up from time to time.

It is best to recall that half a century ago there were no personal computers, not even calculators, just slide rules and prior to that log tables. The history of technology bears evidence to the fact that inspite of lengthy hand calculations, great technological advances took place and engineering marvels built. The scientists, technologists and

engineers had to first conceptualise clearly what they intended to produce and then go about it systematically - step by step. It was that degree of involvement that gave them confidence and determination to achieve their objectives. Intellectual curiosity and willingness to soil hands were added factors.

To cite a case a person was once called upon to design a suspension bridge and he was armed only with a slide rule. He was not in a city or town but in a camp and hence had to design the tower and the foundations from first principles. He designed the towers and the foundations but was hard put to size the suspension ropes; then an Engineer from the Engineering Regiment came to his rescue with an Army Manual. What had enabled the person to complete his task were the fundamentals that had been lucidly ingrained in him by his teachers. All this was also because the teachers were clear in their fundamentals and were dedicated to transferring their knowledge.

Where does engineering education stand now in India? Reportedly the employability of most is a big issue. The education system per se comprises the teacher and the taught in a conducive environment equipped to impart that knowledge. Practice makes perfect is an old adage and applies fully to engineering too. The students must undergo training in the field or workshop and learn how to translate their learning into practice. It is in the field or workshop that the trainee gets transformed in to a ready engineer with the ability to think on his/ her feet. All the above are necessary ingredients and unless all are satisfied the result would be far from satisfactory.

Students generally follow the masses or go by what their parents/ elders advise. Very few go by their own calling and opt to do what they have a liking and aptitude for. For those who have the passion, what primarily needs to be done is ensure that the students understand what is being taught, that their knowledge base is wide and that they develop the ability to apply what they learn. Another essential requirement is hands on training in their college/ institute and later in the field or shop floor or the plant, etc. There is then the ability to express clearly verbally and in writing. There other issues too which require to be addressed. Above all the students must at the end of a course be able to visualize and develop an intuitive feel as to whether what they are doing is right or needs tweaking. Computer outputs should be relied on only if the software has been validated for that particular algorithm.

The above subsumes that the faculty be well qualified and of high quality, continuously engaged in updating their own knowledge preferably through research and development plus due interaction with the continuously evolving industry. Dedication to the profession coupled with patience to explain in a simple lucid manner is the hall mark of a good teacher. How many qualify for that is the question?

The environment and facilities provided by the college/ institution is another major factor that determines as to how well the students learn.

As mentioned earlier, practical training in the field or workshop is extremely important to produce "ready engineers" and not mere theoreticians. The latter cannot even identify let alone appreciate practical issues. Mere sitting in an air-conditioned office does not give a person the gut feel and intuition unless the person is fully - mentally and physically involved. It's the hard learning in the field that makes a person a professional in the true sense.

Last but not the least is membership of Professional Associations/ Institutions to remain in touch and network with senior professionals and remain abreast of the developments in the profession.

Engineering is still not a legally recognized profession in India; however, CEAI has been pursuing the same with the Government of India to legislate just as for other professions such as Advocates, Chartered Accountants, Doctors, Architects, et al.

Happy Reading and Learning



A P Mull



MESSAGE FROM EDITOR ENGINEERING EDUCATION IN INDIA

I am very glad that the Consulting Engineers Association of India (CEAI) is bringing out quarterly magazine on 'VIEW POINT'. The special issue of September 2017 focuses on "*Engineering Education in India*" and eminent persons from Industry, Academia and practicing professionals have contributed articles on important topics on Quality Enhancement, Accreditation, Industry-Institution Interaction and Incubation and entrepreneurship and skill required for Industry.

I am sure the special edition brought out by the CEAI is of great help for students and faculty from academic institutions and practicing engineers to fostering Industry-Institution collaboration to logical end also reduce Education-Employment gap among professional students in the country and also skills to meet the Industry needs.

I wish the CEAI all the best in future endeavors and I am very glad to associate as Guest Editor for the September 2017 issue of VIEW POINT on '*Engineering Education in India*'.

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Engineering Education in India - A Perspective

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A surfeit of News and Articles on Indian Engineering Graduates not being employable, or being under-employed, are currently doing the rounds. Considering the average attention (and available time) span these days, I doubt if readers have managed to study and analyze the connected observations. A few articles on general undergrad education – mostly middles on editorial pages of dailies, have stretched their imagination and blamed the British colonial rule for the Macaulayan manipulation of education in India that aimed to produce an army of ever-ready assistants for the government, notwithstanding the fact that we also inherited the technologies of management from the colonizers. Running companies in a structured fashion, leading teams and becoming experts at industrial organization became second nature.

Moreover, we have had seventy years to change our destiny if we so desired.

While this Macaulayan statement may be easy to believe for some of us who forward WhatsApp posts on social media without so much as a ‘by your leave’, I would go a step further and check out the credentials of the source. Most such surveys are conducted by management organizations who themselves may not possess the required technical competence, except perhaps, collation of data converted to statistics, combined with elementary but colourful pi-charts. They ascribe a fairly large weightage for personality, language, elocution, etc. while the actual technical competence parameter is way down the ladder, most probably because their own involvement and competence in core engineering metrics is only peripheral.

Here-in-after, enter, Human Resource Organizations.

While earlier fresh graduate engineers were interviewed for employment by other senior professional engineers in the same industry, but with the private sector being perennially understaffed, this scope is now being increasingly farmed out to HR organizations that may have a skewed comprehension of employable expertise, especially in the technical field of engineering sciences. It is no secret that management skills and wisdom can well be honed from experience, but technical acumen has to be imbibed at an appropriate chronological age.

The basic difference in the approach between a technical interview and an interview by HR is the assessment that **“being a topper is not important, but having a thirst for knowledge and the ability to comprehend, are the real issues”**. In one lifespan, nobody will ever know enough. One will always have to make decisions without being able to see around the bend.

Two recent high profile instances are the delayed discovery of UNSUITABILITY QUOTIENT for CEO’s of some well known business groups. International consultants had been hired to go head hunting all over the world to look for the best. The rest, as we all know, is history.

The results of being uneducated or educated are not guaranteed (refer pic. read uneducated in place of non-educated)

Similarly, the causes & results of being under educated (read: unemployable), educated (read: employable) and highly educated (read: innovative) are debatable, since some people drink from the fountain of knowledge, while others just gargle.

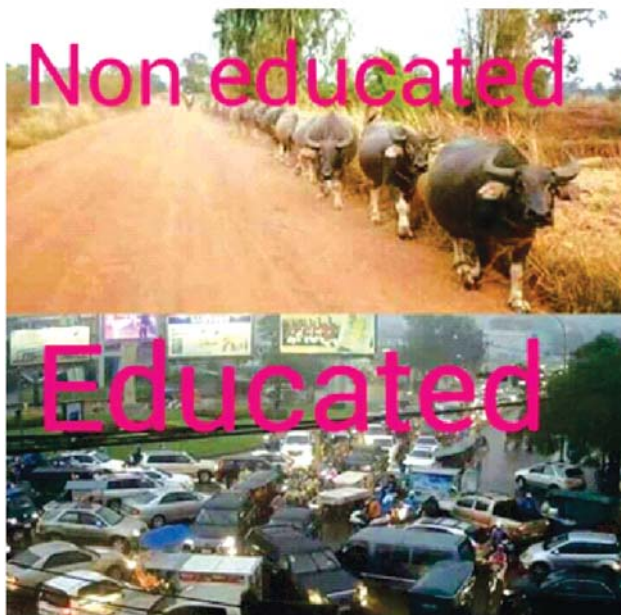
This is perhaps the most plausible ‘Root Cause Analysis’ for such news items.

Regarding Engineering education – I would present a contrarian view. In India we should be grateful that AICTE has had an axiomatic approach and not been meddling with the syllabi every so often. It is well known that the fundamentals of science & engineering, though in a continuous state of discovery, do not undergo a sea change every so often. It is only their applications which may experience rapid changes or progress.

Undergrad courses are designed for students to imbibe established fundamentals and experience some related applications on “How to think, rather than what to think”. Thereafter, when they step out into the professional world, they come across practical developments whereupon they choose their personal interests, requirements or opt for further studies.

AICTE’s recent thought on mandatory internship beyond the four year course, is a welcome step toward seamless integration of graduate engineers to professional working.

Who will u call educated?



Vacant seats at IITs touch a 4-yr high

121 Spots At 23 Elite Institutes Go Unfilled Despite Seven Rounds Of Admission

Times News Network

Mumbai: Vacancies across the IITs have touched a four-year high. A total of 121 spots went unfilled despite seven rounds of admission.

The 23 IITs have a total of 6,962 seats and 121 of them remained vacant after completion of the counselling for admission. The number of vacant seats was 96 last year, 116 in 2015 and three in 2014.

IIT-BHU, Varanasi had the maximum number of empty seats — 32 — followed by IIT-Dhanbad (Indian School of Mines) with 23 vacancies. IIT-Jammu (13) and IIT-Kharagpur (10).

Last year too, the trend was similar with IIT-Varanasi having the highest unfilled seats (36), and IIT-

VACANCIES

Sl. No.	Name of the Institute	Vacant seats*
1	IIT Kharagpur	9
2	IIT Bombay	1
3	IIT Delhi	2
4	IIT Kanpur	6
5	IIT Madras	1
6	IIT Roorkee	4
7	IIT Guwahati	4
8	IITs MAU, Varanasi	32
9	IITs IITs Varanasi	5
10	IIT Hyderabad	6



The 23 IITs have a total of 6,962 seats. The number of vacant seats was 96 last year.

IIT-Kanpur and IIT-Hyderabad. Joining them this year is IIT-Jodhpur which also does not have any unfilled seats. Last year, merely one seat was vacant at IIT-Jodhpur. In 2017, a seat each is vacant at IIT-Bombay, IIT-Madras, IIT-Palakkad, IIT-Ro-

parand IIT-Goa. Until a few years ago, IITs did not conduct a second round of admissions and unfilled seats used to be transferred to the preparatory programme, a bridge course to bring quota students up to the mark. In 2008, TOI had cam-

paigned that IITs conduct multiple rounds of admission to fill up colleges' capacity. It was after this that IITs started conducting second round of admissions, and as a result the number of vacancies fell since 2009.

This year, the last round of counselling was held on July 19. All the IITs completed admissions by July 25. An IIT Council official said the institutes had been asked to discontinue some of the courses that were not attracting students. The IIT Joint Admission Board is likely to meet soon to discuss such courses and take a decision on steps to bring down the number of vacancies. The IITs, especially the new ones, increased their intake by 400 seats this year.

Due to a reduced demand even in premier institutes of engineering and technology (refer news item), there is no denying that we need to cut down on the number of colleges. This obviously provides an opportunity to weed out the non-performing institutes and improve quality in the rest

Perhaps the proposed umbrella of HEERA (Higher Education Empowerment Regularity Authority) will help synergize both the AICTE and UGC powers for the benefit of technical education in India. Towards that end we sincerely hope that the paramount need to

include a level of moral science, social consciousness and spirituality in technical education is also addressed so that science and technology can be used to end poverty and develop sensitivity to the condition of India’s deprived sections. It will also teach engineers the art of holistic and dynamic equilibrium so that they never tend to extremes, and make a meaningful difference in the ecosystem. The benefits of liberalization and infrastructure are yet to percolate to the bottom of the social ladder. Global innovations force-fitted to Indian conditions are unlikely to ameliorate their living conditions. **Only India focused innovations can provide the required succour.**

In the previous two decades, many engineers found employment in the IT sector, but today the situation is that many engineers may be working in a field that probably has no direct connection to what they might have studied in college. Some with a tunnel vision may consider this as a waste of national resources, while others would consider an engineering degree as the new datum of a digital world. Though initially confined to the younger

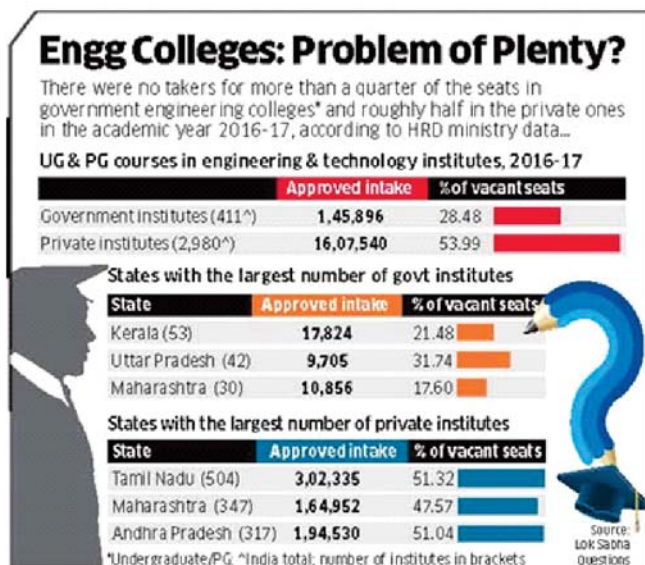
generation, slow but steady penetration of digitization has begun to percolate to the hinterlands. Take, for example, news of Akodara, a tiny village with a population of only 1200 people, situated in the Sabarkantha district of Gujarat around 90 kilometres from the state’s financial capital Ahmedabad in Gujarat, which was completely unaffected by de-monetization in November 2016, simply because nobody in the entire village handles cash !!!

The rapid pace of innovation and related applications has created a piquant situation where the fundamentals are now available bunched within application softwares. As a result the young engineers are increasingly dependent on computers and artificial intelligence (AI). They no longer feel the need to comprehend or ingest the first principles of engineering fundamentals and are guided by the robotics churned out by intangible man-machine synthesis, which may vary with the quality and content of the software applications at their disposal, coupled with their own knowledge content. For an engineer, every blueprint is a step towards progress.

It is these very engineers who have made disruptive innovations as the new normal.

It is a well known fact that Engineering drives economic progress. **While USA produces around 1 lakh Engineers per year for a \$16 Trillion Economy, India produces 15 lakh Engineers for a \$2 Trillion Economy.** Though this may sound to be a great punch line but the reason for this wide chasm in productivity is not far to seek. In the west, professional studies are generally self-financed, and hence draw only the committed who would tend to continue in their chosen field, while in India, the same percentile are financed by their parents, so a course is just a course. We therefore observe that nearly half of the engineering graduates do not end up with engineering related productivity to the economy. If you look at the sectoral composition of any economy, some of the sectors may need very few engineers per se, e.g. Tourism, Finance, Trade, Hotels and Restaurants, Health, Agriculture, etc.

However, it is an incontrovertible fact that entry to several other fields e.g. IAS, CSE, CAT, etc. is optimized with an engineering background.



Though a large number of engineers are reported to be either un-employed or under-employed, Indian parents still nudge their children towards engineering probably due to the relative ease of admission (refer news item), and also because **Professionals are traditionally viewed through a prism of nobility**, thus placing them on a higher pedestal than non-professionals.

In the conventional format, engineers would be learning on the job for the first twenty years, (Initial Professional Development, IPD) and use that knowledge to carry on for the rest of their working life. Now they need Continued Professional Development (CPD) even during the rest of their working life so as to keep pace with innovations and so-called disruptions. However, very few engineers in our country continue to be involved with their core

subject beyond the mid level age of about 45 years, except perhaps in the case of scientific organizations and boutique professional consultants. In an engineering organizational hierarchy – they perform the role of General Managers. At that level they are expected to help run the organization rather than be involved only with fuzzy number crunching. As a result - over a period of time, they lose touch from their core engineering subject and thus become dependent on the young engineers in the organizations.

This is one of the overriding reasons that engineers with MBA tend to get lateral entry in an engineering organizational hierarchy.

The boutique professional consultants, though having developed an expertise in their own field, either lack the wherewithal and initiative of backward integration or the prowess of aggressive marketing. They are festooned in their own cocoon, operating like a cog in the wheel, stymied by avoidable circumstances of their own making and operating like a cottage industry, little realizing that if they don't build their own dream, others will hire them to build theirs. **This category of engineers cannot be said to be under-employed, but rather under-valued due to their own inhibitions.** Being subject specific experts, they know more and more about less and less. Thus they are hardly ever conscious about or involved with policy making, and their personal expertise generally fades into the sunset with very little direct benefit to society.

Is it these engineers whom we are now labeling as under-employed?

The policies adopted in the country have contributed in large measure to keep our engineering graduates under-employed though several students from our engineering institutes have excelled in India and abroad. To name a few, N.R. Narayan Murthy and Nandan Nilekani of Infosys, Metro-man E. Sreedharan, Raghunath Anant Mashelkar of CSIR, G. Madhavan of ISRO, Anil Kakodkar of AECI & BARC, Indra Nooyi of Pepsico, Sundar Pichai of Google, Satya Nadella of Microsoft, Shantanu Narayen of Adobe, Sanjay Jha of Global Foundries, Dinesh Paliwal of Harman International, et al.

Though propagation of self development was essential during the early days of independence, the intangible line between reinventing the wheel and picking up the relay baton, should have been considered at the right time. As a result, even to this day, continued dependence on imports rather than development of hi-tech manufacturing and production sector, has ensured that our engineering sector remained mediocre. The concept of technology transfer as a corollary to large capital purchases in the defence, power and railway sectors would provide our engineers with honourable jobs and for that we need to focus on boosting our domestic manufacturing and rely less on imports.

On the demographic curve, we have a majority of our population which is young and thus productive. Their proclivity to embrace new technology is overwhelming and is transforming our country. Technology has now progressively begun to occupy a central role in the operations of any business, simultaneously shaping consumer preferences. While the previous concept of forming a think tank to drive transformations in a company may still work for very large conglomerates, but for smaller ones, the speed to develop and market their product is critical to their success. This obviously calls for multifarious skills and leadership abilities spread across hierarchies, complimented with authority and empowerment.

The young entrepreneurs of today have turned the definition of success on its head.

They are primarily driven by results, during the process of exploration and reinvention. If learning follows downstream, that's an added bonus. Otherwise they are comfortable with ambiguity and making their own rules. A few cases in point are the upheavals created in the E-Commerce space which sent governments worldwide into a tizzy with the taxation issue with respect to point of sale/delivery, or the digitized share-a-cab concept of pool cabs in cities for a point-to-point service. Several governments were caught unawares with these concepts but have been forced to modify the existing laws to accommodate the same, since the concepts itself was beneficial to general public.

I would therefore consider that these are exciting times to be an engineer if the undergrad courses can be slightly fine tuned to meet next generation challenges of the digital era.

Quality Enhancement in Engineering Institution through Outcome Based Approach



Prof. D.N. Reddy

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In India, QS World University Ranking may not sound immediately very important to us when we are faced with several challenges and priorities in the Education System of India. However, it is useful to understand the parameters used for the ranking. They are Academic Reputation (40%), Employer Reputation (10%), Citations (20%), Faculty Student Ratio (20%), Promotion of International Students and Faculty (5% each). These parameters are not very different from the expectations of the stakeholders in our education system.

India has evolved an educational system for itself over the past six decades keeping its priorities and global trends into consideration. The major conflict we see in Indian Education System today is between quality and scale. Post independence, we started off with quality as the primary factor in establishing IITs and NITs. This was followed by a phase with focus on large scale increase in educational institutions. With private participation in establishing institutes and large scale demand from middle class the past decade has witnessed a tremendous growth in the number of private institutions in the country. The governance of these institutions and the degree granting authority has been delegated to the Universities established by the state grants. Consequently majority of the institutions today are in an affiliating system mostly offering undergraduate programmes in various disciplines. Today we have 39000 colleges and 700+ Universities. Colleges that are affiliated to a University and form the bulk of the Higher Education System comprising of 80% of the total enrollment. It thus forms the critical component reflecting every aspect of our Education System including QUALITY.

Accreditation should be made mandatory

The existing framework of affiliating system though it has a mechanism to ensure minimum standards of Education; it has no mandatory component of accreditation of the programmes and the Institutes. Much of the reason can also be attributed to the fact that there is lack of uniformity on the parameters and accreditation mechanisms by various agencies. However making accreditation mandatory, promotes academic and nonacademic reforms to promote quality advancement.

21st Century Career outlook for Students

The fast paced world is changing the way Engineers think and work. Engineering graduates in the past preferred to work with one large employer, almost for life, concerned largely with the technical feasibility. They worked and were judged as individuals. However, the demands on Engineers in the 21st Century are diverse. They need to work as Engineers and Non-Engineers being concerned with market, technical and societal feasibility. Rapid advancements in ICT and Globalization and reduction in transaction costs have created opportunities for the formation of more agile organizations and Dynamic Workforce beyond geographies. The challenges for Engineering graduates are also on the high and in addition to the technical skills; they have to be equipped with the requisite Soft-Skills to succeed in their career. The graduates will have to work and are evaluated on interdisciplinary teams, may be cross-border. They will have to work for a number of firms of different size and maturity. The

Millennium Engineer should therefore be additionally equipped with soft skills, business skills, problem-solving, communication, teamwork, self-assessment, change management, lifelong learning, inter personnel and intercultural adaptability Skills in global setting. Several International accords have taken shape and graduate attributes for the 21st Century Engineer have been identified [Outcome Based Education (OBE)]. India for the past decade has not only been the major contributor of global workforce but has demonstrated partnerships in Research and Innovations, solving many of problems faced by world over.

Engineering Education in a Knowledge Society

While all knowledge is important and useful, engineering education plays a very dominant role in developing knowledge and skills which are vital to the growth and maintenance of knowledge, knowledge-based and knowledge processing industries. Apart from providing specific domain knowledge in different engineering disciplines and producing experts in computer science and engineering, and information communication technologies, all engineering graduates irrespective of their fields of study are given education and training to acquire a reasonable level of competence in problem solving skills, software development, computer applications, modeling and simulation, and environmental impact analysis areas, which are important in creating new applications for knowledge and in marketing them both for domestic applications and for export.

In recent years with the advent of the knowledge age, there has been a significant increase in enrolment in engineering programs all over the world including India in computer and information sciences, software engineering and information and communication technologies. India has taken a major lead in this area and is exporting both manpower and skills in IT to most countries in the world. To maintain its leading position in this area, the engineering education system in the country has to continuously improve quality, upgrade facilities, and produce graduates with globally marketable skills.

Moving towards electronic data management and having institutional website to provide ready and relevant information to stakeholders are desirable steps in this direction. In other words, effective use of ICT in HEIs will be able to provide ICT literacy to the campus community, using ICT for resource sharing and networking, as well as adopting ICT-enabled administrative processes. Therefore, NAAC accreditation would look at how the institutions have put in place their electronic data management systems and electronic resources and their access to internal and external stakeholders particularly the student community.

Assessment and Accreditation of Higher Education Institutions

The forces of globalization and liberalization influenced the Indian Higher Education in a big way. In a situation where Higher Education, similar to the goods and other services has to compete internationally, quality assurance becomes inevitable. Further Indian institutions operate within a larger framework comprising of several agencies, national contexts and societal expectations and each of these have a unique rendition of the goals. At the functional level, the effectiveness of the Higher Education Institutions (HEI) is reflected in the extent to which all these layers of goals mutually concur. In such contexts the Accreditation and Assessment process is a beginning to bring in uniform quality and position HEIs in such a way that they address more directly the quality provision and the expected needs of the stakeholders.

Focus of Assessment

NAAC assessment lays focus on the **institutional** developments with reference to three aspects: *Quality initiative, Quality sustenance and Quality enhancement*. The overall quality assurance framework of NAAC

thus focuses on the values and desirable practices of HEIs and incorporates the core elements of quality assurance i.e. internal and external assessment for continuous improvement. The value framework of NAAC starts with its choice of unit of evaluation i.e. the Institution as a whole. The Accreditation and Assessment process of NAAC which involves a combination of self evaluation and external peer evaluation implicitly or explicitly is concerned with looking at the developmental aspects of the HEIs in the context of quality.

Self-evaluation is crucial in the process of Accreditation and Assessment and has a tremendous contribution in promoting objectivity, self-analysis, reflection and professionalism on the part of institutions. The self-evaluation proforma of NAAC provided as “manuals for self study” maps out different inputs, processes and outputs and facilitates HEIs to evaluate their strengths, weaknesses and areas for improvement. The self-evaluation process and the subsequent preparation of the Self-Study Report (SSR) to be submitted to NAAC involves the participation of all the stakeholders - management, faculty members, administrative staff, students, parents, employers, community and alumni. While the participation of internal stakeholders i.e. management, staff and students provide credibility and ownership to the activity and could lead to newer initiatives, interaction with the external stakeholders facilitate the development process of the institution and their educational services. Overall it is expected to serve as a catalyst for institutional self-improvement, promote innovation and to strengthen the process.

NAAC’s role in steering assessment not only continuing to coordinating function but extends to the *post-accreditation activities* especially in facilitating establishment of strategic resulting in building a quality culture. The IQACs are not only expected to facilitate the internalization and institutionalization of quality, but also to activate the system and raise the institutional capabilities to higher levels ensuring continuous quality improvement.

Criteria and Key Aspects for Assessment

The criteria-based assessment of NAAC forms the backbone of the Accreditation and Assessment. The seven criteria represent the core functions and activities of an institution and broadly focus on the issues which have a direct impact on teaching-learning, research, community development and the holistic development of the students. The NAAC has identified the following seven criteria to serve as the basis for assessment of HEIs:

1. Curricular Aspects
2. Teaching-Learning and Evaluation
3. Research, Consultancy and Extension
4. Infrastructure and Learning Resources
5. Student Support and Progression
6. Governance, Leadership and Management
7. Innovations and Best Practices

The Criteria-based assessment promotes judgment based on values. For example the Criterion on “Governance, Leadership and Management” promotes the values such as participation, transparency, team work, systems view, justice, self-reliance and probity in public finance.

The Key Aspects identified under each of the seven criteria reflect the processes and values of the HEI on which assessment is made. The questions under each of the Key Aspects focus in particular on the outcomes, the institutional provisions which contribute to these and their impact on student learning and development.

The strengths or weaknesses in one area may have an effect on quality in another area. Thus the issues addressed within the Criteria and Key Aspects are closely inter-related and may appear to be overlapping. The criteria and the Key Aspects are not a set of standards or measurement tools by themselves and do not cover everything which happens in every HEI. These are the parameters for transformational change and provide an external point of reference for evaluating the quality of the institution under assessment.

NAAC uses the same framework across the country. Using the same criteria across the country provides a common language about quality and makes it much easier for everyone to go in one direction and in evidence based policy making.

Accreditation and assessment agencies

Indian Education System Policy is access, inclusion and quality. To ensure quality and meeting quality in form of assessment and accreditation, presently two agencies NAAC and NBA are entrusted responsibility by the Govt. of India. NAAC is for institution accreditation and NBA for programme accreditation.

Outcome Based Education (NBA)

To bring in Quality in Technical Institutions, the Government of India is in the process of making Accreditation mandatory. In India, National Board of Accreditation (NBA) is the body responsible for accrediting the Technical Institutions. As India has become the permanent member in Washington Accord since 13th June 2014, Technical Institutions need to follow Outcome Based Education (OBE), if they want to go for accreditation. In OBE, one of the main criteria is the attainment of Course Outcomes. This is very important as these Course Outcomes will be mapped to Programme Outcomes, which in turn will be mapped to Programme Educational Objectives, which will in turn be mapped to Vision and Mission of the Department and Institute.

Why the Need for Accreditation?

- An accredited engineering degree means the degree is recognized by the Indian government.
- It is also a sign of the degree being of high quality and the holder of the degree has already attained a certain level of knowledge, skill and maturity of thought related to the relevant discipline.
- A person with accredited engineering degree may be able to work for the government, as well as private sector.
- He/she may subsequently become a Professional Engineer.

Accreditation Criteria (NBA)

- Vision, Mission and Programme Educational Objectives
- Programme Outcomes
- Programme Curriculum
- Students Performance
- Faculty Contributions
- Facilities and Technical Support
- Academic Support Units and Teaching-Learning Process
- Governance, Institutional support and Financial Resources
- Continuous Improvement

Expectations from OBE

- Programme Objectives/ Learning Outcomes
- Graduate Attributes
- Student Centered Learning
- Continuous Improvement
- Committed Faculty / Empowerment
- Skills and Competence

Course Outcomes

In the new Outcome Based Education model as prescribed by National Board of Accreditation (NBA), one of the most important criteria is the Attainment of Course Outcomes (COs). The Course Outcomes can be attained through several Direct and Indirect Assessments. This all can be achieved with clearly defining the Course Outcomes of the Course. In this paper, we have taken a Sample Course and we have clearly explained the methodology used in the assessment of attainment.

Assessment Tools

To begin with we need to clearly specify various Direct and Indirect Assessment Tools that contribute to the COs attainment. The Direct Tools can be Task 1 and Task 2 Performance, Mid Semester Examination 1 and Mid Semester Examination 2 Performance, Semester End Examination Performance. The Indirect Tools can be Course Exit Survey. Table 1 summarizes the tools and their weightage in assessment.

Table-1: Course Outcomes Assessment Tools & Weightage

Course Outcomes Assessment Tools	Weightage
Task 1 Performance	10% - 20%
Task 2 Performance	10% - 20%
MSE I Performance	20% - 30%
MSE II Performance	20% - 30%
SEE Performance	30% - 40%
Course Exit Survey	20% - 30%

Good Management Practices in Assessments

Good Management Practices are essentially a technique or methodology that, through experience or research, has become an innovative or better practice, which is recognized as 'best' or 'pioneering' by other peers. It implies accumulating and applying knowledge about the work in different contexts.

Total Quality Management review as used in Industry (Corporate sector) is referred to as Assessment, while the same in the Education sector is termed Accreditation, at a broad level. The intent behind both of these is to assure quality from the product/ services of the applicant, by taking inputs from relevant stakeholders – Students, Parents, Faculty, Management, Government, Alumni and Industry in the Education sector, or Customers, Employees, Suppliers, Partners, Management, Regulatory bodies, Society and Shareholders (if appropriate).

A Good Operating Practice during assessments in a corporate sector can be exchanged and replicated just like any instructional capital. This paper attempts to capture some such practices that are based on the assessment experiences and interactions with co-assessors across the globe.

Assessment Process

- (a) Individual assessment in stage: Enables team Chairperson to get better individual assessments from the team. There are typically three stages of individual assessment, spread over 2-3 months. The Chairperson defines the time lines for different stages of individual assessment and spends time, with the team on completion of every individual stage. Stage-wise individual assessment yields better quality of individual assessment.
- (b) Digitization of assessment process: in entirety enables better administration of the whole process. The digitization of assessment process in the industry covers areas such as maintenance of assessor pool, mapping/replacement assessors to applicant, and different steps of assessment process, site visit questions, the assessor feedback, and integrating the whole process. Mobile applications have further improved the situation. Given that the formats of SAR (e.g. Institution Information) in the NBA accreditation are structured and the numbers of Accreditation is increasing, digitization will reduce administrative load.

Challenges in Aligning Skills with Global Best Practices: Indian Scenario

There is a growing concern on the quality, standards and recognition of engineering education globally. Consequent upon this trend, the paper addresses issues, concerns and challenges for the Indian engineers a few benchmarks for ascertaining and assuring high quality practices at different levels, as a significant process. This paper highlights the initiative by the National Board of Accreditation (NBA) with Washington Accord (WA) to promote the concept of best practices benchmarking in technical education. Through the World Summit on Accreditation (WOSA-2016) it sets the stage for a discussion on the identification, sustenance, dissemination and adaptation of best practices globally and their relevance in the Indian context. Benchmarking is an ongoing systematic means for measuring and comparing the work processes of a technical course with any particular set of outcome parameters. The challenges are to identify systematically the urgent need to ensure best practices schemes in technical programs. The benchmarking exercise indicates rigorous quality assurance arrangements. With the adoption of Washington Accord and current quality assurance arrangements in engineering education is becoming considerably strong over the period of time and exposure with experience.

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Bridging the Skill & Competency Gaps between Industry 4.0 Requirements and Current Engineering Education in India



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Abstract: *The technological landscape is changing very rapidly. With the advent of new disruptive technologies (like Artificial Intelligence, 3D printing, Big Data, IIoT, etc.) and increased competitiveness amidst globalization and automation, there are never-before pressures on industries to cope up with this onslaught. It is changing the work processes and work contents rapidly. This results in requirement of new competencies for engineers. The industry expects engineering institutes to meet these new requirements. This paper describes key gaps in the Indian engineering education systems and suggests a joint collaborative approach to be adopted by both - educational systems as well as industry, to mitigate these gaps and take engineering education in India to greater heights.*

The present Industrial scenario is moving through an evolution (now recognized as Industry 4.0), where the new technologies are significantly altering not only the existing work processes/ products/ services, but also giving rise to many altogether new businesses. E.g. the 3D printing is expected to take product customization to unprecedented levels; the Big data is providing newer insights on customers; Artificial Intelligence is increasing productivity and taking over many tasks, and so on. IIoT is redefining and merging the digital and the physical world rapidly. This is expected to cause significant disruptions in the way the businesses and industries are run. Coupled with these technological fronts, ever increasing levels of automation and globalization are making the markets extremely competitive. To cope up with these requirements, trained resources with both - knowledge and aptitude are very much in demand. The industry relies on the talent pipeline from engineering colleges to meet their requirements. This young engineering talent is then trained in the company's work processes for them to be enabled towards active contribution in the delivery of products/ services. The success of the company not only depends on the systems, processes and the way of working, but also on the competency and aptitude of the young engineers who are the most active participants on the production/ delivery process. The company performance is greatly dependent on these active contributors.

Before going for campus recruitment, a company fixes its requirement in terms of numbers and also discipline and competency. The skill and competency requirements are normally reflected through the design and rigor of the recruitment tools/process. While going through campus recruitment, recruiting companies often observe competency gaps, which result in compromising on the quality and/ or quantity of recruits. This paper discusses how the fast moving technologies have fostered competency gaps, the challenges and how the engineering colleges and industry can join hands to bridge these gaps.

Understanding the new age requirements and gaps

In the industry, in line with the latest practices, many work processes are digitized. Most processes in the project or product life cycle are built on the digital platforms e.g. proposal management, order intake information sharing and storing, engineering and design, generation of deliverables/ design documents, quality assurance and checking, referring to standard documents, production planning, inventory management and scheduling, manufacturing, delivery chain management, etc. Companies are also migrating to 3-D, 4-D and higher project design platforms

to generate clash-free, cross-disciplinary work and evolving predictability throughout the lifecycle of the asset. In product as well as service businesses, disruptions like remote automation with robotic technologies, Artificial Intelligence, Machine Learning, Big Data Analytics are expected to make significant impact on productivity, quality and reliability. Technologies like 3-D Printing, Laser scanning and survey with drones have eased the way of working and replaced conventional forms of working. All these changes have also opened up new areas for business and new opportunities. It has also impacted significantly the skill requirements and there is a considerable drift towards higher/ more sophisticated skill sets as compared to the conventional way of working.

The fresh engineers may not have many of these skills and requisite competencies as in the college curriculum; many of these topics are not covered. Even if we consider the top engineering colleges in the country, we seldom find formal courses for deep diving or skill sets developed for the students in these new areas. The catch-up of the industrial/ technological advancements in the engineering curriculum and agility of the course contents to match/outpace the new technology related industrial practices is a significant challenge.

We have in our country, engineering colleges with significantly varying standards - in terms of teaching quality, technical infrastructure and laboratory facilities. As a result, the quality of engineers, graduating from these colleges has significant variations. Colleges lacking quality faculty and infrastructure are many times seen as being a rung lower in the competency requirement for the industries and their students have to resort to low skill jobs. Thus, the significant variation in the college standards is another major challenge.

Further, with such significant changes in technological landscape, the teaching staff needs to catch up with the advancements, so as to impart the right skills and competencies to the new generation. Ability of the education system, particularly in India to attract (& retain) the best talents in teaching fraternity has been questionable.

With high aspiration of parents and their drive to impart better education and ensure secured careers for the children, there is certain mechanization towards “cracking” entrance examinations. There has also been significant increase in the number of engineering colleges, which has resulted in increased number of engineers graduating each year. The “employability” quotient, however, is low. While the factors explained above contribute to the low employability quotient, one major cause is also the ineffectiveness of proper filtering of students at various educational levels - including at SSC, HSC and also through the span of engineering education.

In addition, the present trend in the industry calls for adoption of new technologies which require collaborative, integrated, holistic and innovative approach to work, rather than rigid, ‘one discipline-at-a-time (i.e. sequential)’, “silo”ed engineering. A new way of looking at things, team approach and curiosity needs to be encouraged and kindled at an early stage of education. The education system needs to take cognizance of these new requirements.

Thus, from a high level view, following are seen to be major gaps in engineering education systems in the Indian context –

- 1) High degree of tooling and automation, drifting the skill requirements to deeper/ sophisticated levels than that imparted by conventional engineering education,
- 2) Catch up of the engineering curriculum with new requirements and agility in keeping pace with the new technologies on continuous basis,
- 3) Ability of the teaching staff to cope up with above changes,
- 4) Significant variations in the facilities available/ infrastructure for various colleges,
- 5) Absence of graded selection/ filtration system that can match the aptitudes of available talents with requirements at various levels of education, and
- 6) Strong need of soft skills like team/ collaborative approaches, innovation and integrated/ holistic approach for engineering.

Possible mitigation measures

While closing the above gaps is an uphill task, it could be made possible by focused and coordinated efforts by all agencies involved. The approach and steps taken towards mitigation of above issues can be as follows:

A. At primary and secondary levels of education –

1. Improve the quality of the primary and secondary education. Make the syllabi and provide facilities to enable more uniform learning with a sound basic knowledge to seamlessly elevate to higher level courses, including engineering. Provide high emphasis on the team work and collaboration right from early days in the education cycle. It may also involve more hands-on assignments on projects. Also, curiosity and “tell me why” attitude need to be encouraged rather than subjecting students to stereotype examinations and answers. The children may be exposed to multiple vocations/ alternatives so that they could discover professions of their own liking rather than head towards engineering/ medical profession. It may also involve appropriate guidance to be provided to parents.
2. Introduction of proper filtering at various levels in order to manage quality as well as demand-supply balances across various professional fields. The purpose of educational system should be to get ‘learned’ students who can contribute to the society in meaningful way and not to create graduates with certificates. The future trend could be towards lesser routine engineering jobs but more of those requiring deep knowledge and highly sophisticated skills as automation and AI would reduce the conventional work efforts. In order to avoid excess of “low employability quotient” engineers, rightful filtering and grading of students at appropriate levels need to take place. It will ensure better matching of the skill/ talent requirement of a particular field with individual’s aptitude. It needs to be done with great sensitivity so that the children (and their parents) do not lose self-confidence.

The above two steps could ensure a right talent pipeline to engineering colleges.

B. At engineering college level –

1. Ensure availability of appropriate facilities/ infrastructure in all engineering colleges. The effectiveness of auditing and evaluation of the engineering colleges may need to be increased. Corrective actions may need to be enforced to bring in certain minimum required standards. All the students must get exposure to a minimum level of infrastructure/ facilities. This will also help avoiding cut-throat competition for a few top colleges.
2. Ensure availability of the right teaching staff. The qualification levels as well as compensation for the teaching staff may be made commensurate to attract best talent. Industrial consultation for professors may be encouraged or even made mandatory. Similarly, the industry may provide opportunities of short-term teaching assignments to its middle and senior managers that could expose the engineering students to industry experience.
3. Revisit and re-align the syllabi at appropriate intervals to make them nimble and agile. With the current onslaught of frequent technology changes, the curriculum of engineering courses may be reviewed more frequently, say once in 2 years. The syllabus may also be made more uniform across the country, with respect to the minimum contents that may be managed centrally, so that the revisions may also be done more consistently throughout the country. The industry also needs to participate in the revision process.
4. Use industry tools in the engineering colleges. The tools/ software available in the industry should also be made available to the academics and the assignments/ projects may be delivered using these industry tools. There may be a good number of collaborative assignments that expose the students on various interdisciplinary requirements. However, care needs to be taken that it does not compromise

on the skill of “understanding and solving from first principles”. In other words, the tools should be used for familiarity and not to substitute the “learning” side of defining and solving problems manually from first principles.

5. Emphasize on research/ innovation related activities. There needs to be an active orientation of students towards designing and creating their own thought processes or solutions. The industry may need to share their persistent issues/ problems with the academics and the students should be encouraged to come up with their own thinking about providing solutions.
6. Review the duration of engineering graduation. As the subjects become more complex, more sophisticated skills are required at the entry level of work itself (automation taking away easier jobs) and also life expectancy is higher, there may be a potential case to provide more time, say 5 years for engineering graduation. This may provide additional time for students and certain activities like industry training, project work could be done with added rigor. It will also provide additional time for research oriented assignments. In a way, it could mean a shift from the current graduation program to a kind of integrated post-graduation programs (which are offered by some institutes) as the base level of engineering. With additional time and additional research/ industry orientation, the students could be in better position to serve industry and take on higher levels of work.
7. Creating funds. A properly trained fresh engineering graduate could reduce the internal training efforts/ budgets for the company and his/ her quick adoption to the industry requirements can enhance the company’s productivity. Engineering education systems are part of the supply chain for the industry. There needs to be industry wide cognizance of these aspects. This could potentially pave the way for larger investments by the industry in the education systems. Ways to enhance the industrial sponsorships and investments may also be explored at policy levels e.g. tax incentives, etc.

C. During the professional stint of engineers

While the current paper focuses mainly on the engineering education, merely ensuring a good talent pipeline to industry through good engineering education is not enough. The engineer has to apply his knowledge in real life and there need to be learning, un-learning and re-learning process as well. This is the only way to keep up with the pace of technological changes.

While the detailing of these steps is outside the scope of this paper, re-validation and re-certification of engineers engaged in professional fields may ensure requisite learning efforts by all working engineers. It will ensure that they remain updated and abreast in latest technologies. It may necessitate a system of registration and/or licensing for practising engineering profession. Such licensing/ registration practices are followed in some developed countries e.g. Professional Engineer (PE) in USA.

To conclude it may be said that, the technology landscape is evolving fast, driving the ever changing demand in the skill/ competency level of engineers. The engineering education should also be dynamically adaptive to these changing requirements. Changes in the engineering education need to be continuous and agile to serve the industry better. Hence the drive for competency improvement shall also be continuous. There needs to be concerted, focused and coordinated efforts by all related stakeholders, to maintain relevance and alignment of engineering education, with the new technological requirements. This big task cannot be accomplished by the engineering institutes alone, there is a requirement of proactive participation of industry as well, to make it successful and sustainable. If deployed successfully, it can take Indian engineering standards to even greater heights.

Challenges Facing Engineering Education in India



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Abstract: *With a 1345 million population, India is the largest democracy in the world. With an annual intake of about 15,76,500 graduates and post graduates from 10,949 technical institutions spread all over the country, India possesses a large pool of technical manpower today. According to McKinsey International and NASSCOM, however, only 25% of engineering graduates in India are employable due to quality deficit. Quality of technical education is to be further improved for addressing the severe shortage of faculty and manpower to conduct engineering education, research and consultancy services. Standard of educational, research and consultancy institutions in India plays a significant role in meeting the socio-economic goals set out by the Government of India for the development of the country.*

Keywords: Consultancy, Education, Engineering, Quality, Research

1.0 INTRODUCTION

At the time of Independence, India had only a few engineering colleges engaged in under graduate education in engineering. Since then there has been a phenomenal growth in engineering colleges (Annexure-I), 90% of which belong to private sector. Except a few, most of the private colleges have poor facilities and unqualified faculty and most of them run only under graduate programmes. Private engineering colleges are commercially run with the objective of making profit. There is no doubt that engineers coming out from both public and private institutions have made significant contribution for the nation's growth. But the maintenance of quality has become the victim of this growth phenomenon. Lack of maintenance of standards in institutions and failure to monitor the same by the regulating bodies like AICTE/Universities is the main factor responsible for this scenario. It may be worthwhile to compare here the numbers of students admitted at different levels in India and USA (Sharma, 2014).

	India	USA
At UG level	15,00,000	75,000 (5% of India)
At Master's level	75,000 (5% of UG)	37,500(50% of India)
At PhD level	1,500 (0.1% of UG)	7,500 (500% of India)

Thus, technical education developed in India has a distorted image. According to a December 2008 report from the Indian Institute of Technology (Bombay), IITs and IISc provide only 1 percent graduates of the total number of students at Bachelor's level, 4 percent at Master's level, and 40 percent at PhD level. A direct consequence of this is an enormous but unfortunate growth of private coaching centers in all major cities in India where a large number of students enroll for taking IIT entrance test. It is not desirable to promote private coaching centers which have no social significance, charge huge coaching fees and are responsible for deterioration of our secondary and higher secondary education system.

Objective of writing this paper is to critically examine the current status of engineering education in India, the various challenges being faced by technical institutions and how to improve the quality of engineering education for future development of the country.

2.0 QUALITY OF TECHNICAL EDUCATION

Engineering and Technical education in India is offered at various levels by different categories of institutions, viz.:

- (i) Industrial Training Institutes for technicians (ITIs) of 1-2 year duration,
- (ii) Polytechnics for diploma level courses of 3 years duration,
- (iii) Engineering colleges mostly for degree level courses of 4 year duration, and
- (iv) Universities/IITs/IIMs/IISCs/IEST/NITs/ Government and Private institutes of higher education for post graduate education of 2 year duration and doctorates of 2/3 years duration.

Today, majority of our engineering graduates prefer IT, software, banking or similar types of jobs where there is very little scope to utilize the technical knowledge and professional training they receive from the technical institutions during their 4-year degree level program. There is a great deal of mismatch between our social requirements and the educational program and what the students learn from the educational institutions and what they actually practice in real life. According to survey reports by McKinsey and the National Association of Software and Services Companies (NASSCOM), only 25% of the 15 lakh Indian engineers are employable mainly due to quality/skill deficiency.

2.1 Undergraduate Engineering Education

Currently, undergraduate program in engineering/technology is overloaded with heavy dose of theory in diverse subjects of stereotyped nature - often unrelated to the discipline of their specializations. The biggest deficiency in most of the teachers/instructors is lack of any industrial experience. In medical institutions, the doctors receive practical experience while completing internship in hospitals attached with the medical institutes under the able guidance of their teachers. In engineering education, however, no such facilities are available to gather practical experience while learning unless the institute has a compulsory program of industrial training under the supervision of their teachers. It is advisable not to award degree unless an engineering student undergoes compulsory training of one year duration in industries or teaching and research institutes.

Many of the institutes do not have requisite infrastructures and adequate number of faculty and supporting staff. One of the most important factors for deterioration of quality of UG education is the mushroom growth of engineering colleges offering degrees by some nearby universities which have very little say or control in those engineering colleges as they are neither financially nor administratively controlled by the university with which they are affiliated to. It is to be carefully decided whether proliferation of private commercial type engineering colleges in the cities is preferred to technical universities for achieving quality of technical education in India.

UGC organized regional conferences of Vice-Chancellors which culminated in a national conference of Vice-Chancellors (The Statesman, 2007). They have recommended (Annexure-II) private funding in technical education in areas of priority in rural, remote and underprivileged areas. Bhat (2000) narrated some experiences of Public-Private Partnerships in Social Sectors through private funding.

A large chunk of engineers come from the Institution of Engineers and similar other professional bodies recognized by the Government of India as equivalent to degree holders. They are being engaged by many of the private

companies with poor pay and perks compared to graduates/post graduates from IIT/IIM/IISC/IIEST etc. Unlike engineering colleges where students perform workshops, laboratory experiments, tutorials, design classes, industrial training, project works, etc. under the guidance of teachers, there is no such classes for AMIE/AIEEE students, resulting in an inherent draw back in the development of their concept and confidence which are gradually built up in steps in the engineering colleges. It is true that the large requirement of our technical manpower cannot be met by the government alone. However, it is to be kept in mind that substandard institutions, turning out substandard products from public or private institutions, will in the long run damage many of the good things that Government of India is planning and executing for the future socio-economic development of the country at high costs.

Except IITs/IIMs/IISCs/IIEST, quality of engineering graduates and post-graduates from majority of the technical institutions in India is not up to the mark. Currently, India has fifteen IITs (eight of which have only recently started) and 30 NITS, though it is still not clear how the newer IITs and NITs will be staffed with qualified faculty as in the existing ones (The Tribune-2014). Most of the institutions do not have sufficient qualified and trained teachers and adequate infrastructures. Under the prevailing circumstances, majority of the bright and meritorious students in engineering and technology leave India for higher education and research abroad due to their better infrastructures, quality teaching and research guidance, higher remuneration and due recognition of their work. Some of the factors responsible for poor quality of engineering education in India are (Ashok, 2007):

- Inadequate and incompetent Faculties,
- Inadequate physical infrastructure, and funds,
- Lack of autonomy,
- Rigid and outdated curriculum,
- Poor quality of training,
- Absence of R & D activities,
- Poor learner quality, and
- Ineffective linkage with industry.

The biggest problem of engineering education in India, however, lies in non-availability of quality faculty for which Master's/Ph.D. degree is made mandatory by AICTE. An Institute can never grow and develop with part time and ad-hoc type old and retired teachers alone. Young post graduates with strong fundamentals and motivation for research and development form the backbone of any technical institution. They should be recruited very carefully and trained under the careful supervision of senior faculty members and paid salaries and perks as enjoyed by their counterparts in Industry. It should never be forgotten that it is the teachers who mould a student to be professionally competent to deliver the goods to our society.

AICTE may consider introducing their previous scheme 'Teachers Training Program' by recruiting young scholars with attractive compensations to undergo MTech/ PhD program along with teaching/research assistantship. It is a common sight in private engineering colleges for a person who passed with BE/ BTech/ BSc (Engg.) degree to start teaching in the following academic year. Table-1 presents faculty shortage in engineering institutes on national basis (Rama Rao, 2013).

Table 1. Severe shortage of Quality Faculty

Annual intake at UG level	15,00,000 per year
Faculty required for running UG Program (@ 1:15 faculty:student ratio)	1,00,000
Faculty shortage at UG level	80,000
Shortage at Master's level	20,000
Shortage at PhD level	60,000

2.2 Post Graduate Engineering Education

Postgraduate education, research and consultancy in engineering and technology in India are confined to only a few institutions like IITs and NITs and few universities. Despite attractive scholarships, nearly 60 per cent of over 19,000 sanctioned postgraduate seats (in 191 institutions) remained vacant while less than 7,000 completed the PG courses annually (Kakodkar-2011, Subbarao-2013). Very few UG students from IITs and NITs join PG courses there. Majority of their PG students come from private/state run colleges for getting an IIT/NIT stamp. There is no motivation and they are reluctant to do any hard work partly because of their poor UG background but mostly due to want of proper guidance. They utilize the scholarship, libraries and hostel facilities for preparing for IAS and similar examinations for an assured future. Postgraduate students who mainly perform teaching and R&D works join the PG program as a last choice only when they do not qualify in other all India examinations like IAS, IES, IFS, etc. or do not get any appropriate job. Author is convinced that PG education in India is substandard when compared with that in developed countries like USA, Europe, Australia, Canada, etc. Quality of our PG education has been discussed by the author in an earlier paper (Mazumder, 2008). The low out-turn and poor quality of postgraduates, who constitute the supply source of teaching, research and consultancy profession, is a major concern of our technical education system in India.

Under the above circumstances, the quality of our post graduate students is far from satisfactory. The status of our post-graduate education in engineering can be assessed from the fact that against a sanctioned intake of 32,752, actual intake was about 20,000 whereas actual outturn was about 10,000 only (AICTE-1999).

3.0 R&D AND CONSULTANCY

R&D and consultancy works act as a nucleus in all developmental activities. University professors and the young research scholars working under the professors comprise an enormous pool of expertise and resources which must be tapped to solve many a challenging problems faced by the society in the fast changing world with global competition. A major problem being faced by our educational, research, consultancy and industrial institutions today is how to attract and retain qualified and meritorious persons. Most of the research works in India end with publications with little or no application in field (Mazumder-1999, 2014).

Sound knowledge, information, initiative, hard work, perseverance and above all a spirit of creativity are essentially needed for pursuing research and development works leading to innovation and excellence. There is hardly any invention in the large numbers of our universities and technical institutions in the country. Unless the quality of our education and research in science, engineering and technology are upgraded further, we have to pay heavily in future for our neglect and the developed countries will monopolize the jobs related to R&D and consultancy works. The country will be compelled to purchase know-how from abroad and will remain ever dependent on foreign technology and foreign products at an enormous cost.

Universities and research institutes are good in R&D, but poor in delivery of R&D from laboratories to fields. Although efficient in delivery, Indian industries are hesitant to invest in R&D due to an inherent risk involved and a mindset of belittling research and innovation. Most of the industries in India today are reluctant to encourage their employees for academic pursuit as evidenced by lack of any worthy publications from those in industries. There is only a one way flow from academic institutions to industries today. Without a two way flow from educational institutions to industries and vice-versa, engineering education can never flourish. The general trend is to purchase products of superior quality from abroad at exorbitant costs, although there are large numbers of research institutions/universities in the country and there is no dearth of talent.

4.0 Future of Educational Institutions in India

After independence, educational institutions of higher learning were headed by persons of high integrity and character with vision to develop and excel. Today, many of these institutions are being headed by persons of mediocre calibre with political support or favour from top influential persons on cast/community/regional basis, irrespective of their merit. As a result, the topmost and meritorious brains that are really worthy and capable of delivering are leaving the country out of frustration. Out there they make immense contributions towards R&D in the developed countries thereby enriching the standard of the foreign institutions. A mediocre or political person will always like to be surrounded by similar brand of persons resulting in gradual deterioration in the standard and reputation of the educational and research institutions. Present status of research in engineering and technology in a vast country like India can be assessed from the fact that the annual out turn of PhDs in Engineering/Technology has decreased from 506 in 1979 to 374 in 1996 (AICTE-1999). Although the PhD intake has recently increased to 1500, the actual out turn of PhD is only about 1000 per year which is far below India's requirement (AICTE, 2011-12).

Most of the bright students of India capable for teaching and research go to developed countries every year. While India imports equipments and products (developed by Indian scientists and engineers abroad), these countries are importing the best brains from India. China has understood this game very well. Most of their reputed scientists and technologists are encouraged/inspired to return to their homeland after successful completion of studies and training abroad. Talented Indians who go abroad for higher education and research continue to stay and settle there, partly because of high pay and perks but mostly due to a congenial academic environment for research & development and also for the recognition of the work done by them. It seems IITs are built to supply requisite manpower for further development of the advanced countries in the world. Unless this trend can be reversed, India will continue to remain dependent on foreign knowhow and continue to import foreign products at an exorbitant cost.

An educational Institute can develop only through hard work and contributions made by the young and energetic faculty and the employee. The current trend in our educational institutions is to draw as much facilities as possible from the institution unmindful of the health of the parent body. Unless everyone in the institution cares and contributes towards the development of the institute, the health of the mother body is bound to deteriorate.

5.0 Conclusion

The growth of engineering education since the last three decades has been phenomenal with the entry of private players in the country. The quality of most of these engineering institutes is, however, questionable given the fact that employability among the pass outs is very low. The premier institutes are producing a very small number of engineering graduates and post-graduates. The majority come from state run and private colleges; they are neither motivated nor hard working. There is an urgent need to address the problems ailing technical education;

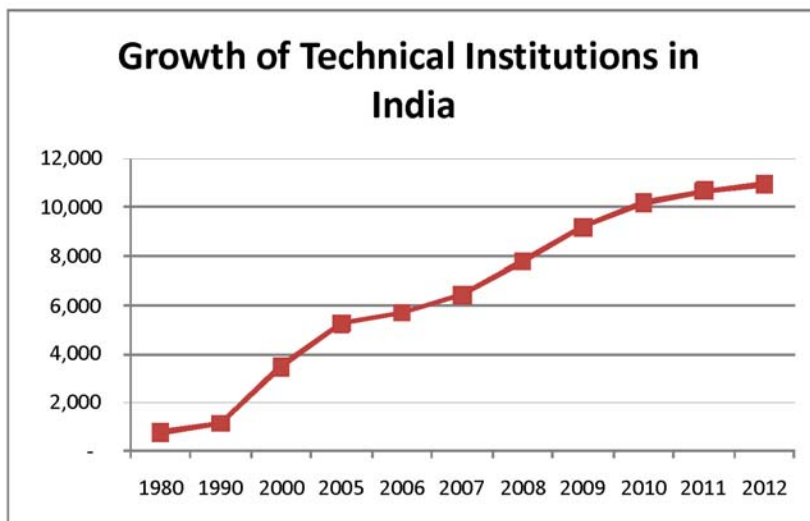
otherwise India will miss the opportunity to utilize its demographic dividend of the young work force which it has. In order to ensure standards as per global norms and mechanism to monitor the same, an uncompromising attitude is essential. In this respect, India becoming a permanent member of the Washington Accord (TOI-2014) is a significant step.

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Annexure-I: Growth of Technical Institutions in India

STATE	1980	1990	2000	2005	2006	2007	2008	2009	2010	2011	2012
Andaman and Nicobar Islands	0	0	0	0	0	0	0	1	1	1	1
Andhra Pradesh	83	112	463	852	907	1111	1450	1672	1769	1813	1840
Arunachal Pradesh	2	2	3	4	5	5	5	5	5	5	5
Assam	8	8	23	24	26	28	32	42	44	46	47
Bihar	25	29	44	53	53	55	63	71	76	82	88
Chandigarh	3	3	10	13	13	13	14	14	14	14	14
Chhattisgarh	9	16	31	43	48	57	82	105	109	109	109
Dadra and Nagar Haveli	0	1	1	1	1	2	3	3	3	3	3
Daman and Diu	0	1	1	1	1	1	1	1	1	1	1
Delhi	0	14	59	71	74	79	83	83	86	88	89
Goa	2	4	11	15	15	16	16	16	16	17	18
Gujarat	36	48	121	196	223	244	280	349	399	430	443
Haryana	28	34	87	141	156	213	346	410	453	491	504
Himachal Pradesh	8	10	13	17	21	32	42	63	72	79	80
Jammu and Kashmir	9	12	27	31	34	34	35	38	39	42	47
Jharkhand	15	16	32	41	41	45	49	52	57	61	61
Karnataka	62	137	413	523	537	578	651	731	777	789	798
Kerala	30	37	106	244	250	252	263	291	315	345	358
Madhya Pradesh	36	47	150	278	311	379	432	510	546	563	569
Maharashtra	106	192	556	740	859	926	1087	1286	1461	1550	1598
Manipur	0	0	3	3	3	3	3	3	3	3	3
Meghalaya	1	1	1	3	3	4	4	5	5	5	6
Mizoram	0	1	2	3	3	4	4	4	4	4	4
Nagaland	0	0	0	0	0	3	3	3	3	3	3
Orissa	19	25	98	134	145	164	210	277	293	299	304
Puducherry	5	8	15	18	18	20	23	26	30	31	32
Punjab	21	25	80	178	189	209	262	313	354	386	402
Rajasthan	37	46	103	174	199	232	284	335	467	484	504
Sikkim	0	0	4	4	4	4	4	4	4	4	4
Tamil Nadu	88	160	578	784	817	900	1046	1220	1328	1382	1422
Tripura	4	4	5	7	7	8	8	8	9	9	9
Uttar Pradesh	93	111	287	428	470	537	688	879	1039	1101	1143
Uttarakhand	17	21	49	69	85	93	119	148	165	175	182
West Bengal	37	40	111	167	178	183	201	223	238	247	258
Grand Total	794	1165	3487	5260	5696	6434	7793	9191	10185	10662	10949



Annexure-II: Recommendations of Regional Conferences of Vice-Chancellors of Indian Universities regarding Private Participation in higher Education

- Non availability of seats in professional and technical higher education in the public institutions has lead to proliferation of private institutes and universities. Though some of them are good but a large majority of them suffer from poor quality leading to production of graduates that are largely unemployable.
- They are run largely on commercial lines even though profit making objectives in educational endeavors are largely prohibited. They charge exorbitant fees which makes higher education exclusivist.
- Public-private partnership and private initiatives and private investment in higher education seem to have become inevitable. They may be encouraged but the following safeguards need to be in place.
- It must be ensured that the quality of higher education is not diluted and commercial considerations do not get preference over the academic factors.
- It must be ensured that the private participation in higher education does not lead to exclusion.
- A strong and effectively regulatory mechanism will be needed to regulate admission and fees to private institutions.
- The government may provide land at subsidized rate for establishment of private colleges and universities in return of which these institutions must agree to provide higher education free of cost to the marginalized social groups and economically backward and poor.
- Community may be encouraged to adopt colleges and provide financial and other support to the adopted institutions.
- The industries should be encouraged to adopt colleges and universities in their neighborhood or those that are engaged in research and development in the areas of their interests. The industries should then sponsor research and make investments in infrastructures and human resources for development of quality and excellence in these institutions.
- The universities should develop technology parks and invite industries to set up units on campus so as to provide training and placement of graduates.
- Universities and colleges should be permitted to establish public limited companies to take up and market their research and patents and revenues generated through these entrepreneurial activities be used for strengthening and updating teaching and research infrastructure.
- It was recommended that there is a need to distinguish between those private institutions that are being run with charitable and philanthropic motives and those that are established with an objective of making profit. While the former category needs to be encouraged and supported, the later will have to be tightly regulated so as to force them perform social objectives of higher education.
- Private investments in higher education should be encouraged in priority areas. Incentives may be offered to private institutions that are established in rural, remote and underprivileged areas that have lower than the national GER due to lack of quality institutions.
- Make it mandatory for the private and deemed universities to offer courses in general higher education in addition to high demand market oriented courses.

Engineering Education in Private Institutions in India-Boon, Bane or Mixed Bag?



Prof. Mainak Ghosal¹

Introduction

India has one of the largest number of engineering graduates joining the ranks of professionals annually in the world. However, the quality of engineers is not up to the mark and by some estimates only 7-8% of the engineering graduates are employable as per the *National Employability Report*. In this 21st century globalized world, engineering education and the profession are facing various challenges and would continue to do so if some serious introspection and steps taken to alleviate them are not taken. The first 5 IITs were setup in the first decade or so after Independence and still continue to serve both locally and globally. During early 1980s there were about 100 engineering colleges but due to the demands of the industry during successive 5 years Plans and incoming liberalization and globalization these colleges became insufficient. This led the Government to allow and facilitate privatization in the technical set up of engineering colleges in India with Tamil Nadu being the first state to do so by opening up 50 new private engineering colleges.

Post 2000, the country witnessed income growth in all spheres. Salary income increased multi-fold and self-employed persons were happy with rising income. Rural income was also on an upswing; maybe at a lesser proportion. A sizeable percentage of the poor upgraded to middle class and the middle to rich class. There was also revolution in mobile telephony, automobile, aviation, higher education, computers, etc. Ample job opportunities were created due to economic growth. Land and real estate values also appreciated. This led to a mushrooming in the number of engineering colleges and today there are over 10,000 institutions. The quality of education in many of the private colleges leaves a lot to be desired. Many of these colleges lack even basic facilities essential for good engineering education and have practically no good quality teachers. But on the other hand, some have excelled and are as good as or even better than many of the Government engineering colleges today. Deemed Universities have also mushroomed. Most of them do not belong to the same class as those recognized as such twenty years ago.

Our engineers are now competing with the engineers from other countries and if they are found to be failing in their knowledge and capabilities they may be substituted by an engineer from any corner of the World, say China or Philippines or Latin America. This global challenge was not so prevalent in our country till the last decade. As Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum expresses in his book *The Fourth Industrial Revolution* that in 21st century technological changes will occur in a cycle of 5 years and to meet the new technological standards we need to follow up with changes in our education system otherwise India's new generation may also miss the bus.

Brief Discussion

Who is an engineer? There are many definitions to it. Engineering can be very aptly described as one of the noblest professions but is not recognized by any statute as that enjoyed by Architects, Chartered Accountants,

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Medical or Legal professionals. One definition has it *'An Engineer is a man who is not learned enough to be a Scientist nor skillful enough to be a craftsman. But clever enough to be a manager. They are required in every set up to be blamed for the short coming of the empirical methods and unpredictability of the human resources, he is working with.'* The engineer in the first decade of the twenty first century no longer conjures the image of a tanned and overworked earnest man wearing half-pants and a bowler hat, involved in site supervision.

The engineer's microcosmic space of the site has significantly expanded to cover broader regions of concern other than mere technical competencies. The engineer today not only has his duty limited to engineering solutions, he is also required to give economical solutions for reaching it to the major section of the society.

Recently, as many as 122 private engineering colleges had to shut down due to a slump in the IT and manufacturing sectors despite 'Make in India' and 100% FDI in Construction, Defence, Aviation, Pharmacy, Food Products & Animal Husbandry resulting in a serious dearth of jobs for those who pass out of private engineering colleges with the unemployment rate growing at 9.5% every year in addition to a report by Labour Bureau that India has been losing 550 jobs each day. In this context the education imparted to a budding engineer is very crucial for his global positioning as well as the development of his surroundings and society. Various review reports have pointed out that there exists a misalignment between engineering education and practice; engineering educators hardly understand engineering practice beyond design and technical problem solving; this large gap between education and practice has become traumatic for young engineers, forcing them to think about alternative occupations. Some of the critical issues brought out by different agencies are:

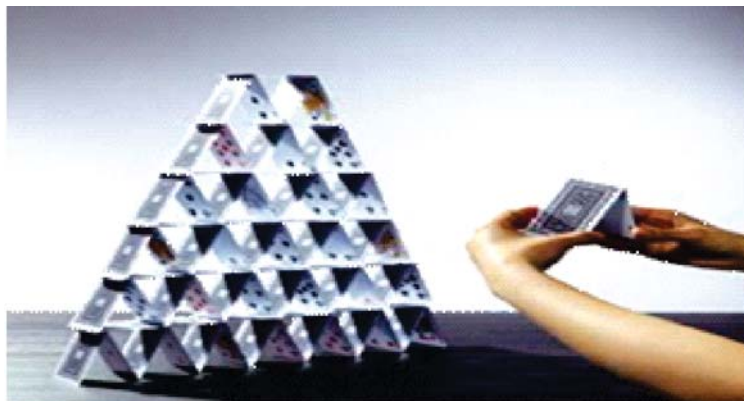
1. Knowledge and capabilities of engineering graduates and post-graduates need great improvement to make them employable, so that they can do more than mere clerical-grade jobs.
2. Engineering education to be made less boring so that students attend classes regularly. 'Adulterated' marks in class tests which resulting in 100% pass outs or excessive high CGPA needs to be stopped.
3. Engineering education must attract talented students who really want to learn and contribute for social development.
4. Engineering requires multidisciplinary knowledge and work experience.
5. Various application oriented skills and innovative approach must be addressed in the engineering curriculum.
6. The desirable attributes of engineering graduates as per the Washington Accord (WA) should be addressed by the engineering educational institutions.
7. Students' (learning) engagements and pedagogy through proper use of ICT like Power Point Presentations, etc. and inquiry-based learning to be incorporated in engineering courses.
8. Greater use to be made of the web-based engineering course materials and open-source learning materials like the National Programme on Technology Enhanced Learning (a Ministry of Human Resource Development initiative) on YouTube conducted by IIT Delhi.
9. Engineering accrediting authorities must be created on the lines of NAAC/NBA (National Assessment and Accreditation Council/National Board of Accreditation) to get the engineering educational institutions to modify their programmes, their relationships with students, role of academic staff/educators, infrastructure facilities, networking with employers, as well as assessment and evaluation methods, to improve the effectiveness of these programmes.
10. Regulate the fees charged by Private engineering colleges so that the hefty fees for admission often under the garb of development fees or often through management quota be stopped.
11. Besides, regulation also must cover the session fees, re-admission fees, library fees, computer fees, compulsory purchase of uniform, transportation fees, caution fees and even some fees taken in the name

of summer camp. These institutions sometimes function as a type of mini-supermarket where they prefer to supply their own material for uniforms and other necessities like school bags, socks and shoes, books, old question papers, exercise books, etc or specify tailors and stationery shops where prices invariably are slightly higher than that of local market even some of them are hand-in-gloves with publishers who churn out substandard repetitive books that these institutions prescribe as compulsory. Recruit appropriate teaching faculty to be able replace those who have either crossed the age of superannuation or do not have the requisite qualifications like Masters' degree or lack proper publications or requisite conference participations.

12. Faulty to get uniform pay scales-offered as per UGC recommendations so that lower salaries, temporary and contract appointment plus practice of private tuitions are eliminated.
13. Put an end to colleges charging for industrial training, which is generally imparted free of cost, and recruitment fees in name of companies which don't exist. Also put a stop to colleges offering foreign trips to Singapore, Bangkok, Indonesia and other places which serve no purpose in the long run.
14. The concept of PPP institutes, which are controlled by a management whose aim is that of a sundry businessman dreaming to be an overnight millionaire at any cost, needs to be stopped.

Sometime back, local newspaper reports suggested that these institutions were marred by campus violence which included 'gherao' of faculties and staff against issues such as right to copying in exams, right to placements for all, right to training, right to ragging, etc.

15. Last but not the least, every year a 10-15 per cent increase in fees has been reported in some of the institutions which needs to be regulated in the interest of the nation and the good of the masses.



Private Engineering education in India-Building card castles in thin air?

Conclusions

There is an urgent need to address the problems ailing the private technical education otherwise India would miss the opportunity to utilize its demographic dividend of a young work force which it can educate, train and deploy to enrich the nation. For this we need a surgical strike on private engineering education industry in India which is going from bad to worse resulting with their institutional properties like Land/Building/Other Assets etc becoming NPAs. Some steps would be as follows:-

- i) Adoption of the model followed by the CBSE for conducting the National-Eligibility-cum-Entrance Test (NEET) in medical courses, a Common Entrance Test in Engineering as proposed by AICTE albeit opposition by some states like West Bengal and Tamil Nadu has to be addressed.
- ii) As education is a State subject, the respective states should come forward with, say-a 'Self-Regulatory Commission' with an aim to regulate the functioning of the engineering institutes as being done in West

Bengal which has constituted such a Commission with representatives from various educational institutions, the Education Secretary, State DGP and the Kolkata Police Commissioner to hold meetings at regular intervals, check balance sheets of these so called non-profitable organizations and decide fees with a rational attitude thus leading to the introduction of a Bill (on the lines of recent West Bengal Clinical Establishment Bill 2017 for Doctors) or Act in future, where anyone (parent/student) can lodge a complaint. Besides steps like banning use of mobile and similar other gadgets in colleges by teachers during working hours (teachers would be able to use the devices in staff rooms, when off duty) and students (students would be able to use in special zones only, during off hours) as initiated by Gujarat and Himachal Pradesh are worth emulating. Moreover, private colleges should also introspect and assess their own standards.

- iii) Private Engineering education organizations/ institutes in India should think beyond just making profits; they need to develop the students knowledge and capabilities plus train them in practical skills with vocational training—both in terms of life-skills as well as livelihood skills in the lines of ‘Skill India’ or ‘Start-up India’, otherwise it would be like building card castles in thin air.
- iv) There is an acute shortage of infrastructure in the private engineering colleges and a dire need for a faculty development programme. As technology changes, the faculty also need to be trained to use new equipment. The salary paid to them be on par with the industry and they should be given opportunities to attend conferences, seminars and professional/ management training programmes to upgrade their knowledge and skill. The concept of ‘skill lab’, ‘job fairs’ and modernization of the whole set-up for training and teaching purposes is the need of the hour. These institutions need to be run by a properly constituted managing committee under a registered society or trust of a non-proprietary character. They must conform to the specifications relating to space and accommodation, laboratory, equipment for hands on training, library facilities, provision for co-curricular activities, well-qualified staff and where possible collaborate with foreign universities to upgrade their profile.

v) To address the concern of dwindling rate of employability of engineers there is a need to develop ‘Industry-Academia Interface’ to boost entrepreneurship among students, as Prof. Saikat Maitra V-C of West Bengal University of Technology (WBUT)- A University under which more than 90% of the private colleges of the state are affiliated, puts in ‘Looking at the market where there is very less scope for engineers, the only solution is to promote entrepreneurship among the next generation. Students who possess idea are often deterred from pursuing that idea and turning it into a full-fledged business since they do not have resources to the capital. We will ensure that the students are also guided as to from where finances can be arranged.’



A Press Note of the media - ‘The Statesman’ News Service supporting Start-Ups

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Role of Civil Engineering for Infrastructural Development in Various Sectors



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One of the oldest and most essential engineering disciplines in the globe is civil engineering. Many structures and constructions have evoked our amazement, right from the pyramids of Egypt to the Taj Mahal in India and all these bear testament to the abundant legacy of civil engineering.

Civil engineering has a significant role in the life of every human being, though one may not truly sense its importance in our daily routine. The function of civil engineering commences with the start of the day when we take a shower, since the water is delivered through a water supply system including a well designed network of pipes, water treatment plant and other numerous associated services. The network of roads on which we drive while proceeding to school or work, the huge structural bridges we come across and the tall buildings where we work, all have been designed and constructed by civil engineers. Even the benefits of electricity we use are available to us through the contribution of civil engineers who constructed the towers for the transmission lines. In fact, no sphere of life may be identified that does not include the contribution of civil engineering. Thus, the importance of civil engineering may be determined according to its usefulness in our daily life

Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works like roads, bridges, canals, dams, and buildings. Civil engineering is traditionally broken into several sub-disciplines including environmental engineering, geotechnical engineering, geophysics, geodesy, control engineering, structural engineering, biomechanics, nanotechnology, transportation engineering, earth science, atmospheric sciences, forensic engineering, municipal or urban engineering, water resources engineering, materials engineering, coastal engineering, surveying, and construction engineering.

Civil engineers play a very crucial role in the development of infrastructure which involves fundamental structures that are required for the functioning of a community and society, like roads, water supply, sewers, electrical grids, telecommunications, renewable energy, water sources identification and boring (wells), purification systems for clean water, hazard waste management and so on.

Civil engineers can manage to do the aforementioned projects related to infrastructural development as the fundamental idea of **less space and more efficiency** is embedded in all civil engineers which are crucial factors in development of infrastructure.

The job role of a civil engineer is extremely important as it equates for the overall safety of society in many different facets. It is important to look at the role that a civil engineer plays and realize what they do in their daily job duties that make the area safe for the people who live there.

It is important to first provide a formal definition highlighting the role of a civil engineer. A civil engineer is responsible for using their civil engineering background to plan and oversee various construction efforts in many different areas. They apply civil engineering principles to ensure that structures are constructed in the safest, sturdiest manner.

A civil engineer engages in many general responsibilities on a daily basis. These responsibilities are a crucial part of their job and enable the civil engineer to engage in their profession to the best of their ability. One general

responsibility of the civil engineer is to analyze various factors concerning a construction job. The civil engineer will analyze the proposed site location as well as the entire construction job which is to be completed at such a site. They will analyze the process for completing the construction job every step of the way. The civil engineer must also plan the construction project that will be taking place in conjunction with the results they found due to their analysis of the proposed project. During the process and at the end, the civil engineer must inspect the product to ensure that all rules, regulations and guidelines have been explicitly followed.

A civil engineer is a person who practices civil engineering; the application of planning, designing, constructing, maintaining, and operating infrastructures while protecting the public and environmental health, as well as improving existing infrastructures that have been neglected.

In some places, a civil engineer may perform land surveying; in others, surveying is limited to construction surveying, unless an additional qualification is obtained. Civil engineers usually practice in a particular specialty, such as construction engineering, geotechnical engineering, structural engineering, land development, transportation engineering, hydraulic engineering, and environmental engineering. Some civil engineers, particularly those working for government agencies, may practice across multiple specializations, particularly when involved in critical infrastructure development or maintenance.

There can be major tensions as a result of the need to balance professional activities between the various boundaries constraining, yet at the same time opening up, the range of activities within which civil engineering endeavours are carried out – e.g. designs for a new motorway bridge need to consider both the details of the bridge itself in terms of strength, materials, etc. and also at the same time, the wider implications of traffic use in the future as well as the construction use and potential depletion of resources and emission of greenhouse gases, as a wider more globally impacting consideration. However, depending on the clients' brief, whether or not there is the need for the bridge in the first place may or may not be considered within a wider societal and environmental perspective. Yet, it seems that civil engineers are mostly able to balance their activities successfully avoiding transgressions of the codes of ethics and professional conduct, especially where the professional is working for a large organisation.

Engineers have long been proud that they do what anyone can, but they do it better, more efficiently and more cost-effectively. Civil engineers rightly can claim a special place in *'directing the great forces of nature for the benefit of mankind'*. Self-evidently the works done by our forebears almost always benefitted mankind, in the widest sense as well as benefiting the immediate client (the one who paid). Definitions of civil engineering also include references to 'problem-solving' often resulting in a preoccupation with 'problems' rather than opportunities by engineers. Maximising the benefits and solving problems seem to be good definitions of what civil engineers actually do.

Civil engineering utilizes technical information obtained from numerous other sciences, and with the advancement in all types of technologies, the civil engineering has also benefited tremendously. The future of civil engineering is expected to be revolutionized by the new technologies including design software, GPS, GIS systems and other latest technical expertise in varied fields. Technology will continue to make important changes in the application of civil engineering, including the rapid progress in the use of 3-D and 4-D design tools.

Civil engineers have *"always addressed the core issues of sustainability, working for society within the environment to least cost or greatest value"*.

Civil engineering can be described as a specialised department of engineering that bargains with the layout, building and routine maintenance of bridges, structures, dams and other buildings. Human civilization can't exist without significant contributions from this branch of engineering and it is thus an indispensable self-discipline. Civil Engineers are generally used in development routines equally the non-public and general public sectors.

Sharpening and Scaling the Industry Readiness through Remote Internships



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Abstract: *In this era of Information and Digital Revolution, the Information Technology (IT) sector has witnessed rapid growth and quick, successive technology changes. Introduction of IT into various Industry Domains required a technically skilled workforce with Domain experience. However, recruiting a workforce with the right Domain skills has always been a challenge for the IT Industry, particularly in the product engineering area. Industry depends on Academic Institutions for a workforce that has the right mix of Domain and Technology skills and is able to apply the knowledge in real-time scenarios. While a person's attributes can be developed and improved over time through training, Domain skills can only be acquired through real-time practical assignments. Domain skills and industry-readiness can be achieved through a student-centric process, in which each individual is an active stakeholder in the learning process. Playback sessions, participation in case study analysis, and in national and international conferences, hands-on training, and so on, play an important role in enabling meaningful, contextual and application-oriented learning. Some Institutions have also introduced employability skills improvement programs and workshops that enable students to improve their Domain and Technology skills. However, these workshops have not entirely helped students to understand the practical problems in the Industry, and the students' focus is not on studying a specific Domain, as they are not aware about the Domain and the Technology they will be working in when they join the IT Industry. This paper discusses a collaborative model that will help Industry and Academia to come together and create an Industry-ready workforce. This model addresses how Industry can collaborate with Academia to provide students Domain training with hands-on practical work, which can help students to understand and solve real-time Industry problems. This model also provides a practical approach to make students productive from day one of joining the IT Industry. This model leverages the existing channels and fine-tunes the academic process to create Industry-ready graduates. This collaborative model will help create a sustainable workforce in an ever-changing environment and will help address the needs of IT Industry as well as align the Academia to the Industry trends.*

I. INTRODUCTION

Today, IT Industry is one of the largest employers in the country. In Financial Year (FY) 2015 alone India's talent pool was 5.8 million. However, a large number of these graduates do not possess the requisite skills in Domain and latest Technologies; they are simply not Industry-ready by the time they join the Industry. The average time taken by the Industry to train and deploy these fresh graduates into projects is approximately one year. This need to re-skill and up-skill graduates once they join the Industry, and the amount of time this requires, is one of the most important concerns that the IT Industry is facing today.

There is a mismatch between the Academia and Industry’s perception of Technology development, and this, to an extent, is resulting in widening the gap between the knowledge that graduates come with, and what the Industry really requires. While the Academia is focusing on innovative thinking, Industry’s focus is on identifying a concrete, workable solution for business problems, considering the fixed time frames and fixed investment on resources.

Academia and Industry need to collaborate and work together to create a model that will help meet Industry expectations, without disturbing the existing Academic process. Industry can mentor the Academicians and graduates to align with the current technology trends, motivating them to invest effort in resolving Industry problems. This collaborative model must be monitored and guided by both Academicians and Industry SMEs, for successful implementation, and must become a part of the core process of the graduation.

A Remote Internship with Industry collaboration will help create Industry-ready graduates on a large scale. A series of workshops, hands-on practice, group discussions, presentations and a real-time Industry problem as the students’ academic project will definitely help bring students closer to the Industry’s expectations. Industry projects will acquaint graduates with real world scenarios.

This model will first enable graduates to learn the latest technological concepts, and then will help them apply the concepts as part of student academic project, with support from Industry professionals. Students will be mentored by senior Industry SMEs who will be involved with various academic activities including the design of the course curriculum.

An alternative to this model is to create Technology Incubation Centres at colleges with the collaboration of Industry SMEs. However, the focus of this paper is on Remote Internships.

This paper examines how the existing channels can be leveraged and the academic process can be fine-tuned to create Industry-ready graduates. It is time the education system is restructured and collaboration is forged between Academia and Industry, to bridge the gap that exists in terms of technology and Industry expectations.

In general, the IT Industry recruits from campuses every year in the months of July and October. At this point, students appearing for the interview are in the 1st semester of the 4th year. Selected students join the Industry almost after a year, around June or July of the subsequent calendar year.

Post-selection, students spend almost a year of their precious time in the college, working on projects and other activities which may not be entirely aligned with Industry requirements. After they graduate and join the Industry, these

Current Model – induction of graduates	
Academia	Industry
(2-5 days)	(10 months to one year)

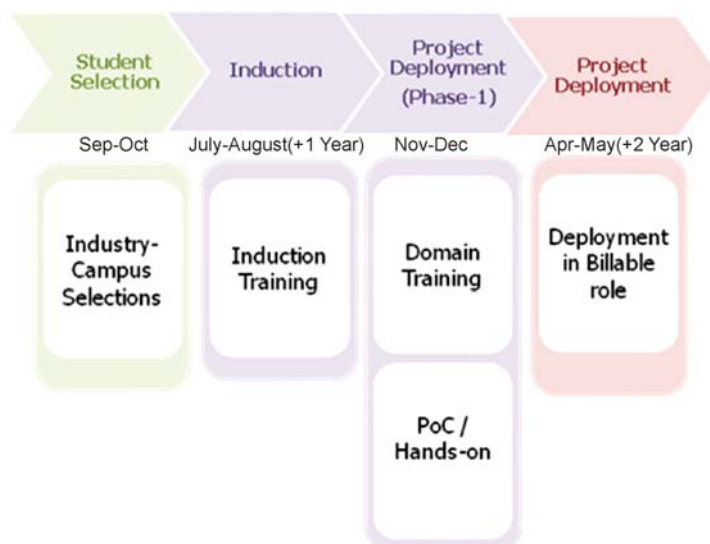


Figure 2. Current Model – Inducting graduates into Industry

new joinees typically attend an extensive Induction Program, which lasts for about 60 working days, that is, close to three months.

During the Induction Program, graduates are trained on soft skills, business skills and current technologies. After Induction, they are assigned to project teams, where time and effort is once again invested in Domain training and at least one hands-on Proof of Concept (PoC) or exercise in the domain.

This entire process may take 6 to 12 months. This waste of precious time, even after graduates join the Industry, adversely impacts all the stakeholders - the academic institutes, graduates and the Industry. It also impacts business results negatively.

II. THE PROPOSED MODEL OF COLLABORATION BETWEEN ACADEMIA AND INDUSTRY: THE REMOTE INTERNSHIP PROGRAM

The Remote Internship Program is designed to bridge the Technology and Domain gap between Academia and Industry, while ensuring that Engineering graduates are Industry-ready in a shorter time frame. This program is a collaborative working model between three key participants – Industry, Academia and Engineering graduates.

Mentoring is an important activity in this model. This model works on continuous mentoring by Subject Matter Experts (SMEs). The Domain SMEs from the Industry are identified and are always in touch with students until they join the Industry. Further, the SMEs conduct Domain-based workshops for the faculty, who in turn mentor the execution of the program. SMEs prepare problem statements covering various domains and latest technologies. These problem statements are explained to trained faculty in colleges, and after a buy-in from Heads of the Department (HoD) and mentors, these problem statements are given as final academic projects for the selected Engineering graduates.

Academia and industry collaborative model contains various phases. In each phase, there are a set of activities that are completed, and some that are carried forward. Details of the various phases, and the activities involved in each phase are given below:



Figure 3. Remote Internship Program: New Academic-Industry collaborative model

1. Initiation:

(June-July)

A. Industry – HODs /Mentors Discussion:

- a. Identifying a Single Point of Contact (SPoC) from the college and organization

B. Student Orientation Sessions:

- a. Orientation session on latest technology trends
- b. Topics to be concentrated from their engineering subjects and the required core competency

Outcome:

- a. All stake holders understand the program and next steps.
- b. A Single Point of Contact (SPoC) is identified from the college and Industry for the Program

2. Preparation

(August - September)

A. Faculty Development Program (FDP) workshops for mentors:

- a. Workshops on various Technologies and domains from Industry SMEs

B. Finalizing the problem statements with HODs/mentors:

- a. Identifying the problem statements for Undergraduate projects and defining the scope and expected outcome of the project.

Outcome:

Mentors/ HoDs are trained on Domains and latest technology areas and Problem statements are finalized.

3. Domain Training Workshops

(October-November)

A. Student Development Program (SDP) Workshop (providing an overview of various Domain Topics):

- a. Workshops on various technology domains by senior architects
- b. Each workshop covers a detailed overview of the domain-specific areas where problem statements are identified and programming workshops
- c. Discussed the problem statements with respective domain owners and identified teams

B. Ready to Go – Execution:

- a. Students will study the material provided by Industry
- b. Queries will be addressed by the Industry SMEs
- c. The Industry SPoC, along with the college SPoC, will coordinate the process

Outcome:

- a. Students are equipped with Domain knowledge and in specifics relating to the problem statements they have covered.
- b. Ready to Go for execution of the project

4. Hands-on (Project):

(4.2 Semester – Dec-April)

A. Project Execution:

- a. Groups/teams will start executing the projects from the second semester of their final year. Industry SMEs along with college guides will guide during the execution.

B. Status Reports and Reviews:

- a. College SPoC will consolidate the project execution status and update the Industry SPoC on a weekly basis.
- b. SMEs will review the executions every alternate week either online /offline based on the complexity of the projects.

Outcome:

- a. Students gain knowledge of the Domain, with hands-on experience
- b. Students complete the final semester project with industry exposure

5. Joining Time

(May-June)

Some of these students will be selected to join the Industry. These selected students will undergo this phase and next phases.

A. Technical Contests

- a. Engaging graduates with interesting Quiz, contests on domain and programming

B. Preparation for Induction

- a. Industry SPoC will prepare customized induction program based on business units need.

Outcome:

- a. Preparation for joining Induction Program completed
- b. Plan for execution of the induction courses

6. Induction Program

(June-Sep)

A. Advance Domain Training Plan

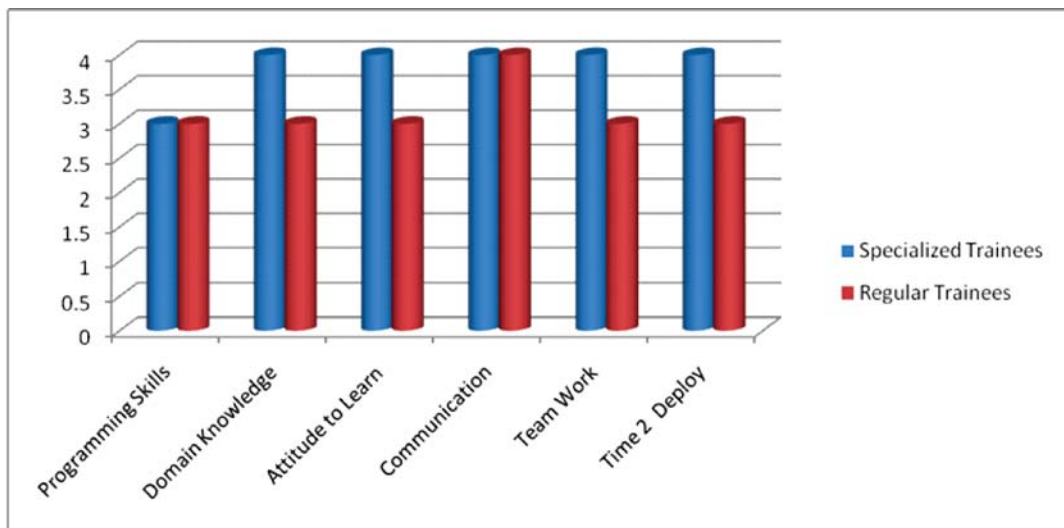
- a. Customized induction training will be provided along with mini project in-line with their UG project.

Outcome:

- a. Complete the training and deploy them into the projects

Graduates are Industry-ready with good knowledge of the Domain, and can be deployed into projects much earlier than the amount of time this currently takes.

III. RESULTS



Specialized Trainees– Graduates who joined Industry after going through remote internship;

Regular Trainees– Graduates who joined Industry without remote internship

Figure 4. Results of Remote internship on the scale of 5

This model was executed as a pilot in four academic institutes, and based on the feedback, was enhanced and implemented in nine academic institutes. We have measured the performance based on various parameters and have witnessed good feedback with respect to team work, domain knowledge and attitude to learn.

IV. ADVANTAGES

This model provides the following advantages to all the stakeholders:

- Reducing the average deployment time, and enabling the IT Industry to meet the technology and business needs.
- Reducing the cost of training (theory and practicals) enabling deployment of Engineers to projects from day one.
- Enabling student focus on their allocated domain in the final year, providing a focused area of study.
- Enabling Academic Institutions to showcase workshops and the projects executed as Industry-collaborative initiatives.
- Enabling Academic Institutions to showcase their abilities in getting the latest research projects and accreditations.
- Enabling Mentors to explore the real-world problems and initiate research in the latest technology trends.

V. CONCLUSION AND FUTURE SCOPE

The model described in this paper seeks to address a gap that has existed for long, between Industry expectations with respect to the quality of talent recruited, and the actual scenario. In the limited instances where this model was adopted, the Remote Internship model reduced the average time to deploy a graduate to projects by almost 6 months, and resulted in cost-saving (in terms of training) and revenue generation (because the fresh graduate can be deployed into projects much earlier). Setting up a separate department in colleges and in the IT Organisations to look after all the logistics, schedules, evaluation criteria and so on, will help. The results indicate that this is definitely worth the effort.

VI. ACKNOWLEDGMENTS

We thank all the educational institutes who supported this initiative. We thank all the SMEs and Managers of the Industry who supported this initiative.

SEMINAR ON 'ROLE OF STEEL IN MARITIME INFRASTRUCTURE'

CEAI in association with Hindustan Steelworks Construction Limited (HSCL) is planning to organise a seminar on 'Role of Steel in Maritime Infrastructure'. The aim of the seminar is to find avenues where steel usage can increase in maritime infrastructure.

Further details about the seminar are being finalised and will be posted on the CEAI website soon.

Institutional Commitments towards Sustainable Innovation and Entrepreneurship



Prof. D.N. Reddy

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Abstract: *Since Independence, India has endeavored to bring economic and social change through science and technology. The effort has been on upgrading the traditional skills to make them relevant and competitive and developing advanced capabilities in the frontier areas of Science and Technology. The visionaries who led the growth of Science and Technology (S&T) in India were convinced that S&T would play an important role in transforming India into a modern, industrialized society. Experience and results show that this confidence was well placed. Science, technology and innovation are even more relevant today. Scientific knowledge and expertise, Innovation, high technology, industrial infrastructure and skilled workforce are the currencies of this new era.*

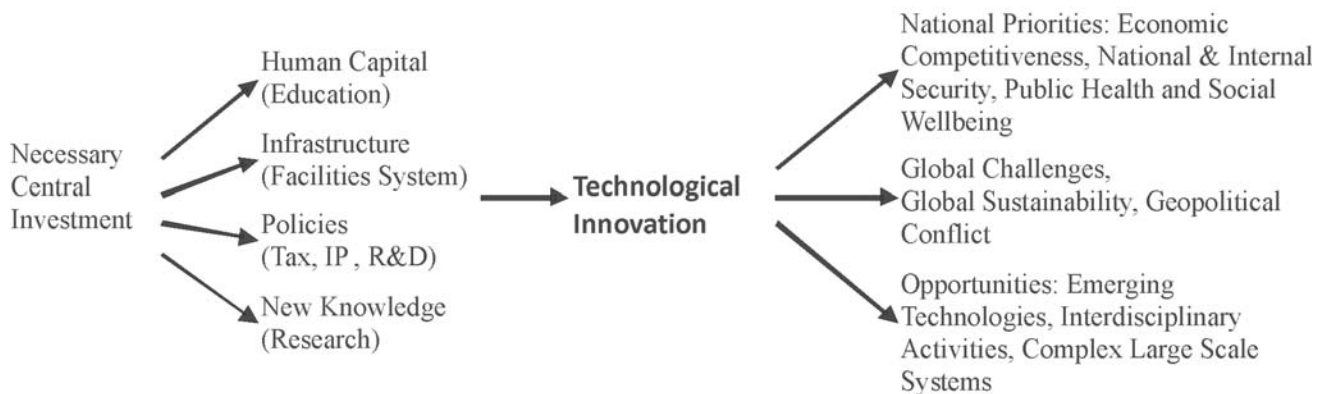
Education is the key driver for the development of society and nation. The rapid technological developments, globalization and the evolution of knowledge based society generated an altogether new demands and increased responsibility for educational institutions today. In addition to imparting knowledge and skills, institutes need to develop environments to encourage and nurture creativity and inventions. Generation of new knowledge through innovations and technology transfer stands the main components for economic growth and competitiveness in the 21st century Knowledge Society. Given this context, Organizations/ Educational Institutes need to be committed to their role of building the new capacity and competencies. The present paper presents the paradigm for innovation and the challenges involved. Further strategies to sustain the technological innovations in educational institutions are also discussed.

1.1 TECHNOLOGICAL INNOVATION

In today's global, knowledge-driven economy, leadership in innovation is essential to nation's prosperity and security. In particular, technological innovation the transformation of new knowledge into products, processes and services of value to society is critical to economic competitiveness, national security and an improved quality of life. But history has shown that public investment is necessary to produce the key ingredients for technological innovation including: New knowledge (Research & Development), Human capital (education, particularly at the advanced level), and infrastructure (physical and now cyber).

Although the flow of knowledge from scientific discovery through development and technological innovation, commercialization and deployment was once thought of as a linear, vertical process, it is now viewed as far more complex, both vertical and horizontal and involving many interacting disciplines and participants.

There is a vast untapped potential in India for wealth creation by increasing the levels of innovation content in the entire economic development activities of the country. It is a tall call but an essential one, if the current levels of growth of GDP were to be maintained over the next two decades. There are several case histories of nations benefiting substantially from a flow of innovations. Innovation will also be a key for sustainability—the ability to meet developmental objectives while ensuring sustainable use of natural resources.



1.2.1 Innovation Eco-system

The elements of an innovation ecology identified earlier fall into a number of institutional domains. An institutional representation of the innovation system is a useful tool for exploring the role of various actors in the innovation process and the way in which they may interact. Five categories of institutional participants can be identified:

- (i) Governments, which play a key role in setting broad policy directions and a primary role in funding basic scientific research,
- (ii) Private enterprises and their research institutes, which contribute to development: and other activities that are closer to the market than governments are,
- (iii) Universities and related institutions that provide key knowledge and skills,
- (iv) Bridging institutions acting as intermediaries under such names as ‘technology centre’, ‘technology brokers’, or ‘business innovation centre’s, which play an important role in closing the gaps among the other actors and have been important to the success of all types of research centres, and
- (v) Other organizations, public and private, such as venture capital firms, federal laboratories, and training organizations.

1.2.2 Innovation System - Global Experience

There is a wide spectrum with regard to the extent to which governments can influence the innovation system. To a large extent, the approaches adopted by various nations in the direction of innovation systems have varied depending on the overall national economic orientation. These approaches have ranged from a ‘directed or coordinated’ model such as the one selected by Japan, to a much more laissez faire model employed in the USA. Countries such as Canada and others in the European Union (EU) region have adopted models that fall in between those of Japan and the US, at least in terms of strategy and sector identification for leveraging innovations. Thus, from the standpoint of a national planning process, there are several approaches to directing and shaping the innovation-led development processes. Although there may be varying levels of the directed or coordinated functions of the governments in shaping the innovation infrastructure, most nations have recognized the similarity of needs for creating an innovation infrastructure.

1.2.3 Creating an Innovation Infrastructure - National Innovation Policy

The forward plan of India is towards faster and more inclusive growth. Faster growth in a globally competitive market environment demands a national innovation infrastructure that connects knowledge systems to wealth creation efficiently and effectively. In the Indian social context, there is a need to ensure that innovative growth-

linked processes do not bypass the poor and leave them out of developmental choices emanating from the benefits of globally competitive innovations. Therefore, the Indian model for innovation should be unique.

The prevailing asymmetry between inventors and investors is required to be bridged. Financing systems for backing up early-stage innovations with risk capital are required. Provisions for exiting from non-profitable innovations also need to be made. Innovations created at the expense of considerable investment of resources would demand a matching Intellectual Property Rights (IPR) regime. While the legal framework for protecting IPR is in place, infrastructure for capturing and protecting IPR is still evolving in India. Use of technology tools and capacity building in the area of IPR management require scaling up. New approaches and programmes are essential for unleashing India's innovation potential. Competitiveness innovation cluster has emerged as a successful global concept. Such innovation clusters in which academia, research and industry partner under viable and equitable PPP are the way forward.

The design and development of a sustainable innovation infrastructure should take into account global best practices, attraction, attachment, retention and renovation of talent within the research and development streams, PPPs, venture and angel financing and capacity building. The realization of Indian Vision 2025 to emerge as a major economic power in the global knowledge economy would call for a sustainable innovation infrastructure.

In order to unleash our full innovative potential, we need to put in place a National Innovation policy, which encourages competition among enterprises, greater diffusion of knowledge and increased support to early-stage technology development initiatives and grass root-level innovators. We need to foster increased collaboration among R&D institutes, universities and private sector enterprises and leverage upon their cumulative strengths in designing and implementing various innovation programmes. There is also a need for an appropriate legislative framework for incentivizing the innovators and commercialization of public funded R&D, where the government, the recipient(s) of funds, the inventor, as well as the public benefit from the protection and commercialization.

2.0 Strengthening Academia – Industry Interface (Including Public – Private Partnership)

The relationship between the academia and industry should be of interactive, collaborative and participative nature, realizing and respecting each other's role and contribution. Efforts are needed to focus on PPP and creation of enabling environments. Effective academia industry interaction will lead to: strengthening competitiveness, promoting innovation and new technology development: on the one hand and ensuring development and supply of qualified S&T manpower. In order to strengthen the interface and tap the PPP potential effectively, the thrust should be on creation of new interface structures such as consortia, partnership [research institutions for basic and applied R&D; (enhancing mobility of S&T professionals; and promotion of technology transfer and new venture creation. Industrial houses may be encouraged to create corpus funds in academic institutions for promoting applied R&D relevant to their needs. Centres of Relevance and Excellence may also be set up in academic and R&D institutions in select areas of S&T, which are of direct relevance to industries. The student internship programme should also be made more meaningful, so that it benefits both the students and the industry.

2.1 Science and Technology for Small and Medium Enterprises

Small and Medium Scale Organization enterprises (SMEs) occupy an important and strategic place in economic growth and equitable development of the country and are the driving force behind a large number of innovations. The post-liberalization era has enhanced opportunities and challenges for this sector. For enabling the SMEs to tide over the problems of technological backwardness and to enhance their access to new technologies, it is essential to understand and assess the real needs of the SMEs and devise approaches accordingly. There is also a need to leverage on modern technologies through increased communication, cooperation and linkages both within the enterprise as well as across enterprises and across knowledge-producing organizations.

2.2 Leveraging International Collaboration Inputs

International S&T collaborations are essentially mechanisms of providing opportunities and platforms to various countries to work together, taking mutual advantage of complementary/scientific & technological capabilities of each other. They provide first-hand acquaintance with scientific and technological developments and work cultures in other countries and access to sophisticated research facilities abroad. Interaction between scientific researchers helps in updating and refining their knowledge base for accelerating the pace of investigation as also to fill up information gaps. Science being location neutral, international collaboration affords the way forward for development of advanced technologies, high tech equipment/ facilities and new-generation materials.

Technology-led growth of the economy is a proven global model of growth, more so of developed nations. This has brought technology-led diplomacy to the centre-stage in international cooperation, and India also needs to leverage such technology-led diplomacy. Several developed nations have been targeting the young population of India for catalyzing the growth of their own science and technology systems. India cannot remain a supply system of talents alone. Our strategy for international cooperation needs to be based on mutual gain and complementary strength. There are nations from which India may stand to gain by teaming up in certain sectors of development. Overall growth in important sectors of the economy cannot be based on total self - reliance as that may prove too expensive and time consuming. Re-inventing and reverse engineering models of growth are also not sustainable for modern India. In such domains, India would need to develop strategic partnerships with other nations after appropriate cost benefit analysis. Energy, water, ecological and nutrition security of India would call for large global models of S&T cooperation. Areas of research such as high energy physics, nuclear physics, accelerator physics and technology, are distinctly international in character. Suitable collaborative projects by mobilizing the national strengths in these areas would need to be evolved and funded in coordination with other agencies.

3.0 Innovation and Entrepreneurship

3.1 Introduction

There is a strong linkage between innovation and entrepreneurship. An entrepreneur shifts economic resources out of an area of lower into an area of higher productivity and greater yield. Entrepreneurs may not invent but they do innovate.

There is nothing technical about innovation. One of the best examples of entrepreneurship is McDonald's. It did not invent anything. Its final product was what any decent American restaurant had produced years ago. But by applying management concepts and management techniques, by standardizing the "product," by designing processes and tools, by offering training and by setting the standards, McDonald's both drastically upgraded the yield from resources, and created a new market and a new customer. This is the essence of entrepreneurship.

3.2 Need for Removing Misconceptions among Entrepreneurs

Entrepreneurship is by no means confined to economic institutions. Entrepreneurs are not capitalists, although they need capital to run their business. Entrepreneurs are not investors, either. They take risks, but so does anyone engaged in any kind of economic activity. The essence of economic activity is the commitment of present resources to future expectations, and that means uncertainty and risk. The entrepreneur is also not an employer, but can be, and often is, an employee or someone who works alone.

Entrepreneurs, as mentioned earlier, shift resources from an area of low productivity and yield to an area of higher productivity and yield. There is always the risk they may not succeed. But if they are even moderately

successful, the returns should be more than adequate to offset whatever risk there might be. One should thus expect entrepreneurship to be considerably less risky than optimization. Indeed, nothing could be as risky as optimizing resources in areas where the proper and profitable course is innovation, that is, where the opportunities for innovation already exist. So, contrary to the popular notion, entrepreneurship should be the least risky rather than the most risky course.

Entrepreneurship is widely perceived to be “risky” mainly because so few of the so-called entrepreneurs know what they are doing. They lack the methodology. They violate elementary and well-known rules. This is particularly true of high-tech entrepreneurs.

3.3 Characteristics of Entrepreneurs

Entrepreneurs have the most diverse personalities and temperaments. People who hate uncertainty are unlikely to make good entrepreneurs. But that is not saying much. For such ‘people are unlikely to do well in a host of other activities as well in politics, for instance, or in command position in a military service, or as the captain of an ocean liner. In all such pursuits, decisions have to be made, and the essence of any decision is uncertainty. But someone who can face up to decision making can learn to be an entrepreneur. Entrepreneurship is more about behavior rather than personality trait. And its foundation lies in concept and theory rather than in intuition.

3.4 Systematic Innovations

Entrepreneurs innovate. Innovation endows resources with a new capacity to create wealth. Innovation creates a resource or changes the wealth-producing potential of already existing Resources.

Innovation does not have to be technical. Few technical innovations can compete in terms of impact with such social innovations as the newspaper or insurance. The Japanese have produced few outstanding technical or scientific innovations. Their success is based on social innovation. Technology can be imported at low cost and with a minimum of cultural risk. Institutions, by contrast, need cultural roots to grow and to prosper. The Japanese made a deliberate decision a hundred years ago to concentrate their resources on social innovations, and to imitate, import, and adapt technical innovations - with startling success.

3.5 Technological Innovation Systems

Structures involve elements that are relatively stable over time. Nevertheless, for many technologies, especially newly emerging ones, these structures are not yet (fully) in place. For this reason, mostly, the scholars have recently enriched the literature on Technological Innovation Systems with studies that focus on the build-up of structures over time. The central idea of this approach is to consider all activities that contribute to the development, diffusion, and use of innovations as system functions. These system functions are to be understood as types of activities that influence the build-up of a Technological Innovation System. Each system function may be ‘fulfilled’ in a variety of ways. The premise is that, in order to properly develop, the system should positively fulfill all system functions. Various ‘lists’ of system functions have been constructed. Authors like Bergek et al, Negro and Suurs give useful overviews. These lists show much overlap and differences reside mostly in the particular way of clustering activities. An example of such a list is provided below.

4.0 New Technologies and Capabilities

To improve competitiveness and retain sustainability, firms require new technologies and capabilities. In this age of rapid innovation and complexity, it is challenging for the firms to develop internally and remain competitive at the same time. Merger, acquisition and alliance are some of the ways to achieve this, but the primary driver is the

desire to obtain valuable resources. Many acquisitions failed to achieve their objectives and resulted in poor performance because of improper implementation.

1. Improper documentation and changing implicit knowledge makes it difficult to share information during acquisition.
2. For acquired firm symbolic and cultural independence which is the base of technology and capabilities are more important than administrative independence.
3. Detailed knowledge exchange and integrations are difficult when the acquired firm is large and high performing.
4. Management of executives from acquired firm is critical in terms of promotions and pay incentives to utilize their talent and value their expertise.
5. Transfer of technologies and capabilities are most difficult task to manage because of complications of acquisition implementation. The risk of losing implicit knowledge is always associated with the fast pace acquisition.

5.0 Conclusion

Knowledge-based innovation has the longest lead time of all innovations. There is, usually a long time span between the emergence of new knowledge and its becoming applicable to technology. There is often a long period before the new technology turns into products, processes, or services in the marketplace. The lead time for knowledge to become applicable technology and being accepted on the market is between 25 and 35 years.

CONFERENCE ON 'PREPARING ENGINEERS/ TECHNOLOGISTS FOR ROLE IN INDUSTRY'

The Engineering Council of India (ECI) with the support of AICTE is organizing its 15th National Conference on 'Preparing Engineers/ Technologists for Role in Industry' on 10th November 2017 at AICTE, NJU Campus, Nelson Mandela Marg, Vasant Kunj, New Delhi 110067.

The sub-themes of the conference are industry's requirements for Skilled engineers, Role of Academia in Preparing engineers for Industry and Framework for internship to meet Industry needs.

*For more details contact: Engineering Council of India,
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Quality of Engineering Education: Parameters to be Considered

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Abstract

This paper expresses concern on the declining standards of quality of engineering education in India and suggests parameters that are relevant in measuring and nurturing quality of engineering education. It identifies misplaced priority structure in enabling quality as measured by the employability of engineering graduates. It proposes a set of recommendations to improve the situation to realize the demographic dividend potential in India.

1. Introduction

Engineering education has seen exponential growth during the past two decades as a result of private equity participation in delivering engineering education. While this has improved access to engineering education, quality and employability as well as affordability have become a cause for concern and have resulted in many debates in the country over the declining quality standards. Hence there is the need for introspection.

The exponential growth of the engineering education is not a sustainable proposition. It is well known concept in System Dynamics modeling that the exponential growth of any system signifies lack of control. This is because the growth in numbers cannot match with the other components of the system. The biggest gaps arising out of this exponential growth are the imbalances in the sub-systems of technical education system which have eventually impacted negatively on the quality and employability of the engineering graduates.

2. Employability as a measure of quality

Quality of engineering education is a multi-dimensional concept and can be measured through the employability of these graduates. Conventionally the concept of quality means “Conformance to Customer requirements”. In case of engineering education the customers are the employers, the government and the society at large. Hence employability of these graduates can be a surrogate measure of their quality. Employability of engineering graduates in India has been a cause of concern and at various forums this low employability has been discussed. Since one needs to measure employability with a view to manage it; various measures of employability have been proposed. Vrat et al (2014) have defined the employability as:

$$E = A [w \cdot K + (1 - w)S]$$

Where E= employability, between 0-1

K= Knowledge, between 0-1

S= Skill, between 0-1

w= Relative weight of knowledge over skill, between 0-1

‘w’ will depend upon the level of engineering education: be at diploma, degree, postgraduate and doctoral level. ‘w’ increase as the level of degree goes up. In this model the attitude becomes a critical success factor and hence it is used in a multiplicative role. Even if a graduate has the knowledge and skill but is perceived to be of negative attitude, he/she may not be employable. The model of employability can be used for developing a holistic curriculum in engineering education. Vrat and Sangwan (2017) have proposed the application of the Quality Function Deployment (QFD) concept of House of Quality (HOQ) to translate the attribute of employability required by customer (employer) into the subjects that need to be taught to acquire them.

3. Role of Human Values and Professional Ethics

In technical education system; the attitude being a critical success factor necessitates that every engineering student be exposed to role of human values and professional ethics to make the students more humane and ethical in their conduct in addition to sound knowledge and skills in their chosen domain of engineering. Otherwise they could misuse their knowledge of technology to harm the society for their personal gain. Technology has to be wisely used for the good of human society and not for cornering gains for the self at the cost of the people, society, or the environment. A good engineer has to be a good human being first and ethical in pursuit of the profession. If we ignore this aspect; the technical advancement can be disastrous for the society. Some trends of this are already visible due to increasing rate of technology enabled crimes and cyber-crimes. UP Technical University (now Dr. A.P.J Abdul Kalam Technical University) Lucknow was the first technical university in the country to recognize this need and introduced a compulsory audit course on Human Values and Professional Ethics in all engineering programmes; without clearing it, one could not graduate. This initiative has now been replicated in some 7-8 state technical universities and also in the Royal University, Bhutan.

4. Factors affecting quality of engineering education

The factors leading to low employability and quality of engineering education system can be grouped into two categories: strategic having long term impact and operational affecting day to day functioning of the institutions. Low quality can be attributed to the following:

- a. **Strategic factors:** these include poor academic leadership, weak management commitment, low faculty quality, out dated curriculum, low research focus, indifferent alumni relations, poor industry-academia interactions, lack of adequate funding to support quality standards, poor policies which may be lacking in long-term focus and having knee-jerk responses due to myopic perception of the ownership. Lack of long range planning leading to imbalances of various kinds –regional, branch-wise, owner-ship pattern, etc. About 90% of institutions of engineering are in private hands and the bulk of engineers are produced through this route. Paradoxically, this sector is over-regulated without much financial support. The regulatory framework should provide a level playing field between government owned and private institutions because both contribute to the same cause of nation building through capable human resources. The approach should be that of nurturing talent through hand holding, facilitating role rather than inspection driven command-control-compliance driven approach.
- b. **Operational Factors:** At operational level, the factors for poor quality are: poor quality of lectures/lab work, inefficient examination system, poor evaluation process, language barriers, absence of effective student feedback system, poor library, sports and cultural events, job insecurity, imbalanced faculty cadre ratios, faculty shortage, low faculty satisfaction and morale, inactive student cell, non-involvement of students in decision making processes; poor quality of internships and low placements.

5. Faculty Quality: A Key Constraint

Faculty Quality is the biggest single factor for quality and employability. Unfortunately this is also a key constraint in the way of quality education. Teaching and research are no longer the preferred career option of job seekers and at times it is the last resort. One cannot expect great quality in engineering education unless faculty is top quality and is motivated to inspire, involve and transform students into outstanding engineers with great minds and positive mind-sets.

The factors responsible for this are multi-dimensional. Societal and social esteem of teaching profession over other coveted services-civil and administrative; and executive positions with many fold payment packages prevent job seekers to opt for teaching and research even in the government sector. In the private sector which account for more than 90% share of output; additionally the lower pay packages; low job security, perceived lack of

freedom and 'psychic' income results in still lower faculty quality in many, if not all cases. Lack of motivation to teach, low morale, lower pay, inadequate job security and over-control in day to day functioning is leading to major faculty quality crisis in engineering education in the private sector. In government sector, high faculty shortage is due to lack of frequent recruitments/promotions rigid faculty cadres-in institutions other than institutions of national importance, which has resulted in 40-50% faculty shortage. Bulk of teaching is being done by casual/guest faculty who may be just fresh graduates paid very low hourly lecture rates with an upper limit on earning per month. Even in IIT's/NIT's there are 30-40% faculty shortages even in old established IIT's and for newly created IIT's/ NIT's the situation is much worse.

6. Policy Paradox and Misplaced Priorities

One major factor responsible for the enormous gaps in faculty quality and/ or numbers is a number of policy paradoxes. Though there are 30-40% faculty vacancies in even the top institutions; due to rigid retirement (age related) policies and inability to attract talented persons towards teaching profession; thus the faculty gaps are increasing. Due to 'expiry date on talent', even capable, active professor retire on a fixed date and that leads to talent shortage at the institutions and talent wastage of these top brains who suddenly sit at home unless they get opportunity in the private sector for re-employment. In developed world such as USA, there is no compulsory age of retirement and a professor could teach, guide research mentor faculty and students as long as one wishes even beyond the age of 90. Thus if Indian institutions-both government and private are allowed to retain talented faculty irrespective of their age; to some extent the faculty quality and shortage issues can be mitigated. The active, talented faculty should never retire.

The second factor that is impacting quality is the misplaced priorities in technical education particularly in the private sector. Many institutions give top most priority to world-class physical infrastructure and buildings; cultural and sports events but faculty quality; teaching-learning processes, quality of academic leadership get lower priority resulting in overall low quality and employability of graduates.

7. Concluding Remarks

The quality of engineers is vital for the economic progress of the nation. It is necessary to reap the demographic dividend potential. However, lack of quality and employability could lead to a demographic disaster if large numbers of unemployable students are added to the economy year after year. Already the engineering education profession is experiencing the 'Boomerang Effect' where this is no longer a sought after career option. This year the enrollments are almost at the same level as they were in 2006. Creating over-capacity without quality is resulting in huge unfilled number of seats. It is important for policy planners, regulators and employers to collectively address these factors in an integrated manner to regain the past glory associated with engineering education in the country.

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How Consulting Engineers can contribute to Engineering Education

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(Views expressed are personal)

India has thousands of engineering colleges and institutions which graduate several lakh engineering graduates each year, mostly with a B.Tech./B.E. degree. Much has been commented upon about the quality and employability of engineering graduates. Amongst the many issues identified therein, one that is often cited, is the need for bridging the gap between theory on the one hand and practice/engineering profession on the other. The benefits of doing so are many, enhanced employability being but one.

In general, engineering teachers/faculty, as well as students, have a limited idea about what is engineering and how it happens. Some of these ideas border on an ideal that once students have studied the courses, and the more the better, they are competent at doing engineering. Such an expectation is overly optimistic and quite unrealistic. Fresh graduate engineers usually undergo a year of training which makes them capable of contributing to engineering work, and learning continues throughout one's career.

Much needs to be done to bridge this gap. For starters, engineering faculty and more so students have no exposure to the world of consulting engineering. There is, therefore, a need for tie-ups between engineering consulting organizations and academic institutions and faculty. Some thoughts on what can be done, and how, are presented below.

Background

From the perspective of students and faculty, several questions can be posed: What is consulting engineering? Or, for that matter, what is engineering itself? What do consulting engineers do? Why are they needed? Who can become an engineering consultant? What is the work like? What are salaries like? What are the career opportunities? How is it connected to classroom education? And so on.

Some of these are addressed by organizations via pre-placement talks and, hence, their reach is limited and it does not contribute to the education process. Something quite different is called for.

On the other side, experienced engineers often ask the question "What can we do for engineering students?" with the hope that the graduates could benefit and become better equipped to fit into the world of engineering and technology. While such a student-centric approach is most welcome, it is important to realize that the key persons in the education process are the faculty and the teachers. While students come and go year after year, it is the faculty who are permanent, and can, therefore, maintain continuity over many batches of students. Hence, it is very important that interventions in the education process must involve the faculty at every stage.

Given this background, how can consulting engineers become partners in the teaching-learning processes? What sort of an institutional framework is required? What types of activities are possible? These questions require an understanding to the teaching-learning processes.

At the college/institution level, what is taught is the outcome of curriculum design, and how it is taught depends on the teaching methodologies adapted. Engineering curriculum is comprised of several courses each of which focuses on a set concept, subject, topic or theme. How all these aspects come together in the success, and/or failure, of a product or system are not explicitly brought out. In other words, while education addresses the

analysis part, the synthesis of the different courses/concepts is not factored in. It is here in the synthesis of theory from different courses and associated engineering practice that consulting engineers can contribute to the education process. Such an approach will also bring practice into the coursework and enrich it.

Many innovations and changes are needed in engineering education and some in which consulting engineers can contribute are discussed below. Most of these can be executed with minimal changes to existing systems and so are easily implementable; how this can be executed is elaborated in the last section.

What needs to be done?

To begin with, awareness about consulting engineers and their activities needs to be disseminated amongst faculty and students.

In the next step, the processes of “doing engineering”, i.e. the making of engineered products and systems needs to be brought out.

Engineering work follows certain practices, some of which are codified. Some of these are broadly referred to as professional practices which are often talked about in academic settings. However, their awareness amongst both faculty and students, and much more importantly, their practice in day to day work is sorely lacking. What constitutes professional practices needs to be communicated and integrated into course work.

The use of codes and standards in design activities is very common. This important feature of engineering needs to be emphasized in engineering education.

The above would expose students to the nature of work done by consulting engineers and this can be followed up by bringing real life situations into the classroom. One way to accomplish this is via case studies about projects from conception to execution, completion, and operation and maintenance. These case studies can also bring out an appreciation of the finer technical details and decisions related to engineering and technology choices. Equally importantly, the human aspects of projects, such as, the people involved, their roles, team work and management could be introduced.

At the level of an individual course, the classroom experience can be enhanced by presenting to students problems that are rooted in real life situations that can be depicted by photographs, videos and engineering drawings, and specification sheets. Students can then be asked to solve them. This aspect would necessarily have to be integrated on a course by course basis with close involvement of the concerned teachers. The problems can be fundamental in nature at the undergraduate level, and advanced at the postgraduate level. Design type problems can also be posed. Some of these could be seeds for defining research projects. Such work can help students appreciate the application, its theoretical foundations, their limitations in the practical context, as well as real world considerations, such as, equipment available, space constraints, etc. Some problems can be posed in project form where the mandate is presented and students have to come up with an engineering design solution in a time frame. Such experiences will enable students to not only understand the theory better, but also its practical aspects.

In the professional world, projects are executed by following well established practices. In academic institutions, every student undertakes one or more projects under faculty guidance which are defined by the faculty and executed and evaluated by them. The processes of student projects are, however, vastly different from those followed by professional engineers. The professional methods of project management are generally not practised. Besides, documentation is not emphasized, and the outcome of most projects has little benefit to society. Consulting engineers can bring considerable value addition to this activity. For one, the tools and practices of project activities need to be propagated amongst colleges who would also need support in its implementation. Another, projects can be formulated such that the deliverables are useful to industry. Such projects can be posed to a team of students,

which could be multi-disciplinary, and jointly guided by a team of faculty and consulting engineers. A variety of problems can be posed and futuristic and innovative ideas can also be explored.

A major challenge is to enable engineering graduates to communicate in the language of the engineer, viz., engineering drawings. In the prevailing curricula, there are courses on engineering drawing at least one of which is common to all branches/disciplines. The courses cover a limited type of drawings and many types of drawings are not taught, e.g. schematics, layouts, wiring diagrams, control schemes, piping, and instrumentation and control, amongst others. The rigour of following national and international standards too needs to be emphasized. In the overall scheme of engineering education, the use of drawings remains confined to a few specific courses and does not become integral to most engineering courses. Further, the drawing course remains just another course instead of becoming a language which should find use in many courses. Much innovation in the teaching and use of drawings is needed where consulting engineers can make significant contributions.

It will be wonderful if the vast and rich experience of consulting engineers can be brought to the students and faculty. Students can benefit from exposure to practical engineering situations, problems and challenges.

How to do it? Some suggestions

With its extensive network of experienced engineers and resources, CEAI can play a central role in addressing the above needs. Activities can take several forms and be spread out over a period of time and be executed across the country simultaneously. A tie-up framework with colleges and faculty would be essential for which CEAI can designate a single point contact for facilitation.

Awareness can be spread via guest lectures, seminars, student-faculty visits to engineering concerns' offices and sites, and preparation of videos, such as those seen National Geographic, and Discovery channels, amongst others.

The role of different entities involved in a project, such as, client, consulting engineer, supplier, erection agency, project management agency, commissioning engineers, supervision, etc. can be brought out as also the role of individual engineers and non-graduate workmen in these organizations. The roles of individuals in such projects, their work profiles, career profiles, expertise, R&D, etc. can also be discussed. This information will give students a realistic picture about the engineering profession and help them in planning their education and careers.

The varied roles and tasks of consulting engineers at every level in practical real situations can be explained. For this purpose, a diverse set of case studies can be produced and used in teaching which could encompass, amongst others, power plants, airports, highways, ports, water and sewage, hospitals, refineries, railways, data centres, and factories.

At the next level, project videos can be supplemented with data drawn from experiences of consulting engineers which could be basis for framing practice problems and projects. A bank of practical problems can be compiled in this manner and made available to students and faculty. One way to present these would be as a "problem statement" comprising of a combination of documents, data, engineering drawings, pictures and videos. It could give the context of the application and a mandate about the engineering solution desired. As relevant, some information about intangibles, standards and practical limitations could also be included. In conjunction with the faculty, the problem fact sheet can be linked with the knowledge base from which the solution will emerge, which in turn should be connected to specific course(s) of the curriculum. Following the problem definition, the faculty and engineers need to work together and generate the solutions and expound on the learning outcomes. This approach will enable the faculty to effectively use these resources in the classroom.

Student internships in engineering concerns are quite common and should be strengthened. Besides, some students' projects at both undergraduate and postgraduate levels can be facilitated or executed in the consulting engineers' offices. Such interactions over a sustained period of time will give the student, as also the faculty, a flavour about professional practices, some of which they will imbibe and practice in the colleges.

However, what is also needed crucially is the involvement of faculty in engineering practice. A faculty hosting programme can be developed by CEAI which can connect faculty and engineering concerns. A good time for such activities are the summer and winter vacations. Besides, faculty can be involved as consultants in specific projects which will give them exposure to engineering work.

The need for preparation of Detailed Project Reports (DPRs), Feasibility Reports and Proposals prior to project commencement needs to be introduced as an essential integral part of students' project activities. Students undertake several projects under the various categories, such as, curricular projects, thesis (including master's and doctoral), co-curricular activities, and innovation work. Experienced consulting engineers can create learning materials on these topics and supplement it with case studies. They can also be resource persons to give feedback on documents prepared by students. The importance of issues beyond technical subjects can be brought out in this task, as also the benefits of detailed planning in advance.

To make the above happen, CEAI could facilitate in many ways:

- CEAI can be a coordinating organization between consulting engineering concerns and educational institutions; its website could facilitate this work.
- Learning resources developed through CEAI can be made available to faculty and students, some of which can be available without restrictions while others can be made available on request.
- CEAI can establish a system where faculty can tie up with experienced engineers for guest lectures, interact with student teams on projects, and provide practical advice in executing projects.
- CEAI can provide a forum for student teams and faculty to interact with consulting engineers on exploring new, alternate and innovative concepts, applications and exploratory ideas.
- CEAI can promote induction of faculty as consultants in engineering organizations.

If a dialogue can be initiated between faculty members and consulting engineers much more can be accomplished. The ideas given above, and many others, can help address critical gaps in engineering education at all levels, viz., undergraduate, post-graduate and research levels. It can also enhance teaching resources that are the need of the hour. The outcome would be better engineering education resulting in engineering graduates who are better prepared for professional work.

CEAI NEWS

WEBINAR PRESENTATIONS

Young Professionals Forum of CEAI organized the following Webinar presentations. The webinars were meant for all practicing engineers. There was excellent participation for the webinars.

a) Presentation on ‘Structures for Spectacular Sports Arenas’

Held on 29 July 2017.

The presentation was by Prof Mahesh Tandon, Managing Director, Tandon Consultants Pvt. Ltd (TCPL), an international expert in the field of Structural Engineering. Many of the structures designed by Prof Tandon and TCPL have been widely acclaimed and have received recognition in India as well as internationally.

b) Presentation on ‘Road Safety Investment using iRAP Star Ratings and Safer Roads Investment Plans’

Held on 8th September 2017.

Mr. Jigesh Bhavsar from ICT (Intercontinental Consultants and Technocrats Pvt. Ltd.) presented the iRAP methodology in brief. It involves assessment of road features that influence risk for vehicle occupants, motorcyclists, pedestrians and bicyclists and assigning safety ratings from 1 to 5 stars.

Mr. Jigesh Bhavsar is one of the winners of the National Young Engineers Award 2016 in the category of Innovation in Design Engineering.

SEMINAR ‘MANAGING PHYSICAL ASSETS To Deliver Business Outcomes Cost Effectively’

CEAI, in conjunction with the Institute of Asset Management (IAM), United Kingdom, is organizing a seminar on Physical Asset Management on 12th October 2017 at Vivanta by Taj President, Mumbai, with the aim of raising awareness and accelerating the adoption of the ISO 55000 standards and best practices

in India. The Seminar is targeted at a limited number of senior decision-makers; and it would be a great opportunity to start a robust dialogue on such an important issue amongst the senior leaders from different sectors.

The adoption of Asset Management best practices has shown remarkable benefits in terms of improved performance, reduction in costs and improved risk control across several industry sectors worldwide. The adoption of ISO 55000 standards is now being mandated by financial institutions such as The World Bank on grants to India and other countries worldwide.

Assets and their realizable values in delivering business and customer outcomes are the primary yardsticks which are used by analysts and stakeholders to assess the viability and performance of companies. Whether the entity is a private company or government owned and whether the assets are tangible or intangible, financial or non-financial, it is the efficient and effective asset management that maximizes value for money and ensures consistent excellence. The process involves the coordinated and optimized planning, asset selection, acquisition/ development, utilization, care, maintenance and ultimate disposal or renewal of the appropriate assets.

Governments, Public Authorities, Bodies and Private organizations and even individuals have over the years built large portfolios of physical assets. Physical assets include public and private buildings, hospitals, education centres, hotels, roads & highways, drainage, railways, ports & harbours, shipping, aviation, water and sanitation, flood protection, dams, irrigation, space research, defence, chemical & industrial plants, power generation and transmission, oil & gas, telecommunication, etc. These assets are vital for the socio-economic development of the nation.

This Seminar is a timely response to the demand for dissemination of recent initiatives which are intended to streamline asset management and to bring the Indian market in line with global best practices. The Bureau of Indian Standards has formally adopted the ISO 55000 suite of asset management standards but to-date the

standards have not been widely implemented in India. Many countries are actively promoting the adoption of these standards by both the private and public sector organisations and to enhance their credibility and competitive position internationally. The National Building Code of India 2016 has also incorporated the "Asset and Facility Management" as Part 12. Thus those adopting the code would also need to abide by the requirements given therein.

For more details about the Seminar, please visit our website www.ceai.org.in.

SEMINAR ON “KOLKATA EAST WEST METRO-UNIQUE CONSTRUCTION CHALLENGES”

CEAI East & North East Region Centre in association with Kolkata Metro Rail Corporation (KMRC) is organizing Seminar on “KOLKATA EAST WEST METRO-Unique Construction Challenges” on 14th October 2017 at Williamson Magor Hall of the Bengal Chamber of Commerce, 6 N S Road, Kolkata.

The seminar would cover the unique underground construction work in soft soil and also cover aspects of sustainability, planning, design and implementation of underground structures, ventilation systems and other utilities being carried out by KMRC.

NATIONAL WORKSHOP ON “NBC 2016 & RECENTLY REVISED SEISMIC CODES – IMPACT ON STRUCTURAL DESIGN, CONSTRUCTION & SAFETY OF BUILDINGS”

CEAI jointly with Indian Association of Structural Engineers (IAStructE) is organizing a National Workshop on “NBC 2016 & Recently Revised Seismic Codes – Impact on Structural Design, Construction & Safety of Buildings”, during 01-02 December 2017 at Sir R N Mukherjee Hall, W B State Center of Institution of Engineers (India), 8, Gokhale Road, Kolkata 700020.

The revised Building Code has been brought out by the Bureau of Indian Standards (BIS) as **National**

Building Code of India 2016 (NBC 2016), reflecting the state-of-the-art and contemporary applicable international practices. In addition, several BIS codes pertaining to earthquake resistant design of buildings have been revised in the recent past. IS 1893 (Part 1) on earthquake design has been revised as **IS 1893 (Part 1):2016**, bringing into state of practice, the progress made in research, scientific and technological development globally, since its last revision. BIS has also revised the code on ductile detailing of Reinforced Concrete Structures subjected to seismic forces, as **IS 13920:2016**. Similarly, **IS 4326** has been revised in the year 2013 and an amendment on confined masonry building construction was issued thereto in 2014. Adopting the latest building codes is only part of the solution. Codes must also be effectively enforced to ensure that buildings and their occupants benefit from advances in seismic provisions in the latest codes.

CEAI and IAStructE aim to bring together the code makers, civil and structural consultants, architects, academicians, builders and developers, urban planners, policy makers and associated government agencies to discuss the impact of these newly revised NBC and other Codes pertaining to earthquake resistant design of buildings.

The exclusive two-day workshop will witness presentations by some of the stalwarts in the industry and the code makers themselves. This workshop will give ample opportunity to all the delegates to interact directly with the experts in the domain and gain knowledge through intensive interaction.

More details about the Workshop are being finalized and will be available in CEAI website shortly.

CEAI NATIONAL AWARDS 2017

As has been the practice in CEAI for many years, the Consulting Engineers Association of India is happy to announce awards for Excellence in Engineering Consultancy Services. CEAI had special category awards for Women Engineers and young professionals in 2015 and 2016, respectively.

This year's awards cover organisations as well as individuals. We invite entries for the Awards in the following categories:

For organisations:

- 1) Excellence in Engineering Consultancy Services and Project Engineering

Field A) Excellence in Project Engineering

Field B) Excellence in Engineering Innovation

For individuals:

- 2) Excellence in Engineering Consultancy Services and Project Engineering

Category A) Excellence in Project Engineering

Category B) Excellence in Innovation Engineering

- 3) Lifetime Achievement Award

CEAI will constitute an independent jury comprising eminent persons to select the awardees. The decision of the jury will be final.

CEAI has invited companies and individuals to participate in a big way by circulating this information widely amongst its employees. The Award brochure and nomination forms have already been circulated to members.

The last date for receipt of nomination is 15th November 2017. All have been invited to actively participate in this prestigious National Award constituted by the CEAI.

REVISED RULES FOR LIFE MEMBERSHIP OF CEAI

The Governing Council of CEAI at its meeting held on 18th July 2017 revised the Rules for Life Membership of CEAI. The revised Rules are as below:

Member (individual) who has been on the roll of the Association for one year and his/her subscription is not in arrears, may opt to become a Life Member (Individual) after paying one time subscription as under:-

Age of Member

- a) 40 to 49 years

Subscription

15 times annual subscription

Member (Individual) above age of 50 years may opt to become Life Member (Individual) after paying one time subscription as under:-

Age of Member

- a) 50 to 59 years

Subscription

10 times annual subscription

- b) 60 to 69 years

5 times annual subscription

- c) 70 years and above

2 times annual subscription

The Governing Council also revised the Clause 2.5(d) of the Rules for Affiliate Member (Individual) as below:

He/she is a graduate from a recognized university or institution in the field of economics, sociology, geography, environment, law and any other field related with engineering work. He/she should be involved in consultancy profession for a minimum period of three years.

The above will be ratified at the EGM in November 2017.

SOME CEAI INTERVENTIONS

Proposed Modification to Regulation 5(4)(ii) of DCR, 1991 for Gr. Mumbai under Section 37(IAA) and directives under Section 154 of the MRTTP

In response to the notification No. TPB 4317/123/ CR-32/ 2017/UD-11 dated 8th March 2017, by the Urban Development Department, Government of Maharashtra, regarding Proposed Modification to Regulation 5(4)(ii) of DCR, 1991 for Greater Mumbai under Section 37(IAA) and directives under Section 154 of the MRTTP Act, CEAI sent a representation to Under Secretary, Government of Maharashtra.

CEAI requested Government of Maharashtra to

improve responsibility and accountability for safe buildings to meet the requirements of The World Bank's "Doing Business 2017".

Recent queries from Government of Maharashtra indicate that a suitable amendment in the regulations will be made as per CEAI suggestions.

MEETING WITH OFFICERS OF INDIAN NATIONAL DEFENCE UNIVERSITY (INDU)

Representatives of INDU came to meet the President and members of CEAI to understand how FIDIC conditions can be beneficial and incorporated in their upcoming project. CEAI members explained about how FIDIC norms are different from other norms, and the advantages of incorporating FIDIC conditions into Contracts to make it fair to all stakeholders.

The CEAI members also explained how the procedures and norms can be adopted for tendering activity. INDU was also informed about other government funded projects, where FIDIC contracts are used.

ISSUES NEEDING URGENT ADDRESSAL FOR PART MONTH PAYMENT OF KEY PERSONNEL AND THEIR HOUSING ALLOWANCE

CEAI wrote a letter recently to NHAI regarding the manner in which payment of part month Input of Experts / Personnel on various on-going Projects under NHAI, is calculated and how this results in significant cumulative loss of remuneration to consultants.

CEAI requested NHAI to look into the interest of Consulting Engineers aggrieved with regard to the subject and explained why the clause needs to be modified based on actual time spent on the project.

Since a large number of Consultancy firms are affected and substantial payments withheld, it was urged that necessary correction be made and clarifications issued.

ISSUE OF POINT OF TAXATION

Based on request from leading members, CEAI has written to Commissioner- GST, regarding the point of taxation.

The Service Industry is suffering on account of a change brought out by the Ministry of Finance's Notification No.25/2012 dated 20.06.2012 of the Finance Act, 2012 vide which the compliance responsibility for service tax was shifted from the Service Receiver to the Service Provider.

Unlike other Service Providers in hospitality, telecom, etc., Consulting Engineers do not immediately receive payment from their Service Receivers, particularly some Client agencies, for months, even years. Therefore, the modified requirement to deposit the Service Tax within 30 days of raising the Bill, despite the payments from the Service Receiver not having been received, imposed drastic financial liability on Consulting Companies

CEAI, therefore made the following suggestions, to help relieve the Consulting Companies of their financial burden, when they are required to deposit service tax payment to the Government even before receipt of the same.

- (a) Reinstatement of the system existing prior to Finance Act 2012, i.e., Service Tax / GST to be paid by the Service Provider within 30 days of its receipt from the Service Receiver, or
- (b) The Service Receiver may pay Service Tax / GST payable to the Service Provider directly to the Authorities, against the Service Tax / GST account of the Service Provider, just as is done for the Income Tax under TDS Provision.

Till such time that a decision is made on the above, CEAI requested that **the Compliance Period of 30 days may kindly be increased to 90 days.**

CEAI is in touch with the office of Commissioner for a personal meeting to explain the issue so that the Commissioner can view the matter holistically, for mitigation of the grievance.

CEAI OUTREACH

As part of an ongoing process, CEAI is continuously expanding its outreach by way of providing support to other professional events and promoting its own to reach

out to new members. Some of these are:

- Confederation of Indian Industry - “2nd edition of International Conference on Industrial Flooring” on 12-13 September 2017 at the Lalit, Mumbai.

Mr A P Mull, Past President CEAI and Former CEO, MD TATA Consulting Engineers Limited chaired the Conference.

- WISE India - “17th International Conference of Women Engineers and Scientists (ICWES17) on 5th - 7th October 2017 at JW Marriott Aerocity, New Delhi.

Ms Sangeeta Wij, CEAI member is involved in organising the Seminar as President WISE India.

- India Smart Grid Forum- 4th Edition of India Smart Grid Week (ISGW 2018), International Conference and Exhibition on Smart Grids and Smart Cities, scheduled from 05-09 March 2018 at Manekshaw Centre, New Delhi.

FIDIC NEWS

FIDIC INTERNATIONAL INFRASTRUCTURE CONFERENCE 2017

FIDIC International Infrastructure Conference 2017 will be held from 1st to 3rd October 2017 at Jakarta, Indonesia. The conference will provide a platform to evaluate and discuss the understanding of what constitutes resilient infrastructure. In the wake of increasing natural disasters, infrastructure programmes are being implemented in some countries, but without properly understanding resilience. Predicting the effects of climate change is becoming more challenging. To ensure that design and construction standards are robust enough, the ability to adapt is critical - from planning, design, and implementation, up to the maintenance phase.

The themes of the Conference are:

Day 1: Resilient Infrastructure

- Plenary 1: Resilient Infrastructure – What Constitutes Resilience?

- Plenary 2: Infrastructure Needs, Benefits and Investment
- Plenary 3: Modelling and Digital Technology in Planning for Resilience
- Plenary 4: Strategies, Planning, Sustainability and Resilience

Day 2: What Do We Need to Change

- Plenary 5: Disaster Risk Mitigation Strategies
- Plenary 6: Resilience and Disaster Risk Mitigation in Projects
- Plenary 7: Designing Resilient Infrastructure
- Plenary 8: Effective Consulting Services to Support Resilient

FIDIC has offered a discount on registration fee for members of FIDIC Member Associations. The discounted fee for CEAI members is USD 1200 and for Young Professional Members is USD 1050.

Members should register online through FIDIC conference website www.fidic2017.org.

FIDIC – ASPAC EXECUTIVE COMMITTEE

FIDIC Member Associations in the Asia-Pacific Region (ASPAC) were invited to submit nomination for the ASPAC Executive Committee election.



CEAI Governing Council unanimously decided to nominate Mr. Sudhir Dhawan, Past President CEAI, for participating in the election and the nomination of Mr. Sudhir Dhawan has been submitted to ASPAC.

The result will be announced during the General Assembly Meeting of ASPAC scheduled to be held in conjunction with FIDIC International Infrastructure Conference on 1st October 2017 at Jakarta, Indonesia.

OTHER NEWS, VIEWS & NOTES

BUSINESS AND CLIMATE SUMMIT 2017

The Business and Climate Summit (BCS) is a high-level annual forum convening global business leaders with solutions for taking on the climate challenge. BCS has travelled from one destination to another - Paris (2015) and London (2016) – building partnerships needed to accelerate the low carbon transition. Carrying on the momentum, the third edition of BCS was held in New Delhi on August 31 and September 1, 2017.

The Federation of Indian Chambers of Commerce and Industry (FICCI), India's apex business organization, hosted the BCS 2017.

The BCS3 in Delhi was a great success, with some major discussion on how to align western driven business objectives and Indian driven political agenda. One is driven by the idea that climate action can be driven as a profit making activity and the public authority expecting climate justice, expecting western world to fund and transfer technologies.

Mr K K Kapila, EC member, FIDIC and Ms Sayona Philip, President CEAI attended almost the full 2 days., attended the BCS summit.

Mr Amit Sharma, Managing Director of Tata Consulting Engineers presented the Consulting Engineers point of view and spoke about Urban Environment & Cities: Built Environment & Spatial Planning.



*Mr Amit Sharma, Managing Director of
Tata Consulting Engineers Ltd*

An interesting discussion took place during the CEOs roundtable (on invitation only) during which it was agreed to have output strategic messages on carbon pricing, disclosure of CO₂ emissions, and best practices.

FICCI INFRA COMMITTEE URGES GST COUNCIL TO HAVE A RELOOK AT ITS GST COLLECTION REGIME

As Published in

www.internationalnewsandviews.com



Mr K K Kapila CEAI Governing Council member and CMD ICT is the Co-Chairperson, FICCI Infra Committee. Thus, FICCI's National Committee on Transport Infrastructure has urged the Goods and Service Tax (GST) Council to

have a re-look at its GST collection regime for Consulting Community and urged it to put the onus of depositing of Goods and service tax on the Client (Service Receiver) both government and Private sector.

At present as per a pernicious practice the consulting community, (service provider) who is not liable for payment of Service Tax/GST (as being not the Employer OR the Service Receivers), are being coerced into payment of Service Tax on behalf of the Employer, whereas, their role is that of a mere collector of tax on behalf of the Government.

Mr. K K Kapila, CEAI Governing Council member and Co-Chairperson, FICCI Infra Committee. said that "FICCI Infra Committee on various occasions has written to Union Minister of Finance and now to GST Council that the Service Tax/GST payable by the Employer of consultant should be collected by Government directly from the Employer. At present the Consulting community continues to be made liable for payment of Service Tax on behalf of the Employer, even before the Consultants receive their remuneration from the Employer."

"In case there is any difficulty in accepting the request for direct payment of Service Tax by the Service

Receiver, the GST Council is urged to restore provision of paying Service Tax within 30 days after receipt of payment. The procedure currently adopted is that the Consulting community is made liable for payment of Service Tax within 30 days of raising an invoice with the Employer. The Employer who in most cases are Government Departments usually respond with payment after considerable delay ranging from 3 to 6 months. In the interim, the Consultant who is technically not liable for Service Tax is expected to make good the same within 30 days, irrespective of fact, whether he has received the payment or not.”

“At present in case of delay in payment of Service Tax by the Consultants attracts an interest of @ 15% p.a. where the Service Tax has not been collected. An interest of 24% was attracted in cases where Service Tax had been collected but not deposited with the Central Government. The same Point of Taxation continues in the GST regime also with an interest of 18% for not paying on time irrespective of the fact that payment has been received or not”

“Further, such Service Tax payment is linked to the value of invoice, whereas actual payment by the Employer to the Consultant may in fact be less than the value of invoice raised. The above procedure of collecting Service Tax has created immense cash flow difficulties for the Consultants on account of Service Tax, which in fact is not payable by them, as their role is merely that of a collector on behalf of the Government.”

“Again it was suggested that the system existing prior to Finance Act 2012 i.e. Service Tax / GST to be paid by the Service Provider within 30 days of its receipt from the Service Receiver. The Service Receiver may pay Service Tax / GST payable to the Service Provider directly to the Authorities, against the Service Tax / GST account of the Service Provider, just as is done for the Income Tax under TDS Provision.”

The above suggestions will help the Consulting Companies to tide over the problems of payment of Service Tax / GST to the Government and relieve their financial burden. It will also help the Government to collect tax revenues effectively.

NATIONAL REGISTER OF ENGINEERS

by

CEAI in collaboration with other professional associations

1. OBJECTIVE

- To establish discipline wise data base of Engineers.
- Registering those engineers who provide quality services to their clients

2. ELIGIBILITY

- Individual Engineers
 - Engineering Companies
- Members of other engineering professional bodies qualify automatically.

3. MEMBERSHIP FORM

- Membership form available with CEAI.

For details please contact CEAI Secretariat.

VIEW POINT

The next issue of the View Point will be published in **December 2017** and will be dedicated to Railways and Metros (non civil engg aspects).

Considering the experience in the subject of CEAI members and various stakeholders and challenges being faced Human Resource Departments across companies , CEAI would be happy to receive articles on the above theme.

Authors could share their views, practical difficulties experienced and suggest solutions. Photographs may be added in the articles for better appreciation of the issues encountered and addressed. The articles for the December 2017 issue of VIEWPOINT need to reach CEAI by 30th November 2017. Articles need to be in Times New Roman 12 with single line spacing.

ADVERTISEMENT IN VIEW POINT

VIEW POINT is circulated to all CEAI Members, Ministries of the Government of India, Public & Private Sector Undertakings, Construction Firms, Contractors, Consultants, Foreign missions and Funding Institutions in India and others organisations related to or dealing with the engineering profession.

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OLDEST TECHNICAL AND ENGINEERING COLLEGES/ INSTITUTES IN INDIA

College of Engineering, Guindy (CEG): It started as the School of Survey, a technical institution established in 1794. The school became the Civil Engineering School in 1858. It was later established as the College of Engineering, Guindy (CEG) in 1859 under the Madras University. [Source: <http://ceg.annauniv.edu/history.html>]

Indian Institute of Technology, Roorkee: As early as the year 1845, Lieutenant Baird Smith of the Bengal Engineers, then Superintendent of the Eastern Jumna Canal, began training young Indians at Saharanpur in Civil Engineering for the grade of Sub-Assistant Executive Engineer. The College of Civil Engineering at Roorkee was established in 1847 and later on in 1854 it was renamed as the Thomason College of Civil Engineering at Roorkee. In 1946 it was renamed Thomason College of Engineering. It became the University of Roorkee in 1949 and the Indian Institute of Technology, Roorkee in 2001. [Source: <https://www.iitr.ac.in/institute/pages/History.html>]

College of Engineering, Pune: The Poona Engineering Class and Mechanical School was opened in July 1854, with an aim to provide suitable learning to the subordinate officers in the Public Works Department. The College was affiliated to the University of Bombay in 1866. In 1911, the nomenclature was changed to the “College of Engineering, Poona”. It was initially affiliated to the University of Bombay for a degree of Licentiate in Civil Engineering known as LCE and later to the University of Pune. In 2003, the college was accorded an autonomous status. [Source: <http://www.coep.org.in/about/history>]

Indian Institute of Science (IISc): It was founded in 1909 as a result of the joint efforts of Jamsetji Nusserwanji Tata, the Government of India, and the

Maharaja of Mysore. In 1886, Jamsetji Tata conceived of a university of science that would work for the benefit of India, and in 1898 created an endowment for establishing such an institution. The Government of India then took up the effort, and, in consultation with scientists in England and in India, decided to locate the Institute in Bangalore, where the Maharaja of Mysore, Shri Krishnaraja Wodeyar IV, donated 372 acres of land [Source: <http://www.iisc.ac.in/about/general-information/about-heritage/>].

Indian Institutes of Technology (IITs): They are autonomous public institutes of higher education, located in India. They are governed by the *Institutes of Technology Act, 1961* which has declared them as institutions of national importance and lays down their powers, duties, and framework for governance, etc. *The Institutes of Technology Act, 1961* lists twenty-three institutes (after the last amendment in 2016). Each IIT is an autonomous institution, linked to the others through a common IIT Council, which oversees their administration. The Minister of Human Resource Development is the ex-officio Chairperson of IIT Council. (Source :Wikipedia)

After the end of the Second World War and before India got independence, Sir Ardeshir Dalal from the Viceroy’s Executive Council foresaw that the future prosperity of India would depend on technology. Therefore he conceptualized institutes that would train such work forces in the country itself. This is considered to be the first conceptualization of the Indian Institutes of Technology.

Dr. Humayun Kabir played an important role in establishing IITs. He encouraged Dr B. C. Roy, the Chief Minister of West Bengal to work on Sir Ardeshir’s proposal for a IIT. In 1945, Dr Kabir along with Sir Jogendra Singh of the Viceroy’s Executive

Council (Department of Education, Health and Agriculture) set up a 22 member committee to prepare a proposal, and made Sir Nalini Ranjan Sarkar the chairman. The Sarkar Committee recommended in 1945 that at least four Higher Technical Institutes on the lines of famous Massachusetts Institute of Technology, U.S.A. be established in the Eastern, Western, Northern and Southern regions of the country. The IIT system was envisioned over time to “provide scientists and technologists of the highest caliber who would engage in research, design and development to help building the nation towards self-reliance in her technological needs.” [Source: <https://www.iitsystem.ac.in/html/page/history>]

On the ground Bengal had the highest concentration of engineering industries, and this was used as a basis

to set up an institute in that state. **IIT Kharagpur** was the first Indian Institute of Technology to be set up and was born in May, 1950; **IIT Bombay** was established in 1958 with Soviet assistance; as a fallout of the prevailing Cold War, the Americans offered to help to set up yet another IIT and it was established in the North as **IIT Kanpur** in 1959. The Government sought the help of Germany for their next IIT. The Germans wanted to set it up in Bangalore but during their visit to Madras, were impressed by the frolicking deer roaming among hundreds of venerable banyan near the Governor’s residence and set up **IIT Madras** in 1959. **IIT Delhi** was established in 1961 with the help of Government of UK. (Source: Wikipedia excerpts)

FIDIC PUBLICATIONS	
1	FIDIC Contracts Guide (1 st Ed. 2000)
2	Short form of Contract (1 st Ed.1999)
3	Dredgers Contract 2nd Ed (2nd Ed 2016)
4	Design- Build- Operate (DBO) Contract (1 st Ed 2008)
5	Guide to Design-Build-Operate Contract (1 st Ed. 2011)
6	Plant & Design-Build Contract (1st Ed:1999)
7	EPC/Turnkey Contract 1st Ed 1999
8	Construction Contract (1st Ed.1999)
9	Construction Subcontract, 1st Ed 2011.
10	Understanding the New FIDIC Red Book, (2006)
11	Design-Build and Turnkey (Orange Book) 1st Ed 1995. Reprinted 2011.
12	Works of Civil Engineering Construction (Red Book) Part I & II and Supplement (4th Ed. 1987 Reprinted 2011)
13	Electrical and Mechanical Works (Yellow Book): (3rd Edition 1987; Reprinted 1988)
14	Electrical and Mechanical Works (Yellow Book) Guide 3rd Ed.
15	Client - Consultant Agreement (White Book) 5th Ed. 2017.
16	Client-Consultant Agreement (White Book) Guide 2nd Ed. 2001
17	Sub-Consultancy Agreement 2nd Ed. 2017
18	Model Joint Venture (Consortium) Agreement 2nd Ed 2017
19	Model Representative Agreement (1st Ed 2013)
20	Selection of Consultants 2nd Ed 2013
21	Insurance of Large Civil Engineering Projects (2004)
22	Professional Liability Insurance 1st Ed
23	Standard Prequalification Form for Contractors 3 rd Ed 2008.
24	FIDIC Integrity Management Guidelines (1 st Ed. 2011)
25	Quality Based Consultant Selection Guide 2011
26	FIDIC Procurement Procedures Guide 1 st Ed 2011

Tech Quiz¹

- Engineering/Technical Education in recognized Institutes is governed by :
 - Institution of Engineers, India
 - UGC
 - AICTE
 - Respective Institute
- Are IIIT's better than IIT's for computer technology based courses?
 - Yes
 - No
 - Maybe
 - Same
- Can an under-grad opt for PHD without having done M. Tech?
 - No
 - Yes
 - Don't know
 - Maybe
- Is it mandatory for an engineer to be a post-graduate to practice as a Consulting Engineer?
 - Yes
 - No
 - Don't know
 - Maybe
- Is work Experience after an under-grad qualification considered equivalent to a higher level qualification?
 - Yes
 - No
 - Don't know
 - Maybe
- Based on your answer above, do you support the concept?
 - Yes
 - No
 - Don't know
 - Maybe
- Is it mandatory for practicing engineers in India to be registered with the Institution of Engineers (India)?
 - Yes
 - No
 - Don't know
 - Maybe
- Is it beneficial for Engineers to be a member of a Professional Engineering Association?
 - Yes
 - No
 - Don't know
 - Maybe
- What is the age limit for CEAI awards of 'Young Engineers'?
 - 38 years
 - 40 years
 - 42 years
 - 45 years

The first 3 persons who mail correct answers to CEAI will get a congratulatory mail and will be acknowledged in the next issue.

¹contributed by Mr Raju Gogia, GC Member CEAI

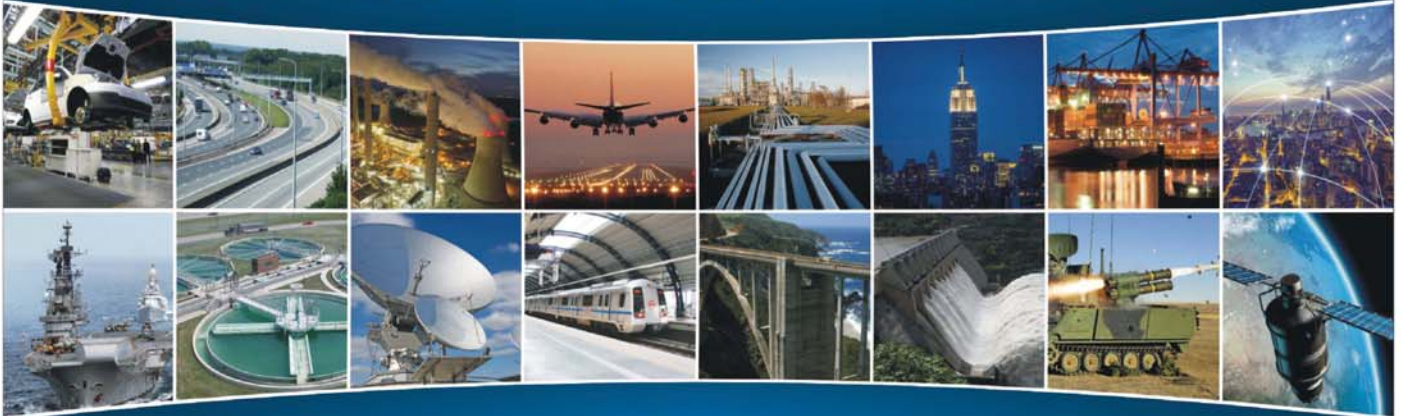
Answers to Tech Quiz June 2017 issue:

1(C); 2(B); 3(B); 4(B); 5(C); 6(C); 7(D); 8(B); 9(B)

Arghya Adhikari of STUP is the winner of the Tech Quiz with the maximum points.

MANAGING PHYSICAL ASSETS To Deliver Business Outcomes Cost Effectively

Date: 12th October 2017
Venue: Vivanta by Taj President, Cuffe Parade, Mumbai



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- Customers/ Users • Private Organisations • Regulators
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Mr. David McKeown
PhD, DIC, FIAM, Director, CEO, Institute of Asset Management (IAM), Chair, UK Delegation to ISO/TC251 (developing ISO 55000 standards)



Dr. Navil Shetty
PhD, DIC, FIAM, Director, Fellow & Technical Chair for Asset Management, Atkins, Convenor, ISO/PC251 for the development of the ISO 55000 standards.



Dr. Manoj Singh
Special Adviser to the Ministry of Railways, Former Special Adviser, Niti Aayog, Infrastructure and Transport.



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07. Railways
08. Offshore, Harbour and Coastal Engineering
09. Metros
10. Water Resources and Agricultural Development
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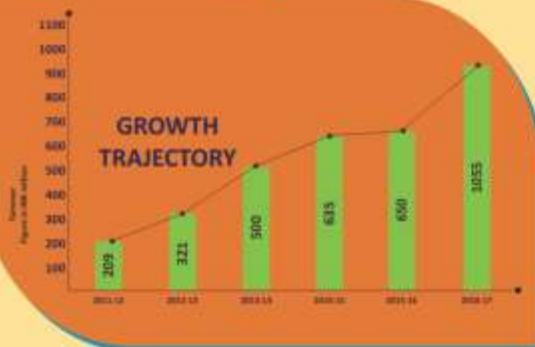
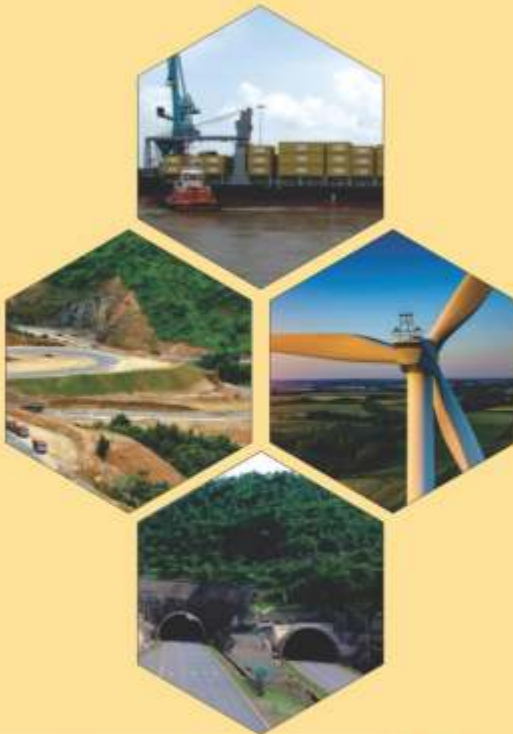


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- Achievers Award 2015 conferred on Mr. Raj Kumar, Chairman and Managing Director, for successfully achieving milestones in the implementation of the AIIMS - Digha Elevated Corridor by the Hon'ble Chief Minister of Bihar Shri Nitish Kumar, on the occasion of 6th foundation day of BSRDCL.
- Rodic Consultants Pvt. Ltd. was featured in "Leading SME's of India" published by Dun and Bradstreet.

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