Engineering Council of India

Round Table Conference

Reform of Engineering Education for Better Employability of Engineers-Contours of Reform

September 13, 2012

Magnolia Hall, India Habitat Centre,
Lodhi Road, New Delhi-110003

Proceedings

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Glimpses of Round Table Conference

September 13, 2012

Opening Session in progress

Dr. Uddesh Kohli delivering Welcome Address

Shri Pawan K. Agarwal, Guest of Honour delivering Theme Address

Prof. Syed Samsul Alam delivering Inaugural Address

Delegates presenting their view points

Views of the Audience

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Organised by :

ENGINEERING COUNCIL OF INDIA

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P.N. Shali

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Challenge in Employabilty

***If the students augment their skills in a few specific areas desired by the industry, employability in the country can be significantly enhancement.* — Ajim Prem ji**

Introduction

The engineering profession is the one that puts scientific knowledge to the practical use of the society that ultimately have economic implications. Thus engineers have to be multi -skilled to meet today's constantly evolving economic and business environmental needs of the project proponents / leaders.

The present day globalization also demands multi disciplinary and multi-skilled engineers for meeting the new and demanding challenges and seizing the opportunities that are emerging and are expected to come up in future. It is a well recognized fact that the present day engineering education system is not producing engineers which the industry really wants and for the R & D sector, with of course some exceptions being there.

We need to produce such engineers; and, therefore, we need to reform our engineering education system. It is also the high time that engineering potential of diploma engineers and base- level-engineer technicians are fully harnessed for the societal benefits. They, however, also need to be re engineered.

The proposed Round Table Conference (RTC) was organized on the theme "Reform of Engineering Education for Better Employability of Engineers-Contours of Reform", which was the culmination of the initiative that was taken by the Engineering Council of India (ECI) in August 2006, by holding the "First National Convention" at Kolkata followed by Six National Conventions, one National Conference and one National Workshop on the same & related themes; and a consensus of all stake holders has come up for reform of the engineering education system.

The speakers were invited from the industry, academia, professional engineers associations/ institutions, R&D establishments who made presentations. The discussions were moderated by a moderator. A short discussion note based on the consensus recommendations of the aforesaid previous programmes of the ECI was also circulated.

The participants were invited from the industry, academia, research institutions, professional guilds of engineers, concerned ministries/departments of the government of India and the state governments.

The RTC concluded with the following recommendations.

Recommendations

1. India should become a leader of engineering knowledge economy through enhancing the standards of its engineering education system.
2. The Indian economy today demands multi-disciplinary & multi-skilled engineers. Such engineers would have to be produced in the country. Therefore, engineering education system of old functional paradigm needs to be looked from the user driven rather than a discipline perspective.
3. Engineering education needs, therefore, to be moved out of its present branch - specific engineering education to multi-disciplinary engineering education and made more practical. It should be done not in one-go, but with caution and in steps. This can be done first by starting a few new branches such as BE (Construction Engineering), BE (Hydrocarbon Engineering), BE (General Engineering) and a combined five-year degree course in engineering & management.
4. For the multidisciplinary curriculum of engineering education, the weights to be assigned to different subjects as humanities, social sciences, basic sciences, mathematics, engineering core subjects, elective subjects, etc, should be decided on a consensus basis of the academics and the industry.
5. For the present, we should revert back to the earlier curriculum of having common subjects during the first two years of the course; and the branch should be given in the third year of the course after evaluating the performance of a student during the first two years of the course. This should be done universally in all engineering branches.
6. The subjects gone obsolete should be removed from the curriculum of all branches.
7. The subjects from the social sciences-economics, statistics, management, communication, law, etc. should be added to the curriculum.
8. Other soft skills such as etiquette, table manners, inter personnel behaviour, etc, should be developed in the students at the college level itself.
9. It should be made mandatory to review engineering curricula after every four years; and it should be done in consultation with the academics and industry. Eminent practicing engineers and eminent engineer consultants may also be consulted, if convenient.
10. Computer simulations should also be developed and used for delivering engineering education and for laboratory practices. It will make it very easy for the students to understand various concepts.
11. Reform of the engineering education system should also include reform of the present common entrance test for admission of students to engineering courses for ensuring the selection of only those candidates who have not only the knowledge of physics, chemistry, mathematics and general knowledge but also aptitude for engineering.
12. There should be one all India common test for admission to engineering institutions. Engineering establishments in the private sector and those of the various state governments should also accept this all India common entrance test for admission to their establishments.
13. We can also think of an option of introducing general engineering course of four years as: three years in a college and then joining work with an industrial unit for one-to-two years and then returning back to the college for the one year to complete the course.
14. The combined degree of engineering & management can also be split in two streams as: first three years in a college and then two or three years of work with an industrial unit and then two more years in the college for completing the course.
15. For making available right engineers to the Industry for their applied R&D, the postgraduate engineering degree can be of six

years comprising a general engineering course of four years and specialization of two years after that.

16. Alternately, it could be a general engineering course with a break of two to three years of work in an industry and two years of specialization thereafter.

17. We need to harness appropriately commonalities and synergies among all the major branches of engineering for developing designing skills in engineers.

18. Recognizing that the fresh engineering graduates lack a strong ethical foundation, introduction of ethics as a subject in engineering education in universities needs a serious consideration.

19. The practical case studies need to be included in the technical books and other reference materials meant for engineering students.

20. Disaster Management needs to be incorporated in the engineering curricula.

21. Emphasis should be on practical engineering education which should also include sustainability aspects by introducing in the curricula a compulsory subject on sustainability which may include the philosophy, the basic and general concepts of sustainability and its practical application.

22. As per the Washington Accord, regulatory mechanism should make it possible to transfer credits between universities/ Institutions in the engineering degree programmes.

23. Though quality improvement programmes for teachers have been reportedly set in motion, results are not yet spectacular. This issue needs to be tackled so that we get quality faculty for engineering education.

24. Industrial training for the students & faculty should be made mandatory. For this, the industry should spend a part of their income on this training, and it should be compensated via tax incentives for any expenditure that it may incur on this training. The cost for this training also can be met from the budget set for Corporate Social Responsibility

25. E-learning and web- based teaching methods need to be introduced.

26. The faculty should give up its arrogant know-all attitude about engineering and be consistently open and learn state-of-the-art developments from practicing engineers.

27. Practicing engineers and eminent engineer-consultants should also be involved in teaching for bring a very rich experience in teaching and setting syllabus. They will not be competitors of the main faculty.

28. Industry - Academia interaction in technical education should be institutionalized for revision of the curricula & its delivery.

29. The industrial training during the third & the fourth year of the course should be in the format of small projects on industrial problems assigned individually or collectively to a group of students, It should also be assessed and marks obtained thereof should be included in the marks obtained from the written examination; and it should be made mandatory.

30. There should be a mandatory working for the faculty with the industry at least for two-to-three terms of one year each during the entire service period; and like-wise, practising engineers and eminent engineer consultants with demonstrated achievements in the consultancy should also be involved in teaching engineering for similar tenures. This will bring better synergy between the two, apart from providing an opportunity to them to have a hands-on experience of the "other side of the fence".

31. After the theoretical course and during – the-course training is over, there should be a mandatory six months- to - one year of paid internship with an industrial unit which should be assessed and credits thus obtained by a student should be added to her/his total credit and the industry should be compensated for any expenditure that it may incur on this internship via the tax route.

32. It should be made mandatory that a student, after clearing the written examination, will get the final

engineering degree only after successfully completing during – the - course training and after- the – course paid internship of six months-to- one year with an industrial unit. A provisional engineering degree however, can be given after the written examination.

33. The practice of delivery of engineering education should be reformed from its present form by placing more emphasis on self-learning and problem-solving.

34. Creativity should be developed in engineering student as a part of engineering education.

35. Evaluation of the faculty by the students should be made mandatory for all the engineering colleges in the country.

36. A working mechanism needs to be created and operated as a matter of regulatory policy on collaboration with the world class universities for the faculty exchange, establishing research centres, apart from developing modern curricula

37. Engineering profession needs also to be regulated like the other professions such as Lawyers, Doctors, Architects, Accountants, etc. are for giving a legal status to engineering profession and ensuring accountability of engineers to their decisions.

38. The continuing professional development (CPD) should form an important element of the regulatory mechanism of engineering profession.

39. The culture of accountability must be infused in the engineering institutions.

40. The foreign direct investment (FDI) for engineering education system should be encouraged with a view to bringing in competition vis-a-vis indigenous institutions for enhancing the standards of engineering education.

41. The vocational engineering education system at the workers level needs to be upgraded and made as an option of 10+2 education, particularly for the students of rural India and the ITI- based education for engineer technicians should be made a part of this process.

42. The curricula and training format of the polytechniques and industrial training Institutes (ITIs) training diploma engineers and engineer technicians respectively need to be re-engineered for imparting required knowledge and skills to diploma engineers and engineer technicians.

43. The English language skill of undergraduate engineering students, diploma & engineer technicians also need to be made better by including the language in their curriculum.

44. The synergy in the various efforts that are being made by the various agencies in training the technical workforce in the country needs to be strengthened.

45. India should become a "Full Member of the Washington Award" without further delay for the recognition of the engineering qualifications by other countries.

46. The administrative set-up for the higher technical education in the country, represented by the UGC and AICTE, needs to be made flexible and purposeful by converting it into a single window set-up or as may be deemed appropriate for managing the higher technical education.

47. The demand assessment of engineers from the different sectors of the economy should be made a regular feature of the work of the regulatory body before sanctioning the new engineering colleges, primarily for arresting the proliferation of engineering colleges of poor quality infrastructure and faculty in the country

48. There is a need for legal recognition of PE certification granted as per the systems and procedures of Engineer Mobility Forum (EMP).

49. Close interaction of academic institutions with entrepreneurs should be mandated as a social corporate responsibility on the part of academia.

50. Spending of public money on higher education and research in non-performing universities/

institutes should be reduced, and the performing institutions should be given more financial grants as encouragement for better quality teaching and research.

51. Performing teachers should also be given financial rewards (e.g. cash incentives for international journal publications, patents filed, or for bringing any other laurels to the institutions, special remuneration package for course loads above average and so on).

52. The faculty jobs need to be made more attractive for the right persons and the CPD of the engineering faculty also needs to be institutionalised.

53. A National Proficiency Evaluation Test (NPET) should be designed & developed for testing fresh engineers who comes out of professional engineering institutions for employment. The recruitment of engineers without the required NPET score should be discouraged.

54. The prestigious Indian Institutes of Technology (IITs) should mentor some lesser known or new engineering colleges for raising their standard.

55. Inter-institute credit transfer should be permitted.

56. It should be made mandatory for the industry to increase their spending on applied research for increasing overall productivity.

57. The professional engineering societies in India should have a role in setting the standards and certify engineers by testing them as per their standards and in the accreditation mechanism of engineering education in India.

58. The management quota for admission to engineering courses should be scrapped, as it affects the quality of intake of students admitted to engineering course under this quota.

59. It should be mandatory for every institution of higher technical education to get accreditation from the regulatory body in the country.

Executive Summary

We are producing engineering graduates for more in numbers. It is not a failure of government policy; it is a demand and supply issue. There is an aspirational demand among our students to go in for engineering education. There is a miss match between demand and supply of engineers; supply overstepping the demand in huge margin. Considering that the Indian economy today remains largely an agrarian economy, we do not have requirement for so many engineers. The focus in the 12th Five Year Plan is how we work together to improve the eco system of the engineering education system. The accreditation and regulatory practices are being addressed; and efforts are being made to make these practices more transparent.

Today unemployability of our graduate engineers is a serious issue. Not more that 25 percent engineers are employable. Then we have a problem with the faculty. Good engineers either go abroad, or they join the industry where they get quite attractive packages. The Industry has stopped taking students for industrial training. Students are not interested in going for research. It is not attractive to work either as a faculty or on any research project. The faculty jobs should be made quite attractive. This is a policy decision. Similarly, research jobs should also be made attractive.

The engineering education today is largely in the private sector institutions; and that too in such large numbers. A large body of these private engineering colleges suffers from many deficiencies like: poor infrastructure, inadequate and inexperienced faculty and no access to training / internship facilities. The challenge before the government is "how to support them". Much more than funding support, they need technical support in terms of what needs to be done. We hope that the competitive pressure will eventually bring up the required quality of engineering education from these institutions. These colleges of the private sector should be monitored for their quality of education and its delivery by the regulatory authority on a regular basis.

The industry has not shown great concern for any improvement in engineering education in this country. The regulatory agency has not only shown lack of initiative, but it has also gone the other way by providing the license to set up new engineering colleges which lack the bare minimum infrastructure facilities and the quality faculty. The industry, being at the receiving end, will have to take initiative to remove the mismatch between the academia and the industry.

The industry should adopt some engineering institutions. It should pose their problems to the academia for resolution. This is a normal practice in the western countries. We must conduct our MTech and PhD programmes in collaboration with the industry. This collaboration between the academia and the industry experts will not only enrich these programmes, but also it will make these programmes relevant to the needs of the industry. The Industry should also come forward to accept students for training & internship.

We should make internship in an industrial unit of about six months to one year after the course mandatory. This should be a paid internship. The industry should be compensated for any expenditure that it may incur via the tax route or from out of the funds earmarked for corporate social responsibility (CSR).It should also be made mandatory that student must pass this internship, as in the case of medical education. During – the- course training should be project-based for the last two years of the course; and it should also be assessed. The engineering degree should not be granted after the students pass written examination, but it should be given only after they pass during-the-course-industrial training and internship with an industrial unit. A provisional degree, however, could be given after the students pass the written examination.

There should be national proficiency evaluation test for graduate engineers who come out from our colleges annually for employment in the industry .This test will not only access the competency of fresh graduates, but it will also tell us about the quality of education that a particular engineer college is imparting.

We must restore common syllabus during first two years of the course, allot branch during the third year of the course. This was the practice in the past and it worked very well in imparting the basic knowledge of all major engineering disciplines to the students. The curriculum should be revised every four years for bring in it changes, as required.

In order to meet the shortage of faculty, we should involve practicing engineers from the industry and

eminent engineer consultants to teach engineering students, as was the case in the good old days. An engineer who has developed oil-well and refined oil can be a better teacher to teach these subjects. So the faculty should change its mind set and allow the practicing engineers to teach engineering students. The faculty, who perform well, should be given incentive to keep them motivated.

We must make it mandatory for the engineering faculty to work in the industry for two to three years in their career; and like –wise we must make it mandatory for the practicing engineers to work on the faculty for similar duration. The CPD of the faculty should also be made a mandatory requirement under regulatory rules for the engineering faculty. We should create training infrastructure for the engineering faculty.

We need to produce multidisciplinary and multi-skilled engineers. For this we should create new branches in engineering such as, construction engineering, hydrocarbon engineering, general engineering in which basics of all important branches are covered, such as civil, electrical, mechanical, materials and metallurgy, electronics and computer engineering. Then we should also add to the curricula basics of subjects such as, economics, statistics and management. A common branch of engineering & management of five years duration also needs to be created for the manufacturing sector.

Parents should not put pressure on the students on what profession they should pursue, students should be left free to decide what profession they should pursue. If this is done, the basic problem that we are facing in higher technical education will vanish.

The regulatory authority should make it point to assess the demand for engineers before giving license to new engineering colleges. Credit transfer from one university/ college to another college is not possible in India at present. We should make it possible. This will give freedom to the students to move out from one course to other or from one engineering college to the other. It should be mandatory for every institution of higher technical education to get accreditation from the regulatory body in the country.

We should include communication- both written and oral- as a subject in the engineering curriculum. Besides, one foreign language such as Spanish, or, French should also be taught to give engineers an opportunity to work in the Latin America, or, Africa where industry is growing and there is demand for engineers there.

The professional societies / institutions of engineers have a role to play in engineering education. They have been making engineers from out of the shop floor people all these years. Of late, this has been stopped by the government. Here in this mode of engineering education, students are working technicians. In other words those people who could not afford engineering education from the main stream colleges. They joined the industry. They are the better candidates for engineering education as they have industrial experience behind them. The role that these socities/institutions have been playing in engineering education should be restored.

Opening Round

Dr. Uddesh Kohli

At the outset, let me extend a hearty welcome to all participants and guests.

ECI had organized several national conventions on reform of engineering education, particularly with focus on how to make graduate engineers employable. How can engineering education help them in better employability? Several recommendations have been made at these national conventions, national conferences and national workshops, which were organized by the Engineering Council of India on the reform of engineering education for better employability of engineers and related themes respectively, in different parts of the country since August 2006 when the 1st national convention on the subject was held at Kolkata.

The background paper, which has been circulated, summaries the main consensus recommendations of these conventions, conferences and workshops. This Round Table Conference is expected to discuss these recommendations and finalize the conclusions which would be submitted to the government for consideration.

It is heartening that the Planning Commission has sponsored this Round Table Conference and I am happy that Shri Pawan Agarwal, Advisrer Education, Planning Commission has joined us. We had also invited Dr S.S.Mantha, Chairman AICTE, but he could not join us as he is out of Delhi. Planning Commission has identified higher technical education as one of the key areas for the development of our economy for the 12th Plan. Prof Syed Samsul Alam, Vice-Chancellor, Aliah University, Kolkata, will join us shortly. May I request Shri Pawan Agarwal to address us on the theme of the Round Table Conference?

Shri Pawan Kumar Agarwal

You are aware that there has been exponential growth in engineering colleges during the past decade or so. We are producing engineering graduates for more in numbers. It is not a failure of government policy; it is a demand and supply issue.

There is an aspirational demand among our students to go in for engineering education. The families are willing to pay for this education. So, it has become a viable for any private educational entity to set up an engineering college. There are more than 4000 engineering colleges today.

Many polytechniques have also been converted into engineering colleges. We are producing far more engineers today. So there is a miss match between demand and supply of engineers; supply overstepping the demand in huge margin. It is because of this that many engineering colleges in the private sector are closing down. So over a period of time the demand of engineers is expected to match the supply; when it happens, the employability of engineers will not be the issue.

Considering that the Indian economy today remains largely an agrarian economy, we do not have requirement for so many engineers. Coming to the quality of engineering education system, it has not been that good. Most of the engineering colleges in the private sector do not have quality infrastructure and good quality faculty. The quality of engineering education in IITS and, by and large, in NITS and some private sector colleges is very good.

The centre government's intervention for maintaining the quality of engineering education has been in IITs and NITS and some other institutions, where much of the funding comes from the central government, which constitute a miniscule of the total institutions that we have in the entire engineering education in the country. We will ensure that these institutions will eventually become the exemplars of the top quality of engineering education in the country.

We had a conference in New Delhi on how to bring NITs at par with the quality of education of IITs. Noting much came out of this conference. We started the technical

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Shri Pawan Kumar Agarwal, IAS, Senior Adviser (Education), Planning Commission

education quality improvement programme of the NITs in IIT Delhi. The second programme is going on. The focus of the programme has been on funding and infrastructure.

The focus in the 12th Five Year Plan is how we work together to improve the eco system of the engineering education system. The challenge before the government is how to support them - given the fact that the engineering education today is largely with the private sector institutions and that too in such large numbers. We have also supported them financially, but it has been minimal.

I think much more than funding support, they need technical support in terms of what needs to be done. We hope that the competitive pressure will eventually bring up the required quality of engineering education from these institutions. But the regulation is working against this competition. There is no incentive for one institution to do batter than the other institution except the premium that they charge for the seats under the management quota. The present policy is to create a healthy competition among institutions.

The second is related to accreditation and regulatory practices. These are being addressed; and efforts are being made to make these practices more transparent. The eco system of engineering education can not improve by top down approach, nor can it be totally done through centralized mechanism. It has to be evolved. It has to be done through communities; it can be done by engineering associations who are themselves practising engineers. The Planning Commission can support these efforts of the associations.

I appreciate the efforts being made by the Engineering Council of India – a federation of 30 engineering associations- for the reform of engineering education by organising 7 national conventions in different places in the country. About 64 recommendations have come up from these conventions; and these have been forwarded. These have to be dealt with at various levels. These recommendations have not been made by a committee of the government of India and hence the action on these recommendations will have to be taken by various agencies at various levels.

It is far more meaningful for all who are represented through the membership of Engineering Council of India to engage more closely with engineering policy through various committees of AICTE, government, or Planning Commission. Through these committees, we can consider these recommendations. From our side, what we can do is to work through clusters, alliances of various kinds say, Engineering Council of India, to improve the quality of higher technical (engineering) across various disciplines. We will be happy to work with Engineering Council of India for benefiting the engineering profession and education practices in India.

Shri Mahendra Raj

Premise has been made that all is not well with the engineering education today. There are about 4000 engineering colleges in India today producing about 8,00,000 engineers annually in the country, but they are not employable.; while as they should have been employable. There is some thing wrong if they are not employable. Is syllabus not good? Is the faculty that teach students not good? Is infrastructure at these colleges not good? Are students not good? We will have to seek answers to these questions. I hope that this round table workshop will deliberate on these pressing questions and come out with some solutions to these.

Prof. Syed Samsul Alam

I want to highlight that in India the quality of engineering education must be underscored. In other words, the improvement of the quality of engineering education is the need of the hour. Today unemployability of our graduate engineers is a serious issue.

Not more that 25 percent engineers are employable. Then we have a problem with the faculty. Where are the teachers who can teach engineering? IITs and NITs, by and large, produce very good engineers, but only very few of them go for the teaching career. They either go abroad, or they join the industry where they get quite attractive packages. So this is a problem. Industry has stopped taking students for industrial training. Students are not interested in going for research. We need to produce more PhDs.

Shri Mahendra Raj, MD, Mahendra Raj Consultants Pvt Ltd & Vice Chairman, Engineering Council of India

Prof. Syed Samsul Alam, Vice-Chancellor, Aliah University, Kolkata

The industry should come forward for industrial training of engineering students; and the academia must respond. The Industry-academia interactive mechanism is not there in India. We need to create this mechanism at the national level.

How many industrial projects do our students get? How many industrial projects do our academia's get? The answer to these questions is almost none. So our engineering students have no exposure to industrial training. The industry-academia collaboration as well as the academia-academia collaboration is a must for sharing our resources. We must create such a collaboration.

There has to be exchange between the academicians and practicing engineers from the industry. The academicians should go to industry for some short tenure thrice during their career and likewise the practicing engineers from the industry should go to IITs & NITs and other engineering colleges for a similar tenure in their career and teach in these institutions. This arrangement will go a long way in bringing synergy between the theory and practice, apart from setting the right curriculum for the engineering education including for postgraduate course and PhDs.

The industry must pose their problems to the academia for their resolution. This is a normal practice in the western countries. We must conduct our MTech and PhD programmes in collaboration with the industry. This collaboration between the academia and the industry experts will not only enrich these programmes, but also it will make these programmes relevant to the needs of the industry.

Round - 1

Prof. B. B. Dhar

Engineering education today has some positive aspects and some negative ones. The positive aspects are: it has become an easy access for any body –provided he has some sound financial resources to become an engineer, as he can easily walk into any private engineering college. The negative aspects are technology, which has grown fast in all dimensions - analysis, design, safety environmental aspects and legal and business concerns.

To keep with the developments in engineering design and analysis together with the safety has become beyond the reach of ordinary engineering institutions. No doubt there are a few institutions (engineering) in the private sector who have kept pace with these developments. These are Amity and Manipal. IITs and NITs also have kept pace with these developments. These institutions have sufficient government funding and other resources at their back. A few other government colleges have also kept pace with these developments.

A large body of private engineering colleges has not kept pace with these developments because these colleges suffer from many deficiencies like poor infrastructure, inadequate and inexperienced faculty and no access to training / internship facilities. The third dimension is the stakeholders- the industry. It has become big, no doubt. It has not shown great concern for any improvement in engineering education in this country.

Then there is the regulatory agency, which is within the hands and reach of the government. It has not only shown lack of initiative, but it has also gone the other way by providing the license to start-up new engineering colleges which lack the bare minimum infrastructure facilities and the quality faculty. Equally important is the role of the students who lack interest in the profession they choose to study under peer pressure, without even understanding what is really good for them.

There is complete mismatch between the engineering educational institutions and the industry as there is hardly any effective interaction between the two. For showing their stake in industry they invite sometimes the executives from the industry as a guest faculty. This is all that they do. In the western countries the industry is fully involved with the engineering educational institutions to the extent that faculty is on the board of directors, or they act are advisers to the industry and advise them on industrial problems that they face. This kind of arrangement is just not there in India.

I think the possible solution to such a mismatch is that the industry should adopt an engineering educational institution and establish a link the same way as the hospitals do with medical colleges. This type of link if establish between the engineering educational institutions and the industry will remove the mismatch between the two and will go a long way in deciding what these engineering educational institutions should teach which will meet the requirements of the industry. It will also go a long way in finding solutions to the problems that the industry faces.

Ultimately it is the end product which matters- that is the type of students that the engineering educational institutions should produce which will suit the industry. This will remove the unemployability problem of engineers. The industry, being at the receiving end, will have to take initiative to remove the mismatch between the academia and the industry.

Dr P.R. Swarup

When I studied engineering there were IITs NITs and a few engineering colleges in the private sector. There were common subjects in the first two years of the course and the branch was given in the third year. During the first two years basic subjects from all the branches were taught, apart from applied physics, applied chemistry and mathematics. I think this arrangement was excellent, as it would impart knowledge to the students from the other disciplines of engineering, apart from the knowledge of the engineering branch in which they would specialize.

The IITs had five year course. Then there were on the faculty people from the central PWD, the state PWD, and the industry. I think engineering education was more practical. Now all that has changed and the engineering

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education has become too theoretical. In those days civil engineer working in the PWD was supposed to be in the field supervising works that were being undertaken. Unfortunately, there has been a major shift in these.

Why we need MTehs and PhDs only on the faculty to teach engineering students. Look at the past IIT Roorkee, then Roorkee engineering college, which was primarily set up for civil engineers. It produced excellent civil engineers; and the faculty was mostly of graduate engineers, who used to work also in the field. Today why cannot the faculty go to the industry and work there for six months or a year taking sabbatical leave? All this is not there now. Today the faculty is entirely of theoreticians and not of practicing engineers. We must change this, and invite practicing engineers to the faculty.

Presently, only civil engineers, by and large, are in demand from the construction sector. A civil engineer is not a construction engineer by virtue of her/ his education. Construction engineer needs a familiarity with the world of business and commerce, dealing with people and resources, environmental, health and safety aspects, legal aspects, project engineering, logistics engineering, procurement engineering, application of IT and communication technology in construction, dealing with partnerships and joint ventures learning the basics of contracts and claims, apart from the changing world of technology itself. So, there is a case for a new branch of Construction Engineering.

We should make internship in an industrial unit of about six months to one year after the course mandatory. There should be national proficiency evaluation test for graduate engineers who come out from our colleges annually for employment in the industry .This test will not only access the competency of fresh graduates, but it will also tell us about quality of education that a particular engineer college is imparting.

So we must restore common syllabus during first two years of the course, allot branch during the third year of the course, involve practicing engineers to teach. We must make it mandatory for the engineering faculty to work in the industry for two to three times in their career; and like –wise we must make it mandatory for the practicing engineers to work on the faculty for similar duration.

Then we must make it mandatory that engineers will go for internship for about six months to one year with an industrial unit after the course is over; we must assess this internship and make it also mandatory that a candidate attending the internship should pass it. Then we must also make during – the –course industrial training project - based, and it should also be assessed. It should also be made mandatory that the engineering students will have to pass this training also.

Dr. (Mrs) Suman Kumari Mishra

We need today multi-skilled engineers to deal with technologies which are advancing at a rapid pace day-by-day. Engineering education system has remained static by and large, over the years. Today, engineering institutions are required to produce quality engineers. This is the demand of the industry today. We have to take action on two fronts; one is by the government from the policy point of view, which will take time; and is the second is at the engineering establishments' level, which will not take time. Those engineering colleges which are not having quality infrastructure and faculty, they should up - grade it. They should also up -grade the curriculum and bring in it changes, as are required.

We should make faculty jobs quite attractive. This is a policy decision. Similarly, we should also make research jobs attractive. This is also a policy decision. The responsibility for taking these two decisions rests with the government. Therefore, the government should intervene to enable it, apart from providing incentives to the students to go for MTech and PhD. We should create as a matter of policy one common branch of engineering and management of five years to make engineer-managers available to the industry. Similarly we should also create a new branch of construction engineering, and a branch in general engineering.

I agree for project based during – the- course engineering education, and after the course internship of at least six months to one year in an industrial unit. In order that the students take these industrial trainings seriously, we should also make passing these trainings mandatory. The government should also intervene and stop further licensing of new engineering colleges. Every engineering establishment should have Board of Studies which should regularly monitor the working of the establish-ment on a regular basis and take remedial measures to make the establishment to deliver, as required.

Dr. (Mrs) Suman Kumari Mishra, Scientist EII, MST Division, National Metallurgical Laboratory, Jameshadpur

A mechanism needs to be established where by the faculty is exposed to the industry on a regular basis; the industry should send its executives to engineering colleges to speak with the students on issues concerning the industry on a regular basis.

Moderator's View - Prof. Syed Samsul Alam

Parents should not put pressure on the students on what profession they should pursue, students should be left free to decide what profession they should pursue. If this is done, the basic problem that we are facing in higher technical education will vanish. Engineering educational establishments should have a good ambiance for academics − teaching, learning and research. The Internship with an industrial unit of six months to one year is a must for giving practical orientation to the engineering education. One semester should be left to during–the-course training. It should be made a requisite for the award of the degree. The students and the faculty will only then take it seriously.

The syllabus should be revised every three to four years and the subjects gone obsolete should be replaced with the emerging ones. The industry should adopt some engineering institutions for special care and nurturing. The National Proficiency Evaluation Test (NPET) for graduate engineers is a step in the right direction for assessing their proficiency in the profession and the quality of engineering establishments that they have come from. The faculty should go to the industry for a short duration of two to three times during their career, if necessary taking sabbatical leave.

This will give them ample exposure to industrial working and industrial problems; and the faculty can also develop case studies for the benefit of the students during this visit. This will be a practical way of covering the syllabus. Engineering colleges of the private sector should be monitored for their quality of education and its delivery by the regulatory authority on a regular basis.

FROM THE FLOOR

Shri O.P. Gupta

The Private engineering colleges, distant engineering education, and the coaching classes in engineering should all be controlled by the regulatory authority. The faculty should be trained for time–to–time. During–the-course Industrial training and six months-to-one year of internship with an industrial unit should be made mandatory and it should also be assessed. It should be made necessary for the students to pass these trainings as well. The final degree in engineering should be awarded after the students also pass these trainings; while as a provisional engineering degree could be given after passing the written test. This needs policy intervention.

Prof. R.P. Lahiry

Professional ethics should be added to the engineering curricula and taught as a subject. The total quality management should be made a regular feature of the engineering education.

Dr. G.P. Karmakar

The faculty should also be drawn from the industry. An engineer who has developed oil-well and refined it can be a better teacher to teach these subjects to the students. So the faculty should change its mind set and allow the practicing engineers to teach engineering students. They will not replace the main faculty, but they will only supplement it. The faculty, who perform well, should be given incentives to keep them motivated.

Prof. Deepak Bhalla

The campus placement of the students determines the creditability of an engineering institution. Creativity and the thought process of the mind is what are required to be developed in the students of engineering for improving on the rate of campus placement. This should be done if we want to create thinking engineers; and it is thinking engineers that we need today.

Shri G. S. Dubey

The students who come out form the private engineering colleges, exceptions apart, are poor in the English language skills. The English language skills, therefore, of these students need to be improved. Besides, communication skills-both written & oral- must be improved in the engineering students.

Prof. Mohammad Kamil

There is mismatch in the demand & supply of engineers, as Shri Pawan Kumar Agarwal, Adviser (Education), Planning Commission has said in the opening session. It means we are producing engineers in large numbers then we have demand for them. Our regulatory authority should make it point to assess the demand for

engineers before giving license to new engineering colleges. The faculty should also be trained on a regular basis.

The industry-academia interactive mechanism must be created at the national level. The infrastructure with the large number of engineering colleges needs to be improved. The industrial training should be made mandatory. It is then only that it would be taken seriously by both the students and the faculty. I would like to suggest that it should be assessed and passing it should be compulsory for the students. It should be normally project – based. The internship for engineering students of six months to one year should also be made mandatory.

Dr. Pitam Singh

Out of 4 lakh faculty in engineering, 3.5 lakh is only BTech and not even Mtech. We produce less number of MTechs and PhDs. while as we need more in numbers of these. We should increase these. Perhaps, there is a need to introduce catching incentives for this for the students so that they are attracted to go for M.Tech course and do PhD thereafter.

Prof. Syed Samsul Alam

CSIR has come up with a programme for MTech and PhDs; and many central universities and engineering institutions have also started these programmes. I think with these programme having been started, the position will improve.

Dr. Deepak Bhatnager

We do not raise our voice to the people who are responsible for policy formulation. We should do it. Very valid points have been raised in this session and in the opening session by the learned panellist , and I agree with all the suggestions that have been made by them.

Shri Paritosh C. Tyagi

Major environmental concerns and basic principles of ecology should find a place in every engineering curriculum. The subject of economics also should be included wherever it has not been done so far. It is also recommended by the AICTE.

Shri P. Mishra

I wholeheartedly wish that the much coveted engineers Bill will emerge as a healthy Bill from its present "advance stage". We should have a forum for establishing good fellowship with peers and groups having common interest with a view to develop synergy among them, particularly the industry, the professionals, the academia, R&D institutions, govt. departments for creating benchmarks as regards the status and standing of the engineers in the society. We should take a fresh look at the regulatory architecture and design syllabi of all the branches of engineering education emphasizing on energy efficiencies green manufacturing practices and environmental aspects.

The 21st century engineers should possess the 21st century skills and actively pursue technology intensive solutions to leverage potential newer sources of energy viz, solar, wind, thermal, coal bed methane (CBM) , underground coal gasification (U.C.G.), shale gas etc.

It is said that ceramics is a 27000 year old subject, dating back to 24000 B. C. Over the years it has emerged as a branch dealing with the study of properties, manufacture, design and application of ceramic materials and it includes technology of making ceramic products like glass, tiles, cements, kitchenware, decorative items, furnace lining, super conductors and dielectrics. It is felt that ceramic engineering in the 21st century has lot of potential and prospects.

We should find an answer to the question: Why presently a large number of seats in the engineering colleges all over India are lying vacant. This is a worrisome trend needing a searching scrutiny.

Shri Vijaya Singh

Rapid changes are taking place in technology. There is a need for increasing levels of specialization. At present, there are courses for civil, mechanical, electrical, electronic and chemical engineering, this much of spacialisation is insufficient. In the case of mechanical engineering for instance, after graduation, the student may join the automobile industry, or work on construction and maintenance of thermal power houses, steel mills, chemical plants and refineries, manufacture, operation and maintenance of construction machines or work on agricultural machines, each one of which requires specialization.

The same situation applies to civil engineering; an engineer may join a builder and construct high-rise buildings and workshop structures or a power company and build civil works of thermal power-houses and steel plants or may work on the construction of highways and

railways, including construction of well compacted formation design and laying of pavements and construction of small, big and very important bridges on major rivers, on river training works, wells and caisson foundations, requiring compressed air working, PRC and triangulated girders, suspension bridges, cable-stayed bridges etc, construction of dames, hydroelectric powerhouses, canals, barrages, waterfalls and other hydraulic structures. The same may be said about electrical engineers and the field of electronics also.

A newly graduated engineer should have a thorough knowledge of the specialty he or she proposes to pursue. It is clear that every engineer cannot specialize in all these fields. My suggestion, therefore, is that the last two or three semesters of an engineering course may be reserved for specialization in the field of the student's choice. During this period, the student must receive intensive class- room training with the help of three-dimensional videos and be also exposed to industry by actual postings with industry for one week every month.

Cooperation of industry for extending the required facilities would be essential. It would be even more helpful if student- placement is done at the end of the sixth semester. An immediate question that arises is as to how time will be found for pursuing the above programme. I am of the view that very few engineers will be engaged on R&D and the time spent on advanced mathematics, such as solving complex differential equations, quantum physics, nano technology, three – dimensional analysis of structures which may never be used by field engineers, should be deleted from the four-year graduation course.

All civil engineers must have basic knowledge of the theory of structures, strength of materials, hydraulics, soil mechanics and design of simple RCC, PRC and steel structures but need not be expert in designing shell-roofs and other complex structures. Similar adjustments will have to be made for mechanical engineering, electrical engineering and other branches of engineering.

Students interested in R&D may study the advanced courses at the postgraduate level where they should have a good grounding in mathematics, physics, chemistry, metallurgy, etc so as to conduct R&D in the field of their choice. It is not possible that an R&D engineer will be an expert in automobile design and also in boiler design or design of steel plants etc at the same time. An R&D engineer must have a thorough knowledge of what is being done at present and should specialize in the seventh and eight semester of the four year course in the field of his choice. He or she can then try to master R&D in a postgraduate course in the same field.

The question may be asked that some of the specialties were there even two or three decades ago and why this problem was not being faced at that time. The answer to the above is that most jobs at that time were in government departments and there was no lateral mobility. An engineer joined the department to work for thirty years or more, and it was the department that spent considerable time and money in imparting training to the engineers prior to giving them independent charge. In the Railways, the period was two years, in UP Irrigation and PWD and others it was one year.

Most jobs now are in the private sector. There is considerable lateral movement and industry does not want to spend time and money on training a person who may take up another job after completing the training. Industry would prefer a "ready-made" product of an engineering college, familiar with the industry, which will be useful from day one or at the most after one month of familiarization. I feel that to achieve the above objective, a radical change is required in our engineering colleges to meet the requirements of industry.

For a builder, an engineer who has not been exposed to earth-moving machinery, piling, equipment, batching plants, tower cranes, pumps, actually at work, is of no use. The same is the case with a mechanical engineer who has not seen components of an automobile and how they are manufactured in a modern plant. He is of no use, though the young engineer may have been a brilliant engineering student with a good first division or distinctions. It is a frustrating situation for the employer and a young graduate.

Round - 2

Dr D. G. Kadkade

Many countries in the world do not give the degree unless there is a production in a plant by a student who has appeared and passed for six months. They are mandated to produce an item in a plant for six months before they get the degree. If you ask a student here can he grind the crankshaft beyond 60 though, he cannot. What miss match is between the theory and practical here? Can we request the government that six month practical training of this type should be made mandatory? The degree should be given after that.

Shri Jatinder Singh

There is a consensus that the present engineering education has no connectivity with industry in terms of employability. While the large industry and medium industry have no problem to train raw engineering graduates, the small scale industry do not have the resources to set up their own training infrastructure, money and the time to train raw graduate engineers. So these industries look for engineers who can deliver straight away after coming out of the engineering colleges. But in this they mostly do not succeed. This is the problem which arises from the present engineering education system.

What we have done to tackle this problem? We have created our guest faculty. This means, our HRD managers, production mangers, production supervisors have been asked to visit engineering colleges and give lectures there to the students and tell them about the industry and what is expected of them when they join it. These guest lectures have been made a part of the performance evaluation system for these managers. This is industry – academia interactive mechanism in a way that we have created. It is working well.

Shri Yogesh Pandya

We are talking about employability of engineers. We are talking about three things namely, engineers, industry, and institutions. We should think of more practical engineering education. In India, we produce more than two-times engineers produced by the US and nearly the same number as in the European countries. Every year we add 20% more engineers. The privatization of engineering education has also lead to this.

How the quality of engineering education can remain excellent in such a scenario? We have age old engineering disciplines like civil, electrical, and mechanical engineering, which still continue. What we should have is the application oriented engineering education so that the person comes to the industry and he/she can start working straight there, which is not the case today. We are facing the problem because engineers that we get are simply not employable.

The kind of investment that we make in this talent nursing, to develop them and to use them to play their role is by no means small. This is the general story across the board. Instead, what we should do is to produce multidisciplinary engineers. We should, therefore, think of moving out of the present engineering discipline-wise engineering education to multidisciplinary engineering education.

We should create new branches in engineering such as, construction engineering, hydrocarbon engineering or that matter general engineering in which basics of all important branches are covered, such as civil, electrical ,mechanical, materials and metallurgy, electronics and computer engineering. Then we should also add to the curricula subjects such as, economics, management, and communication. Such an education will definitely lead to producing multidisciplinary and multi-skilled engineers. We should have a project –based learning. We should create application - oriented disciplines in engineering education.

Then we should not talk in terms of IITs, NITs, and private engineering colleges. We should not have this classification in the quality of engineering education. We should talk about one quality of engineering education. Therefore, we should have one common entrance test for

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engineers throughout India. And all colleges should impart the same quality education. The engineering education is a professional course, so it has to be of the same quality throughout India. Then there should be no gradation; it should be either pass or fail.

IIT Delhi has set up an innovation centre and has taken some projects, but they have not got many projects. But the initiative is excellent for research-based learning and, hence, creating researchers for the industry. We should set up many more such centre in the country.

During – the-course industrial training should be project-based, it should be assessed and the students should also pass it. After - the - course internship with an industrial unit of six months to one year should also be made mandatory and the students should also pass it. The engineering degree should be awarded only after that. A provisional degree can, however, be given after the students pass the written examination.

Prof D.D. Maheshwari

The problem is that reluctant student is pushed into engineering education by peer pressure. The second problem is that many engineering colleges have been set up in the country after the sector was opened to the private sector. The supply of engineers has increased many folds while the demand for engineers has not increase commensurately. Thus a miss match has been created between the demand and supply. The third problem is that many colleges in the private sector have neither quality infrastructure nor the quality faculty. How can we expect output of quality engineers from such colleges? This issue needs to be considered as a matter of reform of the engineering education in the country. AICTE should deal with this issue.

Unfortunately, the people who go to teach engineering are B.Tech, M.Tech or PhD, but do not have experience of industry as such. A faculty with PhD has been teaching a particular subject in mechanical engineering for many years in an engineering college. He was unable to identify a piece of equipment. What we can expect from such a faculty in any industry-academia interface that we talking about? So, we must consider how we can give this industrial exposure to the faculty.

Credit transfer from one university/college to another college is not possible in India at present. We should make it possible. This will give freedom to the students to move out from one course to other or from one engineering college to the other or one university to the other. We should bring in the same type of flexibility in our education system across the board as it is in the US.

The Industrial training during-the-course should be project-based and the faculty should know on what project/projects the student/ students (group of students) is going for training. This training should be assessed and the passing this training by the students should be made compulsory. Similarly, after- the -course internship with an industrial unit of six months to one year should be made mandatory, it should also be assessed and it should be made compulsory to pass this training. The engineering degree should be given only after that. A provisional degree, however, can be given after passing the written test.

FROM THE FLOOR

Shri Satish Bhadur

Engineers may be brilliant, but they are not the best communicators, exceptions apart. This is a deficiency in our engineering education because the subject of communication is not taught as subject in our engineering course. We should include communication-both written and oral-as a subject in the engineering curriculum. Besides, one foreign language such as Spanish, or, French should also be taught to give engineers for seizing the opportunity to work in the Latin America, or, Africa where industry is growing and there is the demand for engineers there.

PANELIST FROM THE DIAS

Shri Yogesh Pandya

I agree with you. There was a survey by New York Times for employability of engineers and it was found that out of four engineers two were not readily employable. Those who were employable had technical skills, communication skills, and presentation skills. Those not found employable, had not these skills. So, communication skills are important for an engineer to

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have. The students have started realizing this. So, communication must be included as a core subject in the engineering course.

Prof N.V. Ratnalikar

The need for engineering education in India is for pedagogy, for quality consciousness, and for the professionalisation at all the three levels; namely, management, the heads of institutions, and the faculty members. Some measures for education and training are required to be taken. We have got 80 technical universities and 3500-4000 engineering colleges in India. We must be quality conscience. We must produce global engineers. For this, we must move out of the present engineering discipline-wise engineering education to multidisciplinary and multi-skilled engineering education for producing the global engineers. If we want to make a change, first of all faculty must change. After every 10 years the faculty must assess the engineering education system and send the feed back to the regulatory authority telling them what changes are required to be made in the system. Adoption of the philosophy of total quality management for all quality efforts is strongly recommended. AICTE should be revamped and made more transparent

Shri P.K. Chatergee

As in other professions, competent authority may consider seriously setting up of teachers training colleges for engineering education. This will improve the quality of teachers, which will in turn improve the quality of engineers.

Shri O.P. Gupta

There should be one syllabus at the national level so that the quality of education of the students coming out of the different colleges is the same. Admission criteria should also be strong. The management quota should be scrapped as it affects the selection criteria. Till the proposal of an engineering college is not backed by the quality infrastructure and the faculty, it should not be approved. Engineering colleges not having the quality infrastructure and the faculty should be told to improve these in a given time frame, if they do not do it, their license should be withdrawn. Internship of six months to a year in an industrial unit must be made mandatory and assessed. It should be made compulsory to pass it.

Shri D.K. Gupta

Engineers do multitasking today. They are not trained for that function. They need to know about tools, technology, and systems. Are they taught this; no they are not. The big corporations have no problem as such with employment of engineers, because 25 % engineers, who are employable, go there. We have a problem with the rest of 75% of engineers who are not employable. Some times they find employment in medium and small scale industries. Present globalization has created the same conditions of doing business for the SMEs as the large corporations have; there need for engineers, therefore, is also the same as that of the large corporations. They need multi - skilled engineers who can handle jobs requiring, apart from technical knowledge, knowledge of other subjects such as that of social sciences and communication. They should be trained in these subjects as well.

Shri Laxman

The feed back from most of the companies is of three things in an engineer, the first the technical fundamentals should be good, practical orientation should be there in teaching theory and conducting the project work and the third is that there should be consistent progress in the marks of a student. For employability, they want 60 % intent and 40 % ability to handle practical aspects including projects. It is possible to make our students employability by creating some support courses and assistance for doing the project work in the college itself because industry is not giving internship, they are not giving project work because they are saying that they do not have infrastructure. So we have to create infrastructure in colleges itself. I suggest, therefore, that the engineering college should have a separate department to coordinate project work.

PANEL INTERVENTION

Prof DD Maheshwari

In most of the cases the students do not want to go the industry. They feel comfortable in the college campus, availing library facility, and availing hostel facility- because food is taken care of. If they have to go to the industry, it will be at a place far from the college. They will have to finds a place to stay, find means to commute to the factory, find food, so many hassles that they have

to face. So the students are not interested for an internship with an industrial unit. We must keep this ground reality in view.

Shri Laxman

The good students will get an opportunity to work in the industry as an intern. I am talking of those students who do not want to go to the industry for the reasons that the panelist have mentioned. I am suggesting the above arrangement for these students. This will give them some industrial orientation. The Industry should also come forward to accept students for training & internship.

Dr. C.S. Surana

CSIR had stated a scheme of technical teachers training programme in 1959. At that time there was shortage of engineer-teachers and I also joined the programme. CSIR stopped this scheme. I would not know why this scheme has been stopped. The programme can be again started to train teachers of engineering, if we think that the quality of teachers is poor. The schools in India should be advised to invite people from the industry and from the engineering institutions for addressing 12 standard students and inform them what is engineering , what is civil engineering, what is mechanical engineering, and so on, I think the peer pressure on students to go for engineering should not be there; and they should decide by themselves as to what profession they should go far. It will considerably reduce the intake of reluctant students into engineering. This practice should be made a regular feature in the country and should also be included in the list of recommendations of this round table.

I do not agree with the suggestion made by the panelist that we should not have the grading in engineering education. We should have the grading because we are not producing engineers only for the Indian industry, but also for the world market. We must develop communication skills in engineers. There should be emphasis on this.

Shri S.Arunachalum

Not producing the quality engineers is the reason for unemployability of engineers today. To improve on the situation, I suggest that we should stop commercialization of engineering education. It has only resulted in poor quality of infrastructure in many colleges and poor quality faculty in these colleges. I think a mechanism on industry-academia interaction is very necessary for improving the quality of engineering education and that of the faculty. We have been talking about it in various fora, but there has been no action on this.

Shri S.K. Madan

Summer training in the industry is there, but the students do not take interest in that training. How to motivate the students to be more interested in the summer training? This is the issue which we need to consider.

Shri D.K. Gupta

Engineering colleges set up in the country during the last 10 15 years, particularly in the private sector, need to be looked into by a committee of the honest people to be constituted by the regulatory authority of honest people for the infrastructure that they have, and the faculty that they have, Then it should be cross checked with what has been recommended as the norm by the AICTE. In case it any college found with poor infrastructure and the faculty, that college should be put on notice for improving these in a given time frame, and if they do not do it, they should be closed down The Industry should stop outsourcing jobs and go far employing engineers to do those jobs.

Shri Gopinath Menon

The professional societies have a role to play in engineering education. They have been making engineers from out of the shop floor people all these years. Of late this has been stopped by the government. They do not want now a parallel system in engineering education, as they did in the past. Here in this mode of engineering education, students are working technicians. In other words those people who could not afford engineering education from main stream colleges, they joined work instead. They are better candidates for going for engineering education as they have industrial experience behind them. We need to look at this issue also.

Dr Deepak Bhatnagar

The English language skill in engineers is not that good. English language should be there in the engineering curricula. The engineering education need to be looked into from the point of view global competence, and

transnational mobility of engineering students, researchers and professionals, and the global mobility of engineers should be given top most priority. There is also an urgent need for research in teaching engineering in the global context. The global excellence of engineers depends critically on mutual commitments to partnerships, especially those that lead to engineering education to professional practice.

A delegate

We should also consider the role of technology in engineering education in the context of quality faculty shortage.

Dr Kalyan Mitra

A token amount of levy should be charged from industries both Indian, MNCs,/ globalized companies for recruiting an engineering graduate from a reputed institutions like IITS, NITs, IISc, BITs,Pilani, etc. This should be used for the implementation of a project on quality improvement of the faculty. However, exemption should be given to those industries which are having innovative research facility/industry – academic interactive linkage in position. There should be a mandatory rigorous paid internship programme of six months to one year after the course for engineers. The industry should be compensated for the expenditure that they may incur on this paid internship via the tax route or out of the budget earmarked for the social corporate responsibiliy. A National Proficiency Test (NPT) should me made mandatory for evaluating students who pass engineering for employment in the industry. After every five years engineers should revalidate their NPT certificates by undertaking a short-term course for updating their knowledge.

MODERATORS VIEWS

Shri J.S. Saluja

Even if best education is imparted, you may not be employed because what the industry wants is the right education. The world right here means a kind of education which will meet the requirement of the industry. It is very important to be understood. What the industry wants is that an engineer who comes out of engineering college should have a fairly good knowledge of the field of his specialization and just reasonable knowledge of other subjects such as project management, economics, project appraisal, writing of feasibility studies on industrial investments, how to prepare a detailed project report, how to draft a contract document, dispute resolution, and industrial law.

They should have also communication skills – both oral and written. Thus they should have a reasonable command on the English language. Preferably, they should also know one foreign language such as Spanish or French. We can say that they should have about 60 % of the domain knowledge and 40 % of the other subjects cited above. This is not so presently. While as engineers for R&D sector should have 80 % domain knowledge and 20 % of the other subjects.

When we look at the manufacturing sector, what kinds of engineers are required there? We will come to some conclusion about this and this is that the manufacturing sector needs engineers whose domain knowledge should include basics of civil engineering, mechanical engineering, electrical engineering, material & metallurgical engineering, electronics engineering, and computer engineering.

We will have to cover in this domain all these subjects. Similarly we can develop modules for construction engineering, and other similar sector- base engineering degrees.

So, we should move out of the present one discipline engineering to multidisciplinary and multi-skilled engineering education. We should reform engineering education accordingly and make it suitable to user sectors.

Concluding Round

MODERATOR'S OPENING REMARKS

Shri T.S. Suresh

We have before us the recommendations of the seven national conventions on them "Reform of Engineering Education for Better Employability of Engineers", a workshop, and other programmes on related themes organized by the Engineering Council of India since August, 2006 in the country. We have also discussed the subject at this round table conference today. Now, we will consider these recommendations. But before that I would like to request panelist to make their presentations.

Dr. M.U. Aswath

Engineering education and curriculum developers must anticipate dramatic changes in engineering practice and adopt their programs accordingly. Innovative ways should be adopted to improve the training of engineers to prepare them for addressing the complex questions raised by emerging technologies. Learner - centric teaching faculty should take up the role of a mentor, guide, coach and facilitator for learning. We must develop oral communication skills in the students. We must develop critical thinking skill in the students by discussions. The problems are solved best by using team approach. We should develop self responsibility skill in the students. We should build self esteem in the students. We should simulate real life situations, and promote student-faculty interactions. We need intense training programmes .There is a need to develop personality-think positive attitude. Overall development of intellectual ability is very necessary. Four years should be made 5 years with 6 months industrial training and 6 months of project work in the industry. The visits to the industry must be compulsory.

Dr V.R. Singh

We must improve the quality of engineering education. It should be mandatory for every institution of higher technical education to get accreditation from the regulatory body in the country. We should produce engineers not only for meeting our demand, but also demand of the global market. We should produce global engineers by having conformity of our engineering education with the global standards of engineering education through international bodies like IEEE and ABE, etc,. The education standards of IEEE and ABE are available.

Dr. G.P. Karmakar

Teaching is my profession by choice. I love it and I think I cannot be best in any other profession. I was previously with ONGC. After working there for about two years I found that it was not my cup of tea. So I left ONGC.I am happy with what I have. In petroleum industry, besides petroleum engineers, we have applied geologists, mechanical engineers, civil engineers, chemical engineers and electrical engineers. We have converted them all as petroleum engineers. And our job is oil exploration and production of crude. Of late we have gone beyond oil production to oil refining. The institute in which I am working, it has been set up by the oil industry and there is a very good interactive mechanism in position between the academia and the industry there. So result is that there is no unemployment for our students. We have entrepreneurs as students who have come to learn about the oil industry. After the course, they will set up businesses based on petroleum. This is a perfect union because the objective of the players is common.

The Gujarat State Petroleum Corporation started the Gujarat Engineering Research and Management Institute as a part of its social corporate responsibility. The institute created the Pandit Deendayal Petroleum University and School of Petroleum Technology. All major oil companies have their offices in Ahmadabad; and it is the Huston, US for India. We interact with almost all the oil companies located in Ahmedabad. So it is a perfect example of industry and academic institution working together for meeting the common interest which is petroleum exploration & production. I wish

Shri T.S. Suresh, Director (Projects & Business Planning) Steel Authority of India

Dr. M.U. Aswath, Prof. BIT, Bangalore & former Secretary General, ACCE (I)

Dr V.R. Singh, Fellow, IEEE, India Council, Member BOG, Engineering Council of India

something similar happenings in the steel industry, power industry and so on. We may not face the unemployment problem then. We are facing a faculty crunch. We are seized of this problem.

Unemployment of engineers of the other branches is a serious problem that we are facing. Today, we see if a person with BTech degree does not get a job, she / he goes for MTech; and if she/he does get a job she /he goes for PhD. I have not met any person who has taken these specializations of her/his own liking. What can we expect from such MTechs and PhDs? This is the case in all branches.

In any reform process that we may decide to go far, I would like to say that the core subjects should not be removed while reforming the curricula. I think the general courses should be restricted to first year. It is my observation. A suggestion came from the floor that the engineering course should be of five years instead of four years in which two years can be general course and the remaining three can be of core courses. Many companies select students through GATE. The petroleum engineering stream has no GATE. It must be introduced in this sector also.

I agree that the syllabus must be revised after every four years. This should be made a mandatory for all the engineering colleges. The industry should be consulted for this. I agree with the suggestion that the integrated course of five years in engineering and management courses should be started. As a matter of fact this course is already being run by some institutes in the country. We will take up the recommendation for adoption.

MODERATOR'S CONCLUDING REMARKS

Shri T.S. Suresh

I appreciate the efforts that the Engineering Council has made on the reform of engineering education system in the country since August, 2006 when it organized the first convention with the theme: reform of engineering education system for better employability of engineers followed by six more conventions, a workshop and a couple of national conferences on the related themes in different parts of the country. Proceedings of these programmes have been published and circulated quite widely including to the concerned government departments for consideration. This round table has been sponsored by the Planning Commission.

Comprehensive recommendations have emerged from this round table conference after day long deliberations for making engineering education industry-specific as well as for making available researchers to the R&D set up in the country including the industry. I will like to mention one recommendation and this is regarding six months of industrial training. This recommendation is important as it will give practical flavour to the engineering education. This is what we need the most today. This used to be a part of curricula earlier and it seems that it is not there now, and it needs to be restored. The industry must have frequent interaction with academia for various things, particularly to tell them what kind of subjects that they should teach.

We encounter all disciplines of engineering in steel industry. We hardly get engineers in ceramic field; and in metallurgy, we have started facing difficulty in getting engineers. Basically engineers prefer white colour jobs these days, and well paid jobs at that. That is why we find engineers of all branches hopping on to the IT sector. So, the trend is to hop on to service industry rather than the manufacturing industry. This is the problem today. How to make engineers interested in the muddy waters of shop floors of the manufacturing industry? This is the question we must address.

Then there is a problem with retaining people in the industry. We have to find solution to this problem. There is a reference to general engineering and also to what is happening abroad. I have met many engineers from aboard and I found they talk about specializations. For example, I met an engineer who was mechanical engineer by qualification - but he had specialized in hydraulics and he will talk about hydraulics only and nothing else. I happen to see the curriculum of some NITs and I found it needs to be up dated; you cannot teach some thing that was relevant 30-to-40 years back. So I think the recommendations that have been made are, by and large, in order, and I think we can implement many of these.

After this, The Recommendations of the Round Table Conference were Finalized and adopted.

Views on Reform of Engineering Education for Better Employability of Engineers - Via E-mail

Engineering Education - A US Perspective

— **John Triplett***

30 years ago, the standard model for higher education in the US consisted of a four year undergraduate degree, a two year Master's degree program, and a four year PhD program. The four year undergraduate program was divided into two years of basic study, during which the student would choose a major, and two years of concentrated study in that major. This was a standard model for all students in all colleges.

Engineering schools, however, were finding that more and more of their undergraduate engineering students were taking more than four years to complete the undergraduate course of instruction.

The institutions were also finding that the different engineering departments were requiring more and more upper-level engineering courses for their individual disciplines, and the different departments were asking if elective courses in the humanities could be dropped from the required curriculum for undergraduate engineering students.

Engineering schools were also dropping the requirements of traditional courses like Engineering Graphics. The upper-level engineering courses within departments were split into majors, so the student had to choose an engineering discipline and a specialty within that discipline at the undergraduate level.

The knowledge base had expanded so rapidly that there was simply not enough time in four years to effectively teach undergraduates basic engineering principles, a general engineering discipline, and other course-work that the University thought necessary to truly educate an individual.

Some US engineering schools then began to offer a combined BS and MS program in Engineering. The combined course work would only require one additional year, according to the university catalogs.

It was a way of mentally preparing the student (and parents) for a full five year course of study. The additional time was sufficient for the student to take the basic engineering courses, the core courses of an engineering discipline, and the other courses that the university thought necessary to grant the undergraduate degree.

The specialty courses are taken in the Master's portion of the curriculum. For those students who do not attend classes year-round, the Master's degree portion probably takes a sixth year for completion. It becomes the standard model again. The system of higher education in the US is traditional and conservative, and changes slowly.

It is at the Master's degree level in the US that engineering students really begin to specialize in a field. In general - there are exceptions - professors take more interest in their graduate students, and spend more time with them. The professor has the graduate students assist in research.

The student should choose a program and advisor in which they have a special interest. Otherwise the graduate student may be requested to go into depth in a subject that is not of primary interest to them.

The two years of course work for the Master's degree well prepares the engineer for a specific engineering discipline.

The Doctorate programs at US universities are designed to prepare the engineer for research. The students choose a very special area of interest, working very closely with their advisor.

The engineer must do original work in the field of interest in order to earn the Doctorate degree. Their specialization often leads to a career path in teaching and research at the University level or research positions in the government or industry.

The standard model for engineering student in the US is now a five year undergraduate program, which includes basic engineering courses in several engineering disciplines, courses in other schools within the university that are considered necessary for a rounded education, and courses in a specific engineering discipline with some specialization in a particular area of interest.

If the student wants to specialize in a specific area, the Masters program offers courses that pertain to that area of interest.

Should the student wish to pursue a particular area in great detail, the Doctorate programs offer that opportunity?

*Shri John Triplett, former Consultant, Delhi Metro Rail Corporation.

Place of Environmental Concerns in Engineering Education

— **Paritosh C. Tyagi**, FIE FNAE*

Environmental concerns may be grouped into four categories, namely, local, regional, fluvial and global. Noise is typically a matter of local concern; large clusters of industries may cause regional environmental problems; wind and stream flow may transfer pollutants to cause fluvial concerns, and global warming or ozone layer depletion can be an example of global environmental concern. Such concerns may be related to a host of factors that may mainly comprise development activities and lifestyles.

Engineers have a key role in the development activities right from planning to the operational phase. Take for example a common activity like earthwork, which does not merely transfer soil from one place to another but it also means generation of dust and noise, traffic congestion, disturbance and erosion of top soil, alteration of drainage pattern, siltation of reservoirs, creation of pools that serve as breeding place for mosquitoes and consequent spread of certain diseases. Similarly, various impacts and consequences follow the activities related to generation of power, manufacture of goods and handling and disposal of wastes. It is generally seen that a primary activity causes its impacts and induces secondary activities, which have their impacts, and so on.

It is commonly observed that engineers have shown major lapse in attending to environmental concerns. Perceptions regarding why it is so may vary widely. My view is that, first and foremost, the engineering education turns them out without adequate understanding about environmental issues, although much knowledge and experience has been gained on this subject in the last fifty or sixty years. Environmental concerns are regarded as a subject of specialization rather than a subject for internalization in engineering education.

The second important issue in this matter is that engineers work for the government or some other client, who have their own priorities in which environment does not often have an appropriate place. Engineers will be able to do justice to their role related to environment and society, if their education equips them to be self-employed and capable of conceiving projects and securing funds for their implementation, with adequate environmental safeguards.

The third point that I would like to make is that engineers are trained in a manner that they tend to focus more on aspects related to structural design and project construction than on resource planning and uninterrupted operation. Reliability of service, for example, is generally not a factor in the formulation of proposals for engineering projects.

The fourth and last point is that engineers are seriously handicapped in understanding environment and ecology because biology is not among the subjects learnt by them. Engineering education and fieldwork need to incorporate a component of the basic knowledge of the principles of ecology as well as sociology.

In conclusion, I would like to emphasize that engineers must understand and own their responsibility in environmental matters, which will be possible only after their educational curriculum is accordingly modified.

*Shri Paritosh C. Tyagi, Consulting Engineer.

Reform of Engineering Education- Some Points

— R N Parbat*

India produced 4,63,253 engineers in 2006, of which 3,766 passed out of 9 IITs, 8,550 from 20 NITs and 4,50,937 from 1337 other Engineering Institutions. Of 4,63,253 engineers, 2,70,115 engineers were trained in IT & CSc and the balance 1,54,087 students were trained in different branches of classical engineering disciplines. Of the entire engineering population, 95 % engineers from IT & CSc stream and 75 % of engineers from the classical engineering disciplines join IT & Computer related industries leaving a small number of engineers for manufacturing industries. The shortfall in the supply of engineers to the main stream engineering organizations is made up by recruiting Diploma Engineers for Engineering Polytechnics and B Sc / M Sc candidates from Science stream. One does not even get the right choice of engineering and scientific disciplines at the time of recruitment. The issue is therefore, very serious and deserves concerted efforts by one and all.

Training and re-training of the recruits has, there, become an ongoing practice. A recent study by The Indian Institute of Metals, sponsored by the Ministry of Steel, Government of India reveals that only 6.5 % engineers from the classical engineering disciplines and 1.25 % of engineers from IT & CSc stream join Iron & steel relater industry, R & D and design / consultancy services. Right now, there is a shortage in the supply of metallurgical engineers, mining engineers and ceramic engineers both at degree and diploma levels. There is, however, no shortage in the supply of ITI trained personal, the number of intake being 6,71,941 in 2007.

The shortfall in Technical manpower may increase further should Steel Industry grow from current 55 million tones production level to 250 / 300 million tones by 2020 and the recruitment pull from abroad continues. It is hoped that the current recessionary pressure will be short lived and Indian GDP growth will attain 7.5 % to 8.5 %.There is also a shortage in the supply of M.Tech & PhD candidates with a consequent shortfall in the supply of teachers and scientists in the engineering colleges/universities and research organisations.In the interim, the only option available is to offer structured training to the available degree and diploma holders both at the engineering colleges/universities and industries.

A Case Study of a Career Growth with the Re-Training Needs

Let us trace through the history of an individual engineer in his 38 years of career growth. Given below are the steps :

1. Research Engineer
2. Assistant to General Production Superintendent
3. Assistant Rolling Mill Superintendent
4. Rolling Mill Superintendent
5. Production Superintendent
6. General Production Superintendent
7. Works Manager
8. Divisional Manager, New Products & New Markets
9. Chief Executive, Rolled Products Division
10. Vice President : Projects, Engineering & Logistics
11. Whole time Director on the Board
12. Chief Operation Officer
13. Managing Director of an Aluminium Co.
14. Executive Chairman of a Thermal Power Co.
15. Executive Chairman of an International Export Oriented Alumina Co.
16. steps in the corporate ladder during 38 years of professional career, meant a career change almost at every 2 ½ years. He could not have coped with the changing demand of the job without very effective RE-ENGINEERING.

What has been the process of Re-engineering?

1. Training to improve Job knowledge
2. Exposure to real work environment
3. Training on Leadership
4. Training on Management skills like

*Shri R.N.Parbat, former Director & CEO of Indian Aluminium Co. and MD of Indal Norsk Hydro JV Co.

- Manufacturing management
- Cost management
- Quality Management
- Profitability Management
- Marketing Management
- Human Resource management

5. Corporate Strategic Management
   - Financial Management
   - Strategic Planning Management
   - International Management
   - Growth Management through Expansion, Merger and Acquisition
   - Board Management
   - Ownership Management

Why so much Re-training is needed?

An Engineer is taught only a few basic principles of Science and Engineering at the Engineering College and these are:

1. Basic principles of Physics, Chemistry, Mathematics and Statistics
2. Basic concepts in only one branch of Engineering, say, Mechanical Engineering
3. Depending on the last degree acquired i.e. ME / M Tech or Ph.D, some Knowledge of solving unknown problems

What are we confronted with in Live-situation?

1. Knowledge in one branch of engineering is inadequate
2. Depending on the type of industry, the demand on knowledge varies
3. In an integrated manufacturing industry with upstream and downstream activities, the demand on one's knowledge varies widely. For example, take the case of Aluminium Industry where knowledge is demanded in the following areas :

(i) Mining and Environment management

(ii) Alumina refining as a chemical process and waste management

(iii) Aluminium smelting as an electro-metallurgical process with recovery and disposal of hazardous waste materials

(iv) Aluminium remelting, casting of shapes and forms including Pigs, Wire Rods, Extrusion billets, Rolling ingots and continuously cast wide strips

(v) Hot and Cold rolling technology with thermo-mechanical treatments and also electro/electronic & mechanical control on shape and profile. Also the knowledge of drawing, punching, pressing and forming

(vi) Rolling of 6 micron thick foil with surface treatments like, lacquering, printing, laminating and embossing

(vii) Extrusion of billets with full knowledge of die-making and control of shape and profile

(viii) Anodizing and Powder coating of profiles

What are the limitations of learning in Engineering Colleges?

The range of knowledge needed for industry can not be provided by the Engineering colleges through formal time bound courses. Re-engineering at specific point of change in the course of career is, therefore, is a must. Besides, there are also major shifts in the knowledge of Science and Technology. Knowledge up-gradation trough re-engineering is the only answer. Mechanical engineers are taught some elementary knowledge on Product design but in live-situation this knowledge is grossly inadequate. No specific course is available for Car body design or say furniture design. Eco-friendly design is still unheard of in many industries. A course on Eco-friendly Product design was introduced at The Indian Institute of Science, Bangalore through academic partnership of Norwegian Institute of Science & Technology (NTNU), Trondhyme with financial support from Norsk Hydro A S of Norway. This programme ran for 5 years, producing a large number of Design engineers with duel education at IISc and NTNU. This was a grand success. More such initiatives should be made to provide front line knowledge to our practicing engineers.

Conclusion

The practice of Re-engineering should be built into engineering curriculum and industrial training programme. No matter which engineering discipline one follows, in the course of one's career there are major shifts in technological discoveries and continuous innovation. Besides, one does not restrict one's expertise in one specific area only. Knowledge of operation is different from the knowledge of Project management and still different from Environment management or development of corporate strategy. Re-engineering is, therefore, a must at the point of career shift. Practice of Re-engineering should be built into engineering curriculum and industrial training programme. No matter which engineering discipline one follows, in the course of one's career there are major shifts in technological discoveries and continuous innovation. Besides, one does not restrict one's expertise in one specific area only. Knowledge of operation is different from the knowledge of Project management and still different from Environment management or development of corporate strategy. Re-engineering is, therefore, a must at the point of career shift.

Reform of Engineering Education - Some Points

— R N Parbat*

After Higher Secondary, Engineering Degree Course should be for 4 Years max. Should any one enter Degree Course after B.Sc. degree with high Honours in Physics, Chemistry, Mathematics or Statistics, Degree Course will be for 3 Years. In the Curriculum, Basic Engineering along with specialisation in Specific Branch of Engineering like, Mechanical, Electrical, Chemical, Metallurgy, Mining, Ceramics, Aeronautical, Naval, Defence, Electronic, Telecommunication, Computer Engineering / System, etc. .

Anyone, wishing Super-Specialization in say, Engineering Design, Project Management, Research orientation, Steel Making, etc. may pursue another 2 Years' Special Education with a Post Graduate Degree.

Those who wish to pursue Ph D after M E / M Tech. may be allowed 3 years' Full-time Research to complete Ph D. This will limit Academic Period from 3 to 8 years. A student can choose career option according to his/her choice or financial status.

Currently, only 6 % of qualified Engineers chose career in a Manufacturing Industry. Reasons are, High remuneration in IT White colored Jobs, promise of highly remunerative jabs after MBA, lucrative offers for Research abroad (mainly for IIT & NIT students) and Engineering Institutions giving preference to such subjects, where there is opportunity in highly developed industrialized countries.

What should we do ? Indian Academic Intuitions and the Manufacturing Industries engaged in Mining, Power Generation, Iron & Steel Making, Aluminium/Copper/ Zinc/ Lead/ Titanium/ Uranium Making, Foundries, Forging Units, Auto/ship Building Industry, Railway Industry, Aircraft Building cum Maintenance Industry should sit together and decide on Engineering Curriculum to suit Indian Industry and Indian Research at our current level of GDP growth related to Indian needs.

Our boys/girls are doing excellent in International Research Organizations as because we in India are producing Specialists to suit Overseas Countries' needs. Also, Teaching jobs and Research work in overseas countries are more challenging and remunerative.

Well, these are some of my immediate thoughts on the subject.

Reform of Engineering Education

— J Ravindranath*

This is a very important initiative by Engineering Council of India considering the increase in the number of engineers graduating year – after - year and decrease in their quality.

The companies are forced to spend lot of time and resources in improving their skills to suit their requirement.

As most of the theoretical knowledge imparted in the college is not useful in the job, it can be restricted to basics, which are essential for the particular discipline. Advanced theoretical knowledge is required only for those involved in research work.

Interaction of the students with the specific industry in the final year is required for him to understand the application part of the subject.

The project work should be done in association with the industry.

The development of managerial skills should be given more importance in the final year.

Most of the fresh graduates are found to be taking more time in acquiring these skills after joining the industry.

More emphasis should be given to application rather than theory in the examinations also.

Nevertheless Industry can not expect to completely get rid of the training of fresh graduates joining them.

These are some of my thoughts, which I like to share with you.

Thank you very much for the opportunity given to me.

NICMAR

NICMAR's Flagship Two - Year Programme

This programme is on Advanced Construction Management is precisely targeted towards creating such an engineer manager for construction business.

The programme's two major modules – one on infrastructure sector and the other on real estate development and financing - have made it a highly sought after programme and the graduates are recruited by a wide range of organizations in these sectors both in India and abroad.

Further, NICMAR has created another complimentary programme on **"Project Engineering and Management"**. The two programmes together now enable NICMAR to seamlessly integrate and address the needs of several of types of project activities and meet the graduate human resource needs of a very wide range of organizations.

Further, work and innovation is contemplated which will enable NICMAR to develop high level specializations, as needed.

*Shri J Ravindranath, Dy General Manager (Mkt-Exports), Salem Steel Plant, Salem-636

Reforms in Engineering Education in India

— Dr. Madhu Ranjan*

Engineering is a practicing vocation. Engineering education caters to following major segments, and each one has its own issues to be addressed to achieve sustainable growth of the country:

- **Manufacturing Industry:** Production, Quality, Maintenance, Planning, Management
  - ***Present Status:*** The fresh engineers are too green, hence need long and expensive training. E.g., SAIL has a 1.5 yrs training program for GETs, and Tata Steel has about an year
- **Projects:** Project Engineering, Project Management
  - ***Present Status:*** India largely dependent on foreign expertise for new projects or for modernization
- **Innovation:** Research & Development, Design Development, Technology Development
  - ***Present Status:*** Apart from incremental improvements, we don't have much to show
  - ***Issues:*** Lack of researchers, lack of motivation for research, as well as lack of research infrastructure
  - **Academics :** Teaching, Fundamental and Applied Research
- **Present Status:** Lack of motivation to opt for academics

Reforms to be considered

- Creation of "Academic Board", having participation from Academia, Industry, Research Institutions, Consultants. This forum
  - Review curriculum, make it more practical oriented
  - Create sandwich programs, incorporating internship programs for students
  - Identify/Create "Visiting Faculties" from Industry/Research Institutions/Renowned technocrats
  - Select practical projects for thesis necessitating participation of the industry
- Industry to sponsor projects/programs
  - Identify/nurture researchers, designers, innovators
- Set-up design institutes/departments

The above are some suggestions, which need to be elaborated/discussed.

*Dr. Madhu Ranjan, Managing Director Elring Klinger India Pvt Ltd, Pune & the National Council Member of the Indian Institute of Metals- A Member Association of Engineering Council of India

Round Table on Reform of Engineering Education for Better Employability of Engineers-Contours of Reform on September 13, 2012

A Brief Note

— Dr. R. Vakil*

The basic issue in higher education in general and engineering education in particular is very poor quality of education. Several surveys have shown that large numbers of graduates of engineering and management are simply not employable. Why? Not because they are not taught "practical" aspects of their discipline. But because of very quality of education they receive. And why this is so? Because, teachers in engineering colleges are simply not available. Senior level teachers with 5 or more years' experience are nowhere to be found.

You do get lot freshers (just out of college) because initial salaries are good. But they have no practical or academic experience. And they have no mentors. Besides they are product of the same system which produces poor quality engineers. In many colleges even such teachers are not available. It is, therefore, not so much the question of quality of education, but of no education at all in some disciplines, and the students are left on their own to prepare for the exam.

So what are we talking about? Is the curriculum outdated and obsolete? Yes. There is no practical bias to teaching? Yes. (The teachers have no experience of any kind, let alone 'practical'. What is the industry looking for in their recruits- students with sound grounding of fundamentals, which is unfortunately completely lacking in nearly 90% or more of the graduates. The industry will be satisfied with students with basic knowledge and understanding of the fundamentals of their discipline. Yes, they should be open to learn, open to new ideas. The industry will take care of the rest.

Everyone in the government and academics and even some well meaning people in the industry are totally blind to this single hard reality of education (of whatever description and at whatever level). They think that the problem will solve if they come out with new curriculum. That it is the easiest thing to do. What is urgent is to take a systemic of the whole spectrum of engineering education including availability of competent teachers at all levels, reforms in curriculum and the teaching-learning process and involvement of industry in technical education at all levels – including management and decision making. Industry-Institute interaction has been talked for several years now, but not much headway is made so far. An example was set by the Stanford University and the Silicon Valley wherein there was free interchange between academicians and industry experts leading to more relevant education and research

*Dr. R. Vakil , former President and Director of CEPT University, Ahmedabad and CMD, VMS Engineering and Design Services Pvt. Ltd.

Scenario of Engineerers/ Technologies in the XIth Plan

— **Prof. K. K. Sharma***

Objectives and Challenges

- The Indian economy: much stronger than it was a few years ago.
- growth rate: 5% in the Ninth Plan period (1997-98 to 2001-02), 7.2 % in the Tenth Plan period (2002-03 to 2006-07)

  [Plan target of 8%]
- While this performance reflects the strength of the economy in many areas, it is also true that large parts of our population are still to experience a decisive improvement in their standard of living.
- The percentage of the population below the poverty line is declining, but only at a modest pace. Far too many people still lack access to basic services such as health, education, clean drinking water and sanitation facilities without which they cannot be empowered to claim their share in the benefits of growth.

What is required from engineering?

- To help in maintaining the expected growth rate by specifying the areas where Nation needs more technical support
  - How to use funds in more effective manner – economy in right direction
  - Where, why, when and by whom to be used- No wastage of Money
  - Execution and effective checking- Proper Use
- With investments, expenditures and demand
- To support or develop new technology
- To improve quality of products and functioning
- To reduce the waste from industries and domestics
- Engineers' Quality Improvement
- To generate more opportunities for setting new industries for need, more employment, more foreign investment, improved quality production, better use of side products, reuse of waste, alternate techniques, more user and environment friendly techniques and products e.g. Waste of chemical oriented industries should not pollute the land, underground water, and the air above earth
- Concept of consumer health
- Industrial growth
- Technological advances
- Human resource development
- Improved livelihood
- Self sustainability
- Ergonomics

Major Challenges

- Providing Effective Essential Public Services for the Poor
- Regaining Agricultural Dynamism
- Increasing Manufacturing Competitiveness
- Developing Human Resources
- Protecting the Environment
- Improving Rehabilitation and Resettlement Practices
- Improving Governance - example NBA
- Reducing Disparities and Divides
- Demand Side Intervention
- Supply side strategy
- Appreciated Research
- Management

*Prof. K. K. Sharma, Assistant Professor (Electronics & Communication Engineering), G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand.

- Promoting Industrial Growth
- Village and Small Enterprises
- Mining
- Professional Services
- Construction, Housing and Real Estate
- Tourism
- Retail Trade and Organized Retail
- Entertainment and Media Services
- Infrastructure Development – Roads, Railways, Ports, Airports, Electric Power, Coal, Oil & Gas, alternate energy initiatives, urban infrastructure, telecom and connectivity
- Demand Side Intervention
- Supply side strategy
- Appreciated Research
- Management
- Promoting Industrial Growth
- Village and Small Enterprises
- Mining
- Professional Services
- Construction, Housing and Real Estate
- Tourism
- Retail Trade and Organized Retail
- Entertainment and Media Services
- Infrastructure Development – Roads, Railways, Ports, Airports, Electric Power, Coal, Oil & Gas, alternate energy initiatives, urban infrastructure, telecom and connectivity

Strategic Initiative for Engineers

- Enhancing quality education
- Helping Disadvantaged and Senior Citizens
- Reemphasis on learn by doing
- Technical/Vocational Education and Skill Development
- Comprehensive Strategy for Better Health
- Rural Infrastructure
- Bridging Divides: Including The Excluded: Growth and Poverty, Employment, Changing Employment Patterns, Employment Generating Sectors, Self-Employment Programs
- Rural Urban Divide
- Balanced Regional Development
- Bringing at Par: SCs, STs, Minorities and others left behind
- Gender Balancing
- Accountability and more sense of responsibility

What is required for engineering?

- Good education
- Uniform education standards
- Education to field gap minimisation
- Periodic training for advance technology
- Good networking of similar type of institutions and industries
- Quality measures
- Well equipped work environment
- Competitive allowances
- Safety and health security
- States should treat engineers at par with centre
- To curb corrupt practices better guidance environment
- etiquette learners availability
- Family and property security from institutions and/ or industries
- State and centre divide should be minimised
- Genuine Consultants
- No bias to gender
- No bias to reserve category
- Partnership in the work unit
- Revisiting to problem

Engineers required in XIth Plan

- For Direct engineering
  - Almost double the number of working engineers.
  - Almost 2.5 times trainers and teachers.
  - 3.5 or more times consultants
- For indirect engineering
  - About 10 times the present strength

Suggestions to meet the challenges

- To produce required number of engineers
  - Open evening colleges in all the approved engineering colleges
  - Increase the intake by the percent of reservation seats. (Change the policy of reservation for over and above rather than existing.)
  - Industries should come forward for training the faculty so that they may produce additional number of engineers of their need.
  - Setting of new engineering colleges in private-public sectors

Suggestions for quality engineers

- Set up a central technical University with upgrading at least one engineering college of each state associated to it.
- records of actual learning process of students should be made a mark of accreditation rather than paper response
- More emphasis on practical knowledge rather than bookish
- Industries may adopt one or more engineering college to place the engineers produced.
- Networking of engineering colleges for better learning environment

Discussion and Conclusion

- Uniform engineering education syllabi in nation.
- 50 to 60 % weight for experimental and practical study.
- Frequent visits to industries in semester vacations.
- Etiquette learners availability at institutions
- Work counsellor
- Time frame based analysis and evaluation for quality of engineering graduates
- National level test -Quality Assurance Test-QUAT- for fresh graduate engineers to make them more efficient for learning
- Alumni associations
- Private Industries: doing well in training engineers to their need
- Government sector
- Public sector
- Research in coordination
- Industry-Institution for training
- Manufacturing Industry
- Design Industry
- IT
- Chemical engineering
- Communication
- Power
- Bio-medical engineering
- Rural engineering
- Material engineering
- General purpose
- Engineers: Quality
  - Number
  - Behavior
  - Working Environment
  - Pay
  - Health
  - Family security
  - Nation-Passion

Reform of Engineering Education- Some Points

— **Dr. M.U. Aswath***

1. Engineering education and curriculum developers must anticipate dramatic changes in engineering practice and adopt their programs accordingly.
2. Innovative ways to improve the training of engineers to prepare them for addressing the complex questions raised by emerging technologies.
3. Learner centric teaching – faculty takesup the role of a mentor, guide, coach and tacilitator for learning.
   - Develop oral communication skills.
   - Simulate critical toinking-by discussions.
   - Team approach for problem solving.
   - Build self responsibility for learning.
   - Develop international skills/ relationships.
   - Build self esteem.
   - Simulate real life situations.
   - Promote student-faculty interactions.

Seminars/Workshops/Technical lectures not sufficient. Intense training program needed

- Students support services.
- Associations
- Forums
- Extra curricular activities
- Tech. fests / cultural fests.

Theatrical society - Nivedan.

Indian musical group – Utkarsh.

ICRC - industrial consultancy & research centre.

Western music group- Rockband.

Development of personalty – ' Think positive' attitude.

- Computer interface club.
- IEEE chapters etc.
- ISTE……
- Merit awards.
- Support courses.

Development of intellectual ability.

- Complex problems.
- Complex ideas.
- Extensive vocabulary.
- Manipulation of information.

Industrial training.

Industrial tours and site visits.

Career guidance programs.

Preparing for campus interviews.

- Written tests.
- Verbal, mathematical.
- Comprehevision.
- Reasoning power, puzzles etc.
- GD, team work……..

Involving with NGO's.

Industry specific programs – contests.

- On track-BOSCH
- Toyota
- Campus connect---Infosys
- Aspirations 2020
- Spark

Mission IOX- Wipro

Osmosis- Mindtree

Transition- Congnizant

Organise open house programs on tech. topics.

Involve in magazines & News letters.

Computer interface club.

X- kalibre

Rotract

Seilstar

*Dr. M.U. Aswath, BIT, Bangalore

Spl. Trg. To rural/Backward community students.

Nuface- Nursery for action, creativity and excellence.

Industry feedback:

1. Fundamentals should be strong.
2. Communication skills.
3. Practical orientation.
4. Frequent syllabus revisions incorporating industry needs
5. Introduction of tutorials for every subject.
6. More attention to overall personality development.
7. Greater motivation.
8. Awareness to socro economic events around.
9. Discipline.
10. Relating theory & practice to Indian environment.
11. Industry- institute interaction programs.
12. More electives of industry requirement.
13. Projects should be more practical & industry oriented.
14. Language labs/ public speaking orientation.
15. Four year should be made 5 years with 6 months project in industry and 6 months industrial training.
16. Industrial tours & visits must be compulsory.

Reform of Engineering Education- A few Cases from Abroad

— P.N. Shali*

While experiments are going on world over in upgrading the engineering education and bringing in new models, there have been concerns on the effectiveness of this process. Educationalists in Australia are concerned about the lack of sufficient investment in teaching and research in engineering. Concerns are also about the amount of time spent by faculty in seeking external support and the corresponding reduction in time for actual teaching and research.

A shift towards general engineering has happened at various educational institutions in the world. Some US universities have started bringing in goals such as excellence, quality, relevance, customer satisfaction and service mentality into the curriculum. Various universities in the US offer seamless programs in engineering which confer B. S. Degrees in Engineering without assigning a branch. As part of the educational curriculum, these programmes also help students to participate in internship programmes which produce better employment opportunities.

The graduates with a general engineering degree have broad knowledge which makes them suitable candidates for most of the career. The University of Illinois in US has a department of general engineering. They have now developed a department of industrial and enterprise systems engineering which imparts education in combined systems and business education and which is one step ahead of the seamless engineering education policy. Some IITs in India present a practical scenario where seamless engineering education has been practiced in a limited and judicious way, appropriate to the requirements of the nation. However, a lot of modifications in the system and refinement of strategies are still possible.

Cases from the UK & Malaysia'

Professor Stephen Lo is Director of The Graduate School at the Department of Electronic and Electrical Engineering at Strathclyde University in Glasgow. He started off as an apprentice engineer. He recommends gaining professional engineering qualifications while working in the industry. 'You don't necessarily have to go through a university course. There is another route!' he says. 'The Engineering Council Examination is more relevant than ever now with university fees going up. Once you get a skill and the qualification, nothing can stop you. And if you work in industry, some of the things you do in the day can be referred to in your studies. The Engineering Council (UK) - a statutory body-examination is multidiscipline too, which makes you more adaptable in the workplace. You should have no problems finding employment after your qualification - I didn't.

One of the registrations to gain is Chartered Engineer (CEng) status. This is achieved through one of the many engineering institutions licensed to award this. There are a number of ways to achieve the academic requirements, but one of the most flexible is through the Engineering Council (UK) examinations. These offer you the chance to work towards CEng status whatever your personal circumstances. They're particularly suitable for people who:

1. Are not able to take an accredited degree
2. Have a non-accredited degree and need to top them up
3. There is no set course that you need to follow or classes that you need to attend. Once you've registered for an examination, you can study in your time and your own pace - it's that flexible.

There are three levels of examination.

Level 5 Certificate: This level focuses on the foundation principles of engineering. It is set at the same level as the first year of a UK degree course.

Level 6 Graduate Diploma: It is set at the same level as the final year of a British BEng.

Level 7 Postgraduate Diploma: It is set at the final year of a British M Eng.

Malaysia

A Study by 'Board of Engineers Malaysia' 2003 to work out a blue print for highly competitive engineering technical work force has set out two paths for engineers and engineer technologists highlighting an engineering and technology spectrum of 'Cheshier – 1998'. In this spectrum, an engineer moves from field services to technical sales to production testing to manufacturing to product development to product design and ending up in research. The engineering technologist moves in exactly the reverse mode.

*Shri P.N. Shali, Director, Engineering Council of India and former Adviser (I&M) and Consultant (SP-NE), Planning Commission.

Major Concerns for the Engineering Profession

The Engineering Profession today faces several problems. The major concerns are as follows:

1. The Profession is not legally recognised
2. There is no statutory body to regulate the profession
3. There are no quality standards for engineering practice
4. There is no legally enforceable code of professional conduct
5. Engineers are often held responsible for delays and cost over-runs in projects
6. There is little effort on Continuing Professional Development (CPD)
7. The image of engineers in the society is quite poor. They are often associated with corruption
8. Indian engineers can not practise in other countries while foreign engineers are free to practise in India
9. The quality of engineering education in many institutions is poor. It does not prepare them adequately for working in the industry. Only about 25% engineering graduates are considered employable.
10. There is also poor image of Indian engineering institutions and education (except for a few institutions like IITs) in other countries and many Indian engineering degrees are not recognized by them.

Engineering Council of India (ECI), which was set up in 2002 by coming together of a number of professional associations/societies of engineers as an Apex body to represent the engineering profession, has been working on some of these issues. Some of the steps taken by ECI are as follows:

1. Draft Engineers Bill

ECI drafted an Engineers' Bill and submitted to the Ministry of Human Resource Development in September 2004. There has been continuous follow-up. The Ministry desired to have a consensus draft. The same was submitted in May 2007. The Bill provides for:

i) Setting up a statutory body to regulate the profession

ii) Mandatory registration of all engineers who wish to practise, including foreign engineers

iii) Laying down standards for engineering practice

iv) Laying down and enforcement of professional code of practice

v) Making Continuous Professional Development (CPD) essential for continued registration

This legislation is expected to address most of the concerns 1 to 8 above. It would also assure the world that strict quality standards are maintained and engineers are certified consistent with those in other countries, to ensure of their mobility across the world for rendering engineering services wherever required.

2. Reforms in Engineering Education

ECI has organized several National Conventions relating to reforms in engineering education. The recommendations were recently discussed in a Round Table Workshop, sponsored by the Planning Commission. The final outcome is being submitted to the government for consideration. This will address the concerns 9 & 10 above

List of Delegates

1. **Dr. A K. Chatterjee**
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2. **Lt. Gen. A. K. Puri**, PVSM, AVSM (Retd.),
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Chairman, IIBE, DSC

3. **Shri Ashok K. Sehgal**
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4. **Shri Ashok Lakhanpal**
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5. **Prof. B. B. Dhar, Senior**
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UNIDO-ICAMT

8. **Shri Basab Banerjee**
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National President, IIPE
Advisor, Govt. of Kerala
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14. **Shri Chander Verma**
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Chairman, CIDC

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Construction Industry Development Council

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60. **Shri Paritosh Tyagi**

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Joint Adviser, Planning Commission

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108. **Shri Y. P. Chawla**

109. **Shri Yogesh Pandya**
Head - HR & Administrative Services ,
L&T MHI Turbine Generators Pvt. Ltd

110. **Shri Yograj Singh**
Office Assistant, Engineering Council of India

Engineering Council of India (ECI)

ECI was established on April 4, 2002, by coming together of a large number of Professional Organizations/Institutions of engineers, to work for the advancement of engineering profession in various disciplines, for enhancing the image of engineers in society, by focusing on quality and accountability of engineers and to enable the recognition of expertise of Indian engineers and their mobility at international level in the emerging WTO/GATS environment. It has emerged as a common voice of its member organizations.

Objectives

The main objectives of ECI are to work for the advancement of engineering profession in various disciplines and for enhancing the image of engineers in the society. To this end, ECI is focusing on quality and accountability of engineers, professionalism and their mobility for delivering engineering services in other countries, with expertise of Indian engineers developed, recognized and accepted at the international level.

Tasks

- Representing Member Associations in government and non- government bodies, and interacting on common policy matters relating to engineering profession
- Working for the setting up of a Statutory Council of Engineers and later interfacing with it, providing support and inputs for developing systems and procedures for the registration of engineers, CPD, code of ethics
- Facilitating authorization of member associations to register engineers; assisting them in developing internal systems for undertaking registration, CPD, enforcing code of ethics; and providing common forum for CPD to support the member associations
- Assisting member associations in interaction with academic institutions and regulatory bodies in regard to their examinations, award of degrees etc
- Providing forum for exchange of information and experience among member associations, coordination, common thinking and views on important matters
- Helping in the analysis of existing education systems/bodies and making suggestions in order to make the education relevant for the engineering profession and employability
- Setting up a Resource Centre and Database of Engineers, which can provide necessary information required for the development of the profession
- Interacting with professional associations/bodies in other countries & international bodies
- Undertaking and supporting research for the development of the engineering profession

Engineers' Bill

ECI has facilitated formulation of a conscious draft Engineers' Bill for the consideration of the Govt. of India. Which lays down the criteria for the process of registration of Practising Engineers and provide necessary statutory framework for the same. The draft is being processed by the Ministry of Human Resource Development.

Membership

Membership of the ECI is open to societies/organisations of engineers who meet the following requirements :

- having been established statutorily or registered in accordance with law.
- having atleast 100 corporate members
- having existed for at least four years, and
- the accounts being audited annually.

Board of Governors

Chairman	
Dr. Uddesh Kohli	Chairman Emeritus, Construction Industry Development Council
Vice Chairman	
Shri Mahendra Raj	Past President, Indian Association of Structural Engineers
Treasurer	
Shri Chander Verma	President, International Council of Consultant Chairman, Construction Industry Development Council & Chairman, Indian Society for Trenchless Technology
Members	
Dr. S. S. Mantha	Chairman, All India Council for Technical Education
Shri S. Ratnavel	Chairman of Task Force, Engineers Bill Committee & Promotional Development Committee Association of Consulting Civil Engineers (India)
Prof. S. V. Raghavan	Vice President, Computer Society of India
Dr. P. R. Swarup	Director General, Construction Industry Development Council
Dr. S. Chatterjee	President, Consulting Engineers Association of India
Shri J. S. Deepak	Joint Secretary, Deptt. of Commerce, Ministry of Commerce & Industry
Dr. Jose Kurian	President, Indian Concrete Institute
Prof. D.V. Singh	Member, Indian National Academy of Engineers
Dr. K. S. Rao	President, Indian Geotechnical Society
Lt. Gen. (Retd.) A. K. Puri PVSM, AVSM	Chairman, Indian Institution of Bridge Engineers (DSC)
Shri J. S. Saluja	National Vice President (NR), Indian Institution of Plant Engineers
Dr. V. M. Mayande	President, Indian Society of Agricultural Engineers (ISAE)
Dr. R. Murugesan	President, Indian Society For Technical Education
Prof. Niranjan Swarup	Executive Director, Indian Society for Trenchless Technology
Shri Dileep K. Nair	Chairman, Institution of Automobile Engineers (India)
Shri Vijay Motwani	Chief Engineer, New Delhi Zone-1, Ministry of Urban Development
Dr. Vinita Kumar	Sr. Adviser (Transport), Planning Commission
Shri M. Narayana Rao	Past President, The Indian Institute of Metals
Dr. Surendra Pal	President, The Institution of Electronics and Telecommunications Engineers (IETE)
Shri Ashok K. Sehgal	Member, The Institute of Marine Engineers (India)

Executive Committee

Dr. Uddesh Kohli *Chairman*	Chairman Emeritus Construction Industry Development Council
Mahendra Raj *Vice Chairman*	President Indian Association of Structural Engineers
Chander Verma *Treasurer*	President International Council of Consultants
	Chairman Construction Industry Development Council, Indian Society for Trenchless Technology & Continental Construction Projects Ltd.
Members	
Dr. S. Chatterjee	President Consulting Engineers Association of India
Dr. P. R. Swarup	Director General Construction Industry Development Council
Dr. Surendra Pal	President The Institution of Electronics and Telecommunication Engineers
P. N. Shali	Director Engineering Council of India

Office Bearers of ECI

Dr. Uddesh Kohli
Chairman

Shri Mahendra Raj
Vice Chairman

Shri Chander Verma
Treasurer

Engineering Council of India

ECI has been formed by coming together of a large number of professional associations / institutes of engineers. The present members are :

1. Association of Consulting Civil Engineers (India)
2. Broadcast Engineering Society (India)
3. Computer Society of India
4. Construction Industry Development Council
5. Consultancy Development Centre
6. Consulting Engineers Association of India
7. Indian Association of Structural Engineers
8. Indian Buildings Congress
9. Indian Concrete Institute
10. Indian Geotechnical Society
11. Indian Institute of Chemical Engineers
12. Indian Institution of Bridge Engineers
13. Indian Institution of Industrial Engineering
14. Indian Institution of Plant Engineers
15. Indian National Group of IABSE
16. Indian Society for Non Destructive Testing
17. Indian Society for Technical Education
18. Indian Society for Trenchless Technology
19. Indian Society of Agricultural Engineers
20. Institute of Urban Transport (India)
21. Institution of Mechanical Engineers (India)
22. International Council of Consultants
23. The Aeronautical Society of India
24. The Automobile Society of India
25. The Indian Institute of Metals
26. The Institute of Electrical and Electronics Engineers. Inc.
27. The Institute of Marine Engineers (India)
28. The Institution of Civil Engineers (India)
29. The Institution of Electronics and Telecommunication Engineers
30. The Institution of Surveyors