Engineering Council of India

5th National Convention on
Seamless Engineering Education for Better Employability of Engineers

September 30, 2009

Tagore Chamber, SCOPE Complex,
Lodhi Road, New Delhi

PROCEEDINGS

Sponsored by :

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Planning Commission, Government of India

Supported by :

Member Associations of Engineering Council of India

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Edited by : P.N.Shali

Contents

Programme

0830 - 1000 Hrs	:	REGISTRATION
1000 - 1100 Hrs	:	OPENING SESSION
Welcome Address	:	Dr. Uddesh Kohli, Chairman, Engineering Council of India (ECI), Chairman Emeritus, Construction Industry Development Council (CIDC) & Chairman, Construction Industry Arbitration Council
Theme Presentation	:	Shri P. N. Shali, Director, Engineering Council of India & Former Adviser and Consultant (SP-NE), Planning Commission, Government of India
Address by the Chief Guest	:	Prof. P.B. Sharma, Vice Chancellor, Delhi Technological University, Delhi
Vote of Thanks	:	Shri J S Saluja, M D, SCPL, Senior Vice president, , Indian Institution of Plant Engineers and Member Board of Governors, Engineering Council of India
1100 - 1130 Hrs	:	TEA / COFFEE
1130 - 1300	:	TECHNICAL SESSION-I Theme : *Reform in Engineering Education for the Better Employability of Engineers - Conclusions and Suggestions from previous deliberations*
Session Chairman	:	Shri S.K. Vij, President, Indian Building Congress
Co-Chairman	:	Dr. P. K. Sarkar, Hony. Secretary Institute of Urban Transport (India)
Keynote Speaker	:	Prof Y.P Kathuria, Visiting Professor in Aichi Institute of Technology Toyota, Japan.
	:	Prof. P Thareja, Head of the Department of Metallurgy, PEC University of Technology (Formerly Punjab Engineering College), Chandigarh
	:	Dr Deepak Bhatnagar, Head, Centre for International Trade in Technology (CITT), New Delhi
Discussions		
1300 - 1400 Hrs	:	LUNCH
1400 - 1530 Hrs	:	TECHNICAL SESSION - II *Theme : Reform in Engineering Education for the Better Employability of Engineers - Policy issues and recommendations*
Session Chairman	:	Dr. Baldev Raj, Distinguished Scientist, & Director, Indira Gandhi Centre for Atomic Research, Kalpakkam, Tamilnadu and Past President Indian Institute of Metals and Indian Society for Non Destructive Testing (ISNDT)

Co-Chairman	:	Dr. G.P. Karmakar, Professor in Petroleum Engineering, Rajiv Gandhi Institute of Petroleum Technology, Raebareli
Expert Intervention	:	Shri L. Pugazhenthy, Executive Director, ILZDA and Immediate Past President, Indian Institute of Metals
Keynote Presentation	:	Dr. Gur Iqbal S Chauhan, Former Executive Director, Steel Authority of India
Discussions		
15.30 - 1600 Hrs	:	Tea / Coffee
1600 - 1700 Hrs	:	CONCLUDING SESSION & PANEL DISCUSSION *Theme : Discussions and formulation of consensus recommendations for the change*
Session Chairman	:	Prof. S.S. Chakraborty, CMD, Consulting Engineering Services (India) Pvt.Ltd
Co Chairman	:	Dr. R. P. Verma, Consultant - R&D, Hindustan Petroleum Corporation Limited, (Formerly : Petrotech Chair Professor, IIT Delhi, Executive Director & Head - R&D, Indian Oil Corporation Limited, Chairman - Indian Oil Technologies Limited, Chairman - Indo Cat Pvt Limited (a JV of Interact, USA & IOCL)
Panelist	:	Dr. Abha Kumari, Assistant Professor, Dept. of Biotechnology, Delhi Technical University (formerly Delhi College of Engineering) Delhi
Panelist	:	Shri Dalip Singh, President, Society of Energy Engineers and Managers (SEEM), Thiruvananthpuram, Kerala
		Discussions and Recommendations

Recommendations

1. Presently, engineering profession in India is not regulated because there being no Engineers Act on our statute, unlike other professions such as Lawyers, Doctors, Architects, Dentists, Chartered Accountants, etc., and a statutory council of engineers in position. The engineering profession in India, therefore, has no legal recognition as such. The engineering profession also needs to be regulated and legally recognized. For this, Engineers Act should be brought on the statute with a mandatory provision for registration of practising engineers the Statutory Council of Engineers set up at the earliest.
2. There is a need to legally define as to who is an engineer and lay down its globally compatible competency standards. This work can be better facilitated by the professional engineers associations / societies / institutions and academic institutions working together.
3. The current engineering curricula need to be reformed for producing multi-skilled engineers needed by the industry with a full consensus of academics, industry and practising engineers.
4. The practical case studies need to be included in the curricula and in the technical books and other reference materials meant for engineering students.
5. The industrial training during the course should be made mandatory. It 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.
6. After the theoretical course and during the course training is over, a paid internship of six months or one year with an industrial unit should be made mandatory as a matter of regulation of engineering education. It should also be assessed and marks obtained thereof should be added to the total score.
7. It should be made mandatory by way of regulation of engineering education that the students will get engineering degree only after successfully completing the training done during the course and six months internship.
8. The industry should be compensated for any expenditure that it may incur during internship training via the tax route as a matter of policy.
9. It should be made mandatory as a matter of regulation of engineering education to upgrade the engineering curricula once in every four years for keeping it in pace with the market trend. For this, the institutions delivering engineering education in the country should have the freedom for setting and revising the curricula keeping in view the changes in the perspective of industry, R&D, etc.
10. An effective interaction between academia and industry is required as a matter of regulation of engineering education for producing quality engineers. This mechanism needs to be created. It will also facilitate curricula revision objectively.
11. Before sanctioning new engineering colleges, demand of engineers should be assessed. Then, before deciding about the curricula, the requirements of the industry should be assessed. These

exercises should be a regular feature of the work of the regulatory body. This will check proliferation of engineering colleges with poor quality infrastructure and of poor quality faculty in the country.

12. Faculty shortage is producing unsuitable engineers. This needs to be bridged. One of the options for this would be permitting, practicing engineers & engineer consultants to teach engineering. This also needs a change in the mind set of our academic establishment.

13. For monitoring the academic performances, reputed faculty members from IIT and NIIT may be nominated in their respective region to be a part of the monitoring team of AICT and UGC.

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

15. There is a clear requirement for a regular training of the faculty so as to cope with the ever emerging challenges from the industry. It should be regularly monitored and corrective steps taken under a laid down action plan and time frame.

16. A working mechanism for facilitating the exchange of professionals for short periods between the academic institutions and the industry needs to be developed for providing an opportunity to them to have a hands-on experience of the "other side of the fence".

17. Evaluation of the faculty by the students should be made mandatory for all the engineering colleges in the country as a matter of policy.

18. It is recognized 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. Reform of the engineering education should also include reform of the present CAT system and procedure for selecting students for engineering courses for ensuring the selection of only those candidates for engineering courses who have not only the knowledge of physics, chemistry, mathematics and general knowledge but also aptitude for engineering.

20. Controls by the regulatory bodies such as UGC & AICTE have not proved as effective as were envisaged. The present regulatory mechanism for the higher technical education in the country, therefore, needs to be reformed and made seamless and more effective and efficient

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

22. The curricula and training format of the Polytechnics 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. Their English language skills also need to be made better by including the language in their curricula.

23. Intra University or intra college transfers should be facilitated, as is the practice abroad. This will enable a student to study a particular course under a particular recognized specialist of that particular subject.

Executive Summary

Engineering Council of India (ECI) took up the theme of seamless engineering for better employability of engineers for these national conventions because the present needs of the industry, services and other organizations are somewhat different from the type of engineering education that we have been having over the years and, therefore, it was felt that can we think of some alternatives that can be suggested to the government after getting a national consensus on those alternatives. In the same context, national conferences workshops were also held with focus on the reform of engineering education for meeting the current and emerging needs of the industry and hence making engineers employable.

Presently, engineering profession in India is not regulated; and has no legal status as such because of there being no Engineers Act on our statute, unlike other professions such as Lawyers, Doctors, Architects, Dentists, Chartered Accountants, etc. Engineers, by and large, are regulated abroad in all the developed countries and in some developing countries, particularly in the neighbouring countries. India is a signatory of the WTO, apart from its economy now stands opened up. Consequently, India is facing a severe competition from the foreign economies. In order to meet this challenge, inter alia it is also important that the engineering profession is regulated and legally recognized. For this, therefore, Engineers Act should be brought on the statute and the Statutory Council of Engineers set up at the earliest. More so, the Engineers Act will also ensure that engineers practice their profession ethically.

What we see today is a situation in which engineering education has largely failed to make engineering profession a privilege to serve and privilege to excel. This requires revisiting the purpose of engineering education and its intricate relationship with the welfare of the society. Engineering was and undoubtedly should be the inspiration of the young minds to take up engineering as a service and not as a mere pursuit for career prospects or for that reason minting money even though from wrong doings by undermining the value of engineering profession.

It is pertinent to realise that much of the damage to engineering education has been done by rapid and often uncontrolled expansion in the name of increasing gross enrollment ratio without proper care and concern for quality and employability. It is a matter of concern that there is craze to establish colleges of engineering in every nook and corner of the country including in the areas where it is difficult to attract faculty and quality students to take up engineering education. What we have not realized is that engineering institutions are neither chemist shops nor primary health centres which need to be necessarily spread to length and breadth all over the country for assuring the well being of every citizen. Rather engineering institutions are to be seen as the focal points to attract the meritorious students from all backgrounds to engage into the pursuit of engineering and technology excellence, to produce capable people who would by their contributions during their work - life make the life of common men, women and children a lot better. The prime question is what can be done now and that too without loss of time to create synergy between engineering education and research, make engineering education campuses tech savvy, create knowledge and innovation power in the world of learning, ensure high industry relevance of the engineering education and enhance industry academia partnership? If we answer this question, we would ensure inter alia better employability of engineers.

It will be path breaking engineering innovations which will only meet the current and emerging challenges and hence take India forward.It is not totally absent to day, sectors such as space, atomic

energy, defense science,aeronautical engineering and some others are depicting innovative engineering.India has achieved comparative advantage in these sectors. What we need is a spread of the innovating engineering to the other sectors of our economy.For this, we need engineers of calibre with passion for innovations and of multi-skills. It will also enable India to meet the current and emerging challenges of the Indian economy in general and the Indian industry in particular.

Now that the trade in engineering services is opening up, which is round the corner, we will get the opportunity to trade in engineering services in the world.For maximising our share in the world market of engineering-based goods and services, therefore, we need to produce innovative engineers of calibre in large numbers from our engineering educational infrastructure that we have. It is for this objective that we should re engineer our engineering education and training system.This can be only done by reforming our engineering education system so that we are able to produce such engineers who should have not only clear concepts of their field of specialisations but also have multi-skills.In other words, we need to produce multi-disciplinary and multi-skilled engineers from every single engineering educational institute that we have in the country.

As a matter of elaboration, it is well recognised that the role of an engineer has undergone a major change with the paradigm shift from the traditional functional organizational structure to cross-functional organizational structures. This shift demands multi-skilled engineers. The current mere specialization in one branch of engineering does not produce such engineers. If you talk of design and development of an automobile or a highly sophisticated space craft, you are talking of interdisciplinary engineering involving highly specialized yet highly connected disciplines. For example designing and production of a car involves not only mechanical, electrical, metals & material engineering but also human engineering, comfort engineering, intelligent electronics, micro processor engineering; and future cars will have to be equipped with capabilities of night vision and artificial intelligence to move on the intelligent transportation systems of tomorrow. Likewise, roads, buildings, bridges and other infrastructure are an amalgamation of civil, mechanical, electronics, computing, clean and green energy technologies, environmental engineering and green building concepts besides a better and profound understanding of project management and maintenance engineering. A power generating utility is not just mechanical & electrical engineering but also involves a higher end knowledge and expertise of today's and tomorrow's electronics, computing, networking and knowledge of highly sophisticated instrumentation and new materials. Further on, tomorrow's convergence of info-nano and biologically inspired products and services shall call for an all together new engineering both in design and manufacturing. As such, there is no dispute in as far as engineering being highly interdisciplinary and requiring trans-departmental specialties.

The important question, however, is how to redesign our engineering degree programmes to cater for ever increasing requirement of higher end specialties and higher end skills of design and project management on the one hand and on the other develop capabilities to work in an interdisciplinary team environment whether in a design centre, a manufacturing floor or at site during commissioning, installation and operation? The engineering degree curriculum and its delivery system need to be, therefore, multi-disciplinary and of multi-tasking.

India's engineering education is currently weak in fostering design capabilities as such. We as a nation are being leveled as a weak nation in terms of our design capabilities. We need to foster the culture of design engineering and problem solving as a part of our curriculum design and delivery system for

building world-class design engineering capabilities. It is all the more so because now India is being considered as a preferred location for design engineering centres by the multinationals. The culture of design and innovation shall create the joy and thrill of engineering so vital to unleash the power of creativity and power of innovation in the talented student community of India. The USA and many other western countries have recognized it.

In the perspective of next 20-25 years, the demand for engineers-degree and diploma - and engineer technicians from the power sector, construction industry, the nuclear power sector, manufacturing sector, public health engineering, environment, etc, is anticipated to grow with continuously growing Indian economy. We need, therefore, more engineers. We need engineers for trade in services and so on. We need multi-skilled engineers. We need quality engineers. We need engineers with excellent designing skills. We need engineers with excellent R&D skills. Though we produce engineers in large numbers, we do not produce, by and large, engineers which are in demand from the industry and other sectors of our economy. Primarily, as said earlier, this is because the quality of engineering education in India is not what it is required to be for meeting the needs of an open economy. Our engineering education is still in its old mould, exceptions may be here and there. We are also not ready yet to compete in the international markets of professional engineering services - though there can be some exceptions here and there. The major constraints are going to be, therefore, of the availability of quality and multi-skilled engineers, engineer technicians and quality faculty for meeting the current and increasing demand from the present and upcoming engineering training establishments.

It is generally felt that the 21st century is not the same as the 20th century and centuries before that. The emphasis should be, therefore, on producing engineers of desired characteristics of the 21st century. When looking at the present position, we find that the engineering education remains confined to its discipline domains and these domains are increasing every second day with new specializations getting added to the list. Specifically speaking, let us look at the question: Is an engineer with basic degree of civil engineering a construction engineer? The answer to this question is simply no; a civil engineer is not a construction engineer. An engineer with a combined degree comprising the basic aspects of civil engineering, mechanical engineering, electrical engineering, electronics and metals and material engineering and skills such as, to deal with the world of business and commerce, with people and resources, environment, health and safety, project engineering, legal, logistics, procurement, application of IT and communication technology in construction, dealing with partnerships and joint ventures, learning the basics of contracts and claims, knowledge of economics, statistics, some basic managerial subjects, etc, is the construction engineer. A construction engineer, therefore, is a professional far more multi - functional and better equipped to deal with complex issues of construction business as such. A construction engineer, therefore, is a professional much more of an engineer - manager. A pure civil engineer is not such a professional. We need to reform, therefore, our engineering education and training. While doing so, we need to place more emphasis on preparing a wholesome personality with engineering as core knowledge. Engineering education needs to be, therefore, looked from the "user driven "or "market perspective" rather than a "discipline perspective".

Moving on to the industry perspective and applying the same argument, one can say that the characteristics of the 21st century engineer from the viewpoint of the industry perspective are: knowledge of fundamental technical domain, neighbouring technical disciplines, the social, ecological and implications of technology, economics, statistics and accountancy and skills such as, problem-

solving, know-how and business process, project management, marketing and finance, interpersonal & communication, deal with various regulatory bodies, capacity and willingness to engage in life-long learning- CPD, cosmopolitan attitude and global mindset and decision-making skills (2nd, 3rd &4th national conventions organized by the ECI). We can extend this argument further to the other sectors of the economy- infrastructure, ports and harbours, highways, steel, oil exploration and production and so on.

What should we do? Should we have a construction engineer - who is an engineer- manger? Should we, therefore, consider creating a new branch of B.E (Construction Engineering)? The answer is yes we should create this branch of engineering with a curricula, apart from the basic subjects of civil engineering as applicable to construction, subjects from mechanical engineering, electrical engineering, automobile engineering, engineering materials, metallurgy, geology & mining, management, law, economics , statistics, arbitration and dispute settlements, environment impact assessment, project formulation, appraisal and monitoring, matters related to finance, etc. Similarly, we can consider creating the other sector-specific engineering branches. The postgraduate engineering education should be subject-specific like thermodynamics, fuels and furnaces, chemical processes, engineering materials, technology forecasting, etc, so that the person who wants to pursue M.Tech course should have such flexibility as would enable him / her to move across many industrial sectors .We need to include subjects from other than engineering branches in the course. It is also suggested that a general course in engineering, as in the USA, France and in some other countries with appropriate subjects from the main branches of engineering and subjects from the other than engineering disciplines included in the curricula would be very suitable to the Indian industry This course could be of five years duration with six months of a mandatory paid internship with an industrial unit. The details can be worked out.

Further, we can consider, as a matter of reform of the engineering education, moving on to the sector-specific engineering degrees. For example, we can have degrees like: BE (Construction), BE (Infrastructure),BE (Manufacturing), BE (Engineering), MBBE - a combined degree in management and engineering of five years including six months of paid internship, BE (Transport Engineering) - Roads, railways, ports, etc., BE (Public Health & Environmental Engineering), etc,.The other variants of civil engineering suggested are: BE (Structural Engineering), BE (Soil Mechanics & Foundation Engineering), BE (Transport Engineering), BE (Construction Management), BE (Irrigation Engineering), BE (Rural Engineering). There should be a mandatory requirement of one-two years of practical experience for seeking admission to the PG courses. In sum, the branch - specific engineering education should give way to the sector - specific engineering education.

As a matter of caution, any reform that we may think of in engineering education, it should be undertaken with caution and as required.We should also try to cultivate passion in the students for engineering profession. Coming to Railways, there is no single institution which teaches railway engineering per say.Recently, a course has been started in the IIT Delhi on metro rail.This is perhaps the first step taken in making a shift from the present branch-wise engineering education to sector-specific engineering education.

We can see very clearly that it is the strength in basic and applied R&D which has made the USA, UK or Germany the leading technology suppliers in the world. As against this, India continues to be a dependent country for technologies.Indian cannot realize its vision 2020 by remaining dependent for

technologies from these countries. This will have to change , if India wants to become both an economic and military power in the world. For this, we should produce more PhDs in engineering sciences as well as in the basic sciences; and we should produce world-class design engineers. The Indian industry should look for future businesses in advance and latest technologies ; spend more money in the R&D as well as for facilitating PhDs studies on developing new technologies as well as innovating the current technologies.

What is generally happening in the western countries has a message in it. This message is that a human being would like to do that which he / she likes & loves to do and for which he / she has the aptitude. In India we thrust a profession on our children. We should encourage our children to decide what they want to do, what profession they want to pursue in life. This is the first important step that we should take. While selecting students for engineering, we should access their aptitude for it and then in engineering for manufacturing, for construction, for research and development, for design, etc. So, we should include a set of questions in the common admission (CAT) test which can bring out clearly the aptitude for engineering and then for what area of the profession.

The cooperation of industry with the academic institutions in the matter of reform of engineering education has to be ensured, particularly in terms of financial assistance for augmenting the infrastructure of these institutions for implementing the reforms which will also include increasing the seats in various engineering courses, exchange of faculty for teaching, revision of syllabi, technology transfer, etc. For this, industry can be compensated in terms of tax exemptions by the government

There is a need for repositioning of the Associate Membership (AM) certificates awarded by the professional engineers associations and recognised by the Government of India equivalent to a BE. Degree in engineering given by universities / institutions recognized by the AICTE, particularly from the point of view that these certificates are also treated equivalent to the engineering degrees awarded by the Indian universities / institutions in the context of Washington Accord so that the engineers of this stream also find their place in the trade basket. The associations of professional engineers are education and training providing institutions in India; and, therefore, they should be considered for giving a status of a deemed university so that they can also grant degrees and diplomas which are recognised as such by the educational system as well as by the Washington Accord. If the competent authority of the government approves it in principle as a matter of policy, these associations can create required infrastructure and other facilities as are needed to be set up for enabling them to get this status.

The cooperation of the industry with the academic institutions in the matter of reform of engineering education has to be ensured, particularly in terms of financial assistance for augmenting the infrastructure of these institutions for implementing the reforms which will also include increasing the seats in various engineering courses, exchange of faculty for teaching, revision of syllabi, technology transfer, etc. The industry needs to be compensated for providing financial assistance for carrying out the reform of engineering education, as indicated above, and expenditure that it may incur on providing the mandatory internship that's suggested for at least six months to the students after their engineering course is over via tax concession as a matter of policy by the government.

The connectivity between the industry and academic institutions is much deeper abroad say for example in Japan, Germany, etc,. This is very week in India. In the chain of engineering education in India, this is one important grey area.This should be addressed.It is this connectivity which will ensure

that what is taught is relevant to the industry for its current needs and for its future needs through new technologies and products. A regular interaction between the industry and the academic institutions is very much needed, therefore, in India for keeping the engineering education in pace with demands of the industry. This can better be done through a standing and efficiently and effectively working instituting mechanism. Though AICTE is supposed to have this mechanism in its structure, it is a general perception that it has not been effective, as it was supposed to be.A regular seminar system should also be included in the curricula , as it is there in the advanced countries such as Japan, Germany, etc, at which industrial problems can be discussed regularly for suggesting remedies to these problems.By this system, engineering students will also come to know what goes on in the industry and they will get familiar with its working, which will be beneficial to them when they take up jobs in the industry.

There is a very effective and efficient working mechanism in position in countries such as Japan, Germany, the US, etc, by which innovative ideas emanating from engineering students or the faculty or both flow to the R&D institutions for developing technologies and then these technologies flow to the industry for the production of products.These ideas also some times move on to the industry for up gradation of the existing technologies. This mecahanism is not there in India.We also need to crate such a mechanism. The central government or the state governments or the industry itself should facilitate creation of such a mechanism and finance projects based on innovative ideas emanating from engineering students or the faculty or both. It will be a sure way to develop new technologies or innovate technologies that are already in use for better results.

In the present selection process for engineering training, aptitude and attitude are not assessed, as a system, in a person wanting to go for engineering. We will have to reform the this selection processes for admission to the engineering profession and include in the process the required inputs for analyzing these two attributes in a person vying for this profession. Coming to the faculty side of the process of engineering education, here also we need to assess aptitude and attitude for teaching engineering. We should include within the reform process the onus of making students innovative via the training process. We need to produce thinking engineers and for that we need thinking faculty. For the right (thinking) people, we should make faculty jobs attractive enough so that they take up these jobs and not opt for the corporate jobs for which they may have no liking and a financial package may have over ruled their aptitude call for the teaching jobs. The itinerary driven engineering courses is not based upon sound foundation, it is damaging the real potential of the students. We should move out of it to a wholesome inclusive & participative engineering education.

There are policy issues involved in the reform of engineering education. The quality and delivery of the engineering programmes should be monitored regularly. There should be a monitoring body for this. Engineering Council of India could perform this role in association with its member professional engineers associations, if this role is given to it. Public-private partnership, as a matter of reform, in the area of vocational training will have a very important role to play in training our workforce- engineer technicians- for meeting the new challenges of the 11th Plan. Many of our industrial training institutes (ITIs) need involvement of industry so that the training that these institutes is relevant to the industry. It should be enabled. Professional Engineering Associations should have a role in setting the standards and in the accreditation mechanism of the engineering education and certify competency of engineers by testing them as per their standards. It should also be enabled. We should permit foreign institutions of higher education including technical education to invest in India as a matter of policy.

Faculty shortage and its present quality is the reason for producing unsuitable engineers. This issue needs to be dealt with. One of the options for this would be permitting, practicing engineers & engineer consultants to teach engineering as a matter of policy. An effective interaction between academia and industry is required for producing quality engineers. This mechanism needs to be created. There is a need for defining legally the practice of engineering - which should include, definition of an engineer and laying down globally compatible competency standards of engineers. The associations of professional engineers should also be involved in this task.

As stated earlier, it is considered necessary to incorporate in our regulatory frame work of engineering education a mandatory provision of at least six months to one- year of paid internship with the industry, as is the case in the medical education, and its assessment should also be made mandatory. The degree should be only awarded after successful completion of this internship with the industry. The industry should be compensated for the expenditure that it may incur via the tax route.

India should have many training schools to cater to the small and medium size companies who cannot afford to have their own training divisions. National and state industries corporations, academic institutions like IIT's, NIT's and various other private and public sector institutions should also come forward for this purpose. Professional engineers associations can also play an important role in this regard.

Controls do not necessarily work. For example, 8, 00,000 technically trained engineers are coming out of UGC & AICTE-certified institutions. So, that kind of certification of institutions apparently has not worked. If UGC & AICTE had done their job correctly, then all these 8, 00,000 engineers should be employable. The present regulatory mechanism for the higher technical education in the country, therefore, needs to be totally revamped and made transparent and more effective and efficient

We should not produce engineers in hordes, as we seem to have been doing so far in order to check the ever deteriorating status of the engineering profession. We have not been following the practice of assessing the demand for engineers-in numbers, specialisations and of what additional skills,etc.There is a need to identify areas for which we need engineers in numbers and of what quality and specialisations and in what time frame we need these engineers. We need to do this on a regular basis.This should be market driven. In short, we should assess and make a prior forecast of the areas in which we need engineers. We may need engineers in general areas; we may need them in some specialized areas;we need to identify these areas through a market study and then line up backward linkage for capacity building with the engineering institutions so that we are able to produce engineers which are in demand. Here, it will also be a required to create incentives for making these areas of demand for engineers attractive to the students for getting trained to work in these areas as engineers. This will mean that the industry and the government will have to coordinate for developing required incentives.

A regular interaction between the industry and academic institutions is very much needed in India for keeping the engineering education in pace with demands of the industry. This can better be done through a standing and efficiently and effectively working institutional mechanism. It is very much there in countries such as Japan, Germany, the US, etc. Though AICTE is supposed to have this mechanism in its structure, it is a general perception that it has not been effective, as it was supposed to be. Such a mechanism can be better built through an independent body comprising the industry and engineering institutions. The Indian industry should play a role here. This mechanism should also

enable the students to get exposed to the industry and to the problems that it faces from time-to-time during the time of their training in engineering institutions.The focus should be on the quality improvement of the Institutes, from where 75% of the engineering graduates (who are generally not employable) come out. At this stage, efforts should not be wasted to plan for incremental improvements in the established Institutes.

In order to maintain certain minimum standard in the quality of incoming students, there must be a common admission test (CAT) for all the engineering Institutes in India. Modalities can be worked out. This could be recommended from this convention. For selecting the right persons to engineering profession, we could also recommend that there should be a provision in the common admission test for the engineering courses for assessing the aptitude for engineering like that of the common admission test for admission to the management course has.

Focus should be on imparting strong fundamental knowledge to all engineering students, which would be their basis for assimilation in the Industry. Specific applications could also be provided. There must be statutory provisions, which will enforce revision in the course curriculum on a regular basis, periodicity to be decided by the (proposed) Regulatory Body. Institutes must organise language classes for students from weaker sections of society, who though competent, are otherwise disadvantaged in English language skills. All Institutes must include representatives of industry (preferably local) in their governing bodies to understand the dynamic requirements of industry and to facilitate periodic exposure of their students to industry. Intake of faculty should be regulated and they need to be exposed to refresher programmes to update their knowledge and skills

There has been a sharp growth in accreditation of engineering colleges in the recent past. It has been noticed that many of these colleges neither have the quality infrastructure nor they have the quality faculty. We will have to address this important issue. A small committee may be constituted by the ECI from among the faculty of IITs and NITs and some of the large professional engineering associations which should deal with this issue and make recommendations to the statutory body for implementation so that the quality of infrastructure and faculty of this large body of engineering colleges are brought at par with that of the standards of IITs and NITs.

We have another problem today that a little more than 50 % of our engineers of all branches including even mining engineers are sucked by the IT industry because they are giving these engineers high paid jobs for the work which do not need specifically engineering qualification as such. This is share waste of our human resources. If the industry was job-wise equally attractive for engineers, there would not have been this job-hopping by engineers. Our industry must, therefore, make jobs very attractive for engineers.

ECI should prepare a discussion note on the consensus recommendations of all the five national conventions that it has organized on this subject of seamless engineering education for better employability of engineers and circulate it to the industry bodies, academia and policy makers for comments. After these comments are received, ECI may constitute a small group of five-six people drawn from the industry, academia and the regulatory bodies- AICTE & UGC which should take up the work of preparing a road map and time-bound action plan on the reform of engineering education and training and submit it to the competent authority of the government for consideration and implementation. The committee should do this work in consultation with the stake holders- the industry, academia and the students.

Opening Session

Welcome Address: Dr. Uddesh Kohli

First of all, I would like to thank the Planning Commission, Government of India for agreeing to sponsor the 5th National Convention and also to the Member Associations of Engineering Council of India (ECI) for supporting the convention. This is the fifth convention in the series of national conventions which were started by the ECI on the theme of engineering education for better employability of engineers with the 1st convention held in August, 2006 at Kolkta followed by the 2nd in May, 2007 at Baroda, the 3rd in February, 2008 at Hyderabad and the 4th in July 2009 at Visakhapatnam, AP. All these conventions were very well attended both by the industry and the academia. We took up this theme because the present needs of the industry, services and other organizations are somewhat different from the type of education that we have been having over the years and, therefore, ECI felt that can we think of some alternatives that can be suggested to the government after getting a national consensus on that alternative. In the same context, national conferences workshops were also held with focus on the reform of engineering education for meeting the current and emerging needs of the industry and hence making engineers employable.

I can see some of you present in the convention have attended these programmes of ECI and, therefore, may know about the ECI, for others, I would like to give some background about the Council, which is like a national federation of professional associations / societies / institutions of engineers. It was felt for a long time that while there were several professional institutions of engineers in India but we did not have one body to represent the entire engineering profession. It was felt, therefore, that we should have an apex body of engineering associations which can take up several tasks identified such as: how to bring accountability in the engineering profession, how to make engineers responsible and how to make sure that the society does not suffer because of any engineering problem or mistake. More so, it was also felt that the other professions like Medical, Architecture, Dentistry, Chartered Accountancy, etc., had statutory bodies to take care of such aspects, while as the engineering profession had none. It was because of this that the engineering profession did not have the legal recognition as such in India. Engineers from other countries, therefore, are free to come here and practice, but if Indian engineers want to go abroad and practice, they have to register there. So, it is a sort of disadvantage and it was observed that it may be necessary to join international agreements like the EMF for engineers' mobility. Accordingly, it was decided that an apex body at the national level needed to be set up which could help in developing such a mechanism in the country and could bring accountability in the engineering profession.

I am pleased to say that Shri K. C. Pant, the then Dy Chairman, Planning Commission and who is also an engineer by qualification took the initiative in 2002 for creating the Engineering Council of India (ECI). He organized a couple of meetings in the Planning Commission at which the setting up of ECI was discussed. Consequently, 24 professional engineering associations, including the Institution of Engineers (I), came together and formed the Engineering Council of India (ECI) which was registered as a non-profit society in April, 2002.Presently; ECI has 27 members including the Institution of Civil

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Engineers (India) and the Institution of Mechanical Engineers (India). ECI has not got corporate members or individual members. ECI has emerged as a common voice of the professional associations of engineers in the country.

For the past seven years, ECI has been working on many of its set objectives. One of the important set objectives of ECI is to the legal recognition for the engineering profession in the country like the other professions mentioned earlier have. ECI had intensive wide consultations and after these consultations, it drafted the Engineers Bill which was submitted to the Ministry of HRD in September, 2004. The Ministry constituted a small drafting committee under the Chairmanship of Dr D.P.Agrawal, the then Member, UPSC, which went through the draft Bill and submitted a report to the Ministry in 2005. The Ministry later said that there must be a wider consensus amongst engineers on the subject. A working group under the chairmanship of Shri R.V.Shai, former Power Secretary, Government of India, who is also an engineer, a consensus draft of the Engineers bill was prepared. It was submitted to the Ministry of HRD in May 2007. We had a meeting with the then Minister of HRD, Shri Arjun Singh when we requested the Minister to expedite the processing of the Bill. But nothing happened. When we called on the present Minister of HRD, Shri Kapil Sibal a couple of weeks back and discussed the matter with him, we found him quite positive about the Bill and he stated that engineers should also be legally recognized as professionals by an Act of Parliament and, therefore, we should have the Act on our statute. He assured that the Draft Engineers Bill that had been submitted to the Ministry will be processed expeditiously by the Ministry. There was, however, only one controversy and this was that in other professions like Doctors, every one has to register after graduation. The draft Engineers Bill which was submitted after consensus provided for registration of all engineers who will practise the profession. The practice was defined in a wide manner which included both jobs and independent practice or what ever one does as an engineer. It is just like that of the medical profession. The Secretary, HRD was of the view that it will not be possible to register all engineers given their rather a very large number that pass out from our colleges every year and those who are already either in jobs or are doing independent practice. Both the Secretary and the Minister of HRD were of the view why should not we restrict presently the registration to independent practicing engineers. The Minister, HRD said that all law graduates are not required to register and only those who want to practice are required to register. In the case of engineers, registration can be made mandatory for those who want to practise the profession independently and it can be voluntary for the others. This is what the position is. This is one important area in which ECI has been working since inception and will follow up regularly the matter till the Bill is passed by toe Parliament and it becomes the Law.

The second area in which ECI has been working is the international mobility of Indian engineers. This implies that the Indian qualifications and the practical experience of the Indian engineers are recognized internationally. There are many countries who have the nomenclature of Professional Engineers (PEs), which is given after assessment following a set rules and procedures laid down by the Washington Accord and EMF- both international agreements- respectively. Both of these international agreements recognize the engineering qualifications and the practical experience of their member countries respectively. AICTE / NBA is a provisional member of Washington Accord. Earlier IEI and ECI had submitted a joint application for membership of EMF, but there being no provision for a joint membership of EMF, ECI facilitated provisional membership of EMF for India resting with the IEI in 2003 with a proviso that it will be passed on to the ECI after it gets the recognition of the government of

India.ECI also facilitated the permanent membership of EMF again resting with the IEI in 2009 with a clear understanding that it will be passed on to the statutory council of engineers after it is set up by an act of Parliament. In other words it means that after the Statutory Council of Engineers is set up, EMF membership of India should be passed on to it otherwise professional registration of engineers under the rules and procedures which are recognized by the EMF will have no legal validity, which it should have for the mobility of Indian engineers on jobs abroad. The Ministry of HRD has also made it clear that any registration done by any other body than the statutory council will not have legal validity.

I welcome Prof. P.B. Sharma, Vice Chancellor, Delhi Technological University, Shri J S Saluja, M D, SCPL, Senior Vice president, , Indian Institution of Plant Engineers and distinguished keynote speakers, panelists and delegates to the convention and hope that at the end of the day some concrete suggestions will emerge from this convention. We have already compiled the recommendations that came up in the previous four conventions held on this subject and which have been widely circulated. ECI will compile a discussion note based on these recommendations and after incorporating the recommendations of this convention and formally submit it to the Ministry of HRD for further necessary action.

Theme Address: P.N. Shali

The role of an engineer has undergone a major change with the paradigm shift from the traditional functional organizational structure to cross-functional organizational structures. This shift demands multi-skilled engineers, as is widely being felt, which the current mere specialization in one branch of engineering does not produce. And, hence, engineers produced are not employable as such. The McKenzie Report states that only 25 % of engineers are employable out of the huge numbers that India produces every year. Alarmed with this ground reality and as a matter of its set objectives, ECI organized four national conventions, one national conference and one national workshop on the subject: seamless engineering education for better employability of engineers. The 5th national convention on the subject is in progress. Seamless engineering education for better employability of engineers is, in essence voice raised by the council for the reform of engineering education for making engineers employable. Consensus from out of these deliberations is for reforming the engineering education for making it more industry-specific. A discussion paper has been circulated, which is based on the gist of consensus points that emerged from these deliberations. The paper makes an attempt to suggest what could be done to bring in the desired reform in the engineering education for making engineers employable and enabling India to take part in trade in engineering services.

In the perspective of next 20-25 years, the demand for engineers from the power sector is anticipated to be around 2, 00,000 engineers; and it is anticipated to be around 8,00,000 for engineer technicians. Construction industry has been growing at the pace of almost 15% per annum. At this growth rate, the demand for engineers from the construction industry alone is anticipated to be around half a million engineers, The nuclear power sector is another fast growing sector of the economy; and the demand for engineers from this sector is anticipated to be around a little more than 50,000 engineers / scientists; and it is anticipated to be around 2, 00, 000 for the multi- skilled engineer technicians by the year 2050

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(DAE estimates). After these sectors, there will be also a higher demand for engineers from the other sectors such as infrastructure, manufacturing, public health engineering, environment, etc. We need more engineers. We need engineers for trade in services and so on. We need multi-skilled engineers. We need quality engineers. We need engineers with excellent designing skills. We need engineers with excellent R&D skills. To day, though we produce engineers in large numbers, we do not produce, by and large, such engineers. This is a well known fact of our life. Primarily, this is because the quality of engineering education in India is not what we need it to be for meeting the needs of the open economy. Our engineering education is still in its old mould, exceptions may be here and there. We do not produce engineers of the quality and skills that are in demand today. We are also not ready yet to compete in the international markets of professional services. The major constraints are going to be, therefore, of the availability of the quality and multi-skilled engineers and engineer technicians; and the availability of quality faculty for meeting the current and increasing demand from the present and upcoming engineering training establishments.

It is generally felt that the 21st century is not the same as the 20th century and centuries before that. The emphasis should be, therefore, on producing engineers of desired characteristics of 21st century. When looking at the present position, we find that the engineering education remains confined to its discipline domains and these domains are increasing every second day with new specializations getting added to the list. Specifically speaking, let us look at the question: Is an engineer with basic degree of civil engineering a construction engineer? I would say no. Then who is? In my view and perhaps many others also are of the same view, an engineer with a combined degree comprising the basic aspects of civil engineering, mechanical engineering, electrical engineering, electronics and metals and material engineering and skills such as, to deal with the world of business and commerce, with people and resources, environment, health and safety, project engineering, legal, logistics, procurement, application of IT and communication technology in construction, dealing with partnerships and joint ventures, learning the basics of contracts and claims, knowledge of economics, statistics, some basic managerial subjects, etc, is the construction engineer. A construction engineer. , therefore, is a professional far more multi - functional and better equipped to deal with complex issues of construction business as such. A construction engineer, therefore, is a professional much more of an engineer - manager. A pure civil engineer is not such a professional. Let us agree. We need to reform, therefore, our engineering education and training. While doing so, we need to place more emphasis on preparing a wholesome personality with engineering as core knowledge. Engineering education needs to be, therefore, looked from the "user driven "or "market perspective" rather than a "discipline perspective".

Moving on to the industry perspective and applying the same argument, one can say that the characteristics of the 21st century engineer from the viewpoint of the industry perspective are: knowledge of fundamental technical domain, neighbouring technical disciplines, the social, ecological and implications of technology, economics, statistics and accountancy and skills such as, problem-solving, know-how and business process, project management, marketing and finance, interpersonal & communication, deal with various regulatory bodies, capacity and willingness to engage in life-long learning- CPD, cosmopolitan attitude and global mindset and decision-making skills. We can extend this argument further to the other sectors of the economy- infrastructure, ports and harbours, highways, oil exploration and production and so on.

What should we do? Should we have a construction engineer - who is an engineer- manger? Should we, therefore, consider creating a new branch of B.E (Construction Engineering)? I think yes we should with curricula apart from basics of civil engineering as applicable to construction subjects from mechanical engineering, electrical engineering, automobile engineering, engineering materials, metallurgy, geology & mining, management, law, economics, statistics, arbitration and dispute settlements, environment impact assessment, project formulation, appraisal and monitoring, matters related to finance, etc. Similarly, we can consider creating sector-specific engineering branches.

Consensus arrived at the previous four national conventions, 6th national conference and Madurai national workshop suggests that the engineering education at the undergraduate level should be such as would produce multi-skilled engineers. Branch-wise specialisations can come at the post graduate level. Here also it is suggested that the postgraduate engineering education should be subject-specific like thermodynamics, fuels and furnaces, chemical processes, engineering materials, technology forecasting, etc, so that the person who wants to pursue M.Tech course should have such flexibility as would enable him / her to move across many industrial sectors .We need to include subjects from other than engineering branches in the course. It is also suggested that a general course in engineering, as in the USA, France and in some other countries with appropriate subjects from the main branches of engineering and subjects from the other than engineering disciplines included in the curricula would be very suitable to the Indian industry This course could be of five years duration with six months of a mandatory paid internship with an industrial unit. The details can be worked out.

It is also suggested that breaks can be included in the course after 3 years, when the student can take a job in an industrial unit as an engineer and work for some years. After that, he / she can come back and join the course for the next two years. This will also give a way out for the current diploma engineering to get merged in the main engineering course. In case diploma course must continue as it is, it should continue to be engineering discipline -specific as at present, but some courses from other than engineering subjects should be included to give the students an opportunity to develop some more required skills for competing for the supervisory positions in the industry.

It has also been suggested that the branch - specific degrees should give way to sector - specific degrees like: B.E. (Construction), B.E (Infrastructure),B.E (Manufacturing), B.E (Engineering), MBBE - a combined degree in management and engineering of five years including six months of paid internship, B.E (Transport Engineering) - Roads, railways, ports, etc., B E (Public Health & Environmental Engineering), etc,.The other variants of civil engineering suggested by Shri K.K Agrawal are as:BE (Structural Engineering), BE (Soil Mechanics & Foundation Engineering) ,B E (Transport Engineering), B E (Construction Management), B E (Public Health & Environmental Engineering),B E (Irrigation Engineering), B E (Rural Engineering), It is opined that these, being specialized degrees, could be considered for M.Tech courses.

Reforms for the postgraduate (PG) degree & Research Programmes have also been suggested .it is also suggested that for seeking admission to the PG courses, there should be a mandatory requirement of one-two years of practical experience. The contents and duration of the PG courses also need re-orientation and reform so as to make them industry - specific research-oriented. The subjects may also include specific industry problems and technology forecasting. Subject credits is a matter of in-depth

discussions after we have narrowed down suggested alternatives. I also think that these suggestions are worth consideration.

What is generally happening in the western countries has a message in it. This message is that a human being would like to do that which he / she likes & loves to do and for which he / she has the aptitude. In India we thrust a profession on our children. We should encourage our children to decide what they want to do, what profession they want to pursue in life. This is the first important step that we should take. While selecting students for engineering, we should assess their aptitude for it and then in engineering for manufacturing, for construction, for research and development, for design, etc. So, we should include a set of questions in the common admission (CAT) test which can bring out clearly the aptitude for engineering and then for what area of the profession's think -as many others have opined in these conventions -that there should be one common admission test for admission to engineering educational institutions- IITs, NITs and the other engineering colleges. We need to have a political consensus for this, which should not be difficult to get.

Trade in Engineering Services: A very important opportunity is developing for engineers in the form of trade in engineering services, opening up of which is round the corner. In order to participate in it, we need to be a full Member of the Washington Accord when only our engineering degrees will be recognised abroad. We also need to have a mandatory registration of PEs or we may call them as practicing engineers in our Engineers Act for getting a legal recognition to the profession, which is not there at present and is also required for enabling engineers to trade their services internationally.

The cooperation of industry with the academic institutions in the matter of reform of engineering education has to be ensured, particularly in terms of financial assistance for augmenting the infrastructure of these institutions for implementing the reforms which will also include increasing the seats in various engineering courses, exchange of faculty for teaching, revision of syllabus, technology transfer, etc. For this, industry can be compensated in terms of tax exemptions by the government.

Policy Issues: The quality and delivery of the engineering programmes should be monitored regularly. There should be a monitoring body for this. Engineering Council of India could perform this role in association with its member professional engineers associations, if this role is given to it.

Public-private partnership, as a matter of reform, in the area of vocational training will have a very important role to play in training our workforce- engineer technicians- for meeting the new challenges of the 11th Plan. Many of our industrial training institutes (ITIs) need involvement of industry so that the training they give is relevant. It should be enabled.

Professional Engineering Associations should have a role in setting the standards and in the accreditation mechanism of the engineering education and certify competency of engineers by testing them as per their standards. It should be enabled.

India should have many training schools to cater to the small and medium size companies who cannot afford to have their own training divisions. National and state industries corporations, academic institutions like IIT's, NIT's and various other private and public sector institutions should also come forward for this purpose. Professional Engineers Associations can also play an important role in this regard.

There is a need for repositioning of the Associate Membership (AM) certificates awarded by the Professional Engineers Associations and recognised by the Government of India equivalent to B.E. degree with that of a university degree, particularly from the point of view that these certificates are also treated equivalent to the engineering degrees awarded by the Indian universities / institutions in the context of Washington Accord so that the engineers of this stream also find their place in the trade basket.

The associations of professional engineers are education and training providing institutions in India; and, therefore, they should be considered for the status of a deemed university so that they can also grant degrees and diplomas which is recognised as such by the educational system as well as by the Washington Accord. If the competent authority of the government approves it in principle as a matter of policy, these associations can create required infrastructure and other facilities as are required for enabling them to get this status.

We should permit foreign institutions of higher education including technical education to invest in India.

Faculty shortage and its quality is producing unsuitable engineers. This issue needs to be dealt with. One of the options for this would be permitting, practicing engineers & engineer consultants to teach engineering as a matter of policy.

An effective interaction between academia and industry is required for producing quality engineers. This mechanism needs to be created.

There is a need for defining legally the practice of engineering - which should include, definition of an engineer and laying down globally compatible competency standards of engineers. The Associations of professional engineers should also be involved in this task. .

It is considered necessary to incorporate a mandatory provision in the higher technical education frame work of at least six months to one- year of paid internship with the industry, as is the case in the medical education, and its assessment should also be made mandatory. The degree should be only awarded after successful completion of this internship with the industry. The industry should be compensated for the expenditure that it may incur via the tax route.

Government of India should bring in Engineers Act on the statute with a mandatory provision for registration of practicing engineers and professional engineers (PEs) and set up a statutory council of engineers without further delay.

Finally: Controls do not necessarily work. For example, 8, 00,000 technically trained engineers are coming out of UGC & AICTE-certified institutions. So, that kind of certification of institutions apparently has not worked. If UGC & AICTE had done their job correctly, then all these 8, 00,000 engineers should be employable. The present regulatory mechanism for the higher technical education in the country, therefore, needs to be totally revamped and made transparent and more effective and efficient.

Inaugural Address: Prof. P.B. Sharma

The New Knowledge Age: The new knowledge age is characterized by the pooling of mind, management of knowledge, sharing of expertise and creating winning teams in the connected globalised economy environment. This implies that the learned quarters and professionals in countries around the globe should be focusing on development of new cutting edge technologies to provide solutions to the pressing problems such as energy security, water scarcity, environmental sustainability in addition to paying attention to ever increasing demands for high productivity and quality assurance conforming to global standards. In this context, the rapid developments taking around the world in the arena of new product development, process modernization and technology enabled solutions are offering a new hope to the mankind for a happy and cheerful living on planet mother earth by opening newer dimensions of human endeavour. The new knowledge age promises to solve the pressing problems of the vast humanity, creating added layers of prosperity, uplifting the quality of the life of a common man, providing greater opportunities for productive engagement of the vast population while at the same time having capabilities to accelerate development and growth without sacrificing the interest of man and environment. This is the promise of the new knowledge age.

Perceptions of Engineering Profession require a change: We must however, remember that advances in technology while opening up new opportunities for human endeavour also create a much greater risk to the human society as well as nature, unless the society responds to the need for absorbing the technological advancements with a care and concern for man and woman and environment. This necessitates more than nurturing talent in engineering and technology or creating capabilities to scale the un-scalable. We perhaps need to change our perceptions of engineering education from engineering being an applied science to engineering being a profession of privilege, a privilege to serve and a privilege to excel. The privilege to serve demands an integration of knowledge, skills and an attitude akin to serving the society and people with utmost devotion and commitment. The privilege to excel requires an unconditional commitment and resolve to constantly engage into the pursuit of excellence. Making engineering profession a privilege to serve and privilege to excel ensures ever rising levels of prosperity while at the same time ensuring happiness all around. On the other hand making engineering profession a privilege to earn and privilege to exploit can spell disaster and misery on a much wider scale than could be imagined. What we see today is a situation in which engineering education has largely failed to make engineering profession a privilege to serve and privilege to excel. This requires revisiting the purpose of engineering education and its intricate relationship with the welfare of the society. Engineering was and undoubtedly should be the inspiration of the young minds to take up engineering as a service and not as a mere pursuit for career prospects or for that reason minting money even though from wrong doings by undermining the value of engineering profession.

Renewed Emphasis on Creation of Competences, Imbibing Human Values and Urge to Excel required: It is in the above backdrop, we must review the whole gambit of human resource development in engineering and technology in the new knowledge age. Our focus has to be on creating competence, imbibing human values, creating the necessary urge to excel on the power of innovation

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supported by constant endeavours to create value and sustainability by assuring high industry relevance to make engineering education in the new knowledge age as a valid means to sustain growth and prosperity while at the same time assuring higher levels of happiness and well-being. This is a tall order and calls for a serious debate and deliberations on the proposed agenda of reforms.

The Crisis Today in Engineering Education: The crisis we face today is largely because of our neglect of quality of education, the loss of academic integrity and also the loss of research integrity. This is further compounded by the loss of professional morality and lack of managerial and leadership qualities of the 21st century where truthfulness, transparency and trust are to be the hallmark of human activity. Despite all this we made a highly impressive progress and this cannot be denied. Our self-reliance in a variety of sectors such as defence R&D, nuclear energy, space science, medical science, pharmaceuticals, agriculture, information technology and manufacturing is largely, if not wholly, supported by the indigenous supply of quality human resource from our engineering institutions in the country. Such is the attraction for India's science and technology workforce that the leading multinationals impacting the world of engineering carry Indian engineering and science graduates in their organizations with high esteem and high proportions, even in the developed countries. All our research laboratories, public sector undertakings, giant industry houses, IT majors and design and consultancy organizations are well-stocked with the quality workforce we produced from our institutions of engineering and technology.

Further, India has emerged as a prime attraction for the establishment of higher-end R&D and design engineering centres by the leading multinationals. This has truly mesmerized everyone as engineering institutions in the country are often leveled as being the producers of low quality graduates. While it is true that the employability of engineering graduates can be increased multi-fold and there is sufficient scope for its enhancement given the favourable conditions that prevail in the country, it is pertinent to realise that much of the damage to engineering education has been done by rapid and often uncontrolled expansion in the name of increasing gross enrollment ratio without proper care and concern for quality and employability. It is a matter of concern that there is craze to establish colleges of engineering in every nook and corner of the country including in the areas where it is difficult to attract faculty and quality students to take up engineering education. What we have not realized that engineering institutions are not chemist shops nor they are the primary health centres which need to be necessarily spread to length and breadth all over the country to assure well being of every citizen. Rather engineering institutions are to be seen as the focal points to attract the meritorious students from all backgrounds to engage into the pursuit of engineering and technology excellence, to produce capable people who would by their contributions during their work life make the life of a common man a lot better, create layers of prosperity to provide ever increasing avenues for productive employment of people and equip the mankind with innovations that shall cause ever rising levels of productivity, quality, prosperity and service. What we should have done is to set up skill development centres everywhere, rather than mushrooming engineering institutions everywhere.

As a strategy, once the skill development centres begin to create productive employment the demand for higher-end engineering education would have emerged. However, we as a matter of national policy either by design or default rapidly accelerated the growth of engineering institutions at degree level without creating the commensurate academic environment for quality education or create

avenues for the productive employment. Naturally, the industry has every reason to voice its concern for low employability of engineering graduates. Let us not make the same mistake by mindlessly adding post graduate programs in institutions around the country without proper care and concern for the quality of education and availability of quality faculty and academic environment.

The prime question is what can be done now and that too without loss of time to: Improve the employability of graduates, create synergy between education and research, make engineering education campuses tech savvy, create knowledge and innovation power in the world of learning, ensure high industry relevance and enhance industry academia partnership.

Engineering Council of India (ECI) has deliberated upon the issues relating to industry relevance and also the issue of improving the employability of engineering graduates. The National Knowledge Commission of India in its reports to the nation has also suggested a number of well-intentioned reforms to redefine the pathways of quality engineering education and research. Let us examine some of these suggestions today when we deliberate on the theme of seamless engineering education under the 5th national convention organized by the Engineering Council of India. The approach paper of the ECI contains the gist of the deliberations at the previous four conventions and also the national conference held in November, 2008 at New Delhi and national workshop held in March 2009 at Madurai, TN on the subject.

The ECI has reason to emphasize on the concept of seamless engineering at under graduate (Bachelor's Degree) level and rightly so as engineering has always been an will be more so a pursuit of interdisciplinary engineering. Whether it is the design and development of an automobile or a highly sophisticated space craft it is interdisciplinary and involves a team of highly specialized yet highly connected disciplines. The car is as much mechanical as electrical, material engineering, human engineering, comfort engineering, intelligent electronics, micro processor engineering and will be equipped with capabilities of night vision and artificial intelligence to move on the intelligent transportation systems of tomorrow. Likewise, the roads, buildings, bridges and other infrastructure are an amalgamation of civil, mechanical, electronics, computing, clean and green energy technologies, environmental engineering and green building concepts besides calling for a better and profound understanding of project management and maintenance engineering. Likewise, a power generating utility is not just electrical engineering or mere mechanical engineering; it also involves a higher end knowledge and expertise of today's and tomorrow's electronics, computing, networking and knowledge of highly sophisticated instrumentation and new materials. What more tomorrow's convergence of info-nano and biologically inspired products and services shall call for an all together new engineering both in design and manufacturing. As such there is no dispute in as far as engineering being highly interdisciplinary and requiring trans-departmental specialties. The prime question, however, is how to design our degree programs to cater for ever increasing requirement of higher end specialties and higher end skills of design and project management on one hand and develop capabilities to work in an interdisciplinary team environment, whether in a design centre, a manufacturing floor or at site during commissioning, installation and operation.

Further, the engineering education system needs to consider multitasking and multidisciplinary curriculum for engineers. India's engineering education is currently weak in fostering design capabilities as such we as a nation are being leveled as a weak nation in terms of our design capabilities.

We need to foster the culture of design engineering and problem solving as a part of our curriculum design and delivery system to build world class design engineering capabilities. All the more that India is being considered as a preferred location for design engineering centres by multinationals in great number. The culture of design and innovation shall create the joy and thrill of engineering so vital to unleash the power of creativity and power of innovation in the talented student community.

Our Experience at the erstwhile Delhi College of Engineering now Delhi Technical University: Our experience at the erstwhile Delhi College of Engineering and now in Delhi Technological University is that once the culture of research, culture of innovation and the culture of design innovations is allowed to be percolated right down to the under graduate levels the inspired minds of under graduates surpass our imagination in terms of product innovation and cutting edge technology developments. The DCE Hybrid Car, the DCE Unmanned Arial Vehicle, the DCE Robotic Submarine, the DCE Super Mileage Vehicle, the DCE Solar Car, the DCE Intelligent Ground Vehicle and the DCE Moon Buggy are the finest examples of what could be achieved in the institutional campuses by harnessing the power of innovation and creativity of the young minds. All these innovations were powered by the interdisciplinary teams of under graduates aptly supervised by the qualified faculty and well supported by the industry and the Government.

We received the Most Innovative Design Award for our Unmanned Arial Vehicle, in Georgia US in the World Design Competition organized by AUVSI International, Best Aerodynamic Design Award for the Super Mileage Vehicle in the International competition at Michigan, US organized by SAE International, FISITA Award for Best Design Endeavour for our Formula Student Car by SAE International in UK and Best Initial Design Award for the Moonbuggy by AIAA in the NASA Moonbuggy Race Competition in USA, the Most Improved Design Award for the Robotic Submarine at San Diego in US and more recently the Director's Award for the Unmanned Aircraft System at Maryland, US in 2009. All this goes to demonstrate that we have a lot to achieve by emulating good practices of synergy between education and research from our leading engineering institutions to rewrite the canvas of engineering education in India.

Well, ladies and gentlemen, the context of today's National Convention is rather important as the agenda is to empower India with the world class engineering and technology education, research and innovation capabilities. The ECI discussion paper contains a highly focused agenda and I am sure that this National Convention shall provide the brainware to sketch out the pathways of engineering education excellence for tomorrow's India, a prosperous and developed India, leading the engineering community around the globe on the strength of the "Wings of Knowledge" and "Power of Innovation" of its engineering and technology manpower and research capabilities.

May I take this opportunity to express my profound gratitude to Dr. Uddesh Kohli, Chairman, ECI and Shri P.N. Shali, the Director of ECI and the Organizing Committee of this prestigious 5th convention for giving me an opportunity to share some of my thoughts with you on this momentous occasion when we are about to embark upon a series of reforms in engineering and technology education sector in our country. Thank you ladies and gentlemen.

Vote of Thanks: J S Saluja

After passing out as a mechanical engineer, I got four offers including from a state government power utility and an engineering college. Primarily, out of these four job offers, I decided to join the state government power utility as SDO because it was an attractive post with lots of social respect attached in those days: plus advantage with the job was that a jeep was also given to you. I was to look after all the construction equipment. On the power sector-side, I was to deal with all types of transformers, other power equipment, etc. The job was SDO (Electrical & Mechanical); while as I was a qualified mechanical engineer and not electrical and mechanical engineer. The problem was that during our course in those days, during the first two years, we were taught some common subjects including that of electrical engineering. But I did not have sufficient knowledge to handle the work related to the electrical side. I did not understand fully the transformers. After this experience I opted for joining the then Hindustan Steel Ltd (HSL) - a company making steel those days. With this, a mechanical engineer having worked as SDO (Electrical & Mechanical) was now joining a steel mill producing steel. I found myself completely lost when I joined the company. I had no knowledge of blast furnaces, coke ovens, open hearth furnaces or that of converters and so on. All this was not taught to me in my course of mechanical engineering. I was told to supervise construction of a blast furnace with all its technological parameters as the project officer. I had to read metallurgy before I could do justice to my job. I became a metallurgical engineer by my experience, while as I had obtained a degree in mechanical engineering. There was a miss match between what you had studied and what you were supposed to be doing on the job; and this miss match continues to be there even today. This is the problem; and the problem can be tackled only by reforming our engineering education by making it seamless and more industry specific. From this point of view I consider these conventions organized by the ECI apt and timely. I thank Prof. P.B. Sharma, Vice Chancellor, Delhi Technological University for having speared his valuable time to be with us and for giving his thought provoking address. I thank all the eminent keynote speakers, & panelist, distinguished delegates and guests for making it convenient to attend the convention. We will be looking forward to valuable recommendations from the convention.

Shri J S Saluja is the M D, SCPL, Senior Vice President, Indian Institution of Plant Engineers and Member Board of Governors, Engineering Council of India.

Technical Session- 1

Session Chairman's Opening Remarks: S.K.Vij

It is an era of globalisation, things have changed quite significantly. We can no longer be in our old mold. It is the era of a competitive education. We have to learn and market our education too. Engineering projects have become very big and technologically complex. Engineering education in broad engineering domains will have to add on new sector- specific engineering education. Engineering Council of India has taken an apt and timely step by having organised four national conventions on the seamless engineering education for better employabiliy of engineers and the fifth national convention on the same subject is under progress now. Further, it has organised a national conference and a national workshop on the subject of reform of engineering education. ECI has taken the initiative with the objective of finding out an alternative system for engineering education for making it meet particularly the current and the emerging needs of the industry and generally speaking of the economy and now it is our duty to take this initiative further for getting the results that we want to get. We also need to consider the suitability of our current engineering education to the up-coming trade in engineering services and identify the grey areas of reform, if any, and carry out the reform that is needed to the engineering education and training.

My own experience as a civil engineer tells me that a mere college curriculum in a particular umbrella branch does not make one an engineer. It is the in depth practical knowledge and clarity of concepts in the branch of specialisation and a very good general knowledge about the basic aspects of the other branches of engineering and social sciences that makes one a very good engineer. Engineers of today need multi-skills to meet the engineering and managerial needs not only of the industry but also of the associated areas .At the same time knowledge i.e specialisation in some areas by an engineer would bring out the best practical engineering in those areas.Such specialists are needed very much. I fully agree that the engineering education today needs to be seamless. This is what is needed by the markets in the current globalisation paradigm of our development, apart from taking part in the global trade in engineering services. Given our rather a very large pool of graduate engineers , diploma engineers and engineer technicians, we are well placed for aiming at a large chunk of the global market of engineering services. But, it can only be possible if we impart required engineering and other skills to these engineers with required engineering education and training. We need to discuss this and bring out a clear road map for reform of our engineering education.

We need to identify additionalities and that too along with additional time frame because every thing cannot be covered in just four years of the graduate course. We must also keep in view the fact that there is a great shortage of infrastructure in the country - both in its quality and quantity. There is even shortage in its planning itself. We talk of life cycle costs. We talk of probabilistic model designs. We need to have quality in engineering designs. We need to identify and forecast areas in which we need engineers in numbers and of what quality and specialisations and in what time frame we need these engineers. I can say that we have not been following the practice of assessing the demand for engineers - in numbers, specialisations and of what additionally skills, etc.We need to do this on a regular basis. This should be market driven. We should not produce engineers in hordes as we seem to have been

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doing so far in order to check the ever deteriorating status of the profession. I think, it is very important.

Further, we may need engineers in general areas ;we may need them in some specialized areas; we need to identify these areas through a market study and then line up back word linkage for capacity building with the engineering institutions so that we are able to produce engineers which are in demand. Here, it will also be required to create incentives for making these areas of demand for engineers attractive to the students for getting trained to work in these areas as engineers. This, in other words, means creating areas of opportunity for students to train themselves for. This will imply that the industry and the government will have to coordinate for developing required incentives.. Engineering education must follow a regulatory path so that engineers that we produce, are employable.

Dr P.B. Sharma has stated in his inaugurals address that our engineers have shown their worth in fields such as space, atomic energy and defence R&D. I fully agree with him on this. But, we should not forget that these engineers have shown their worth only through their dedication . They have acquired not only deep knowledge and understanding of their branch of engineering specialisations, but also through acquiring knowledge and skills of the other subjects. This supports the contention that engineers of today need multi-skills and hence they should be trained accordingly.

Understandably, in the previous national conventions a recommendation has also come up on moving out from the present branch-wise engineering education to sector specific engineering education like in manufacturing, ports and harbours, power generation and development, etc. I think it needs a serious consideration. Coming to Railways, as you may know, there is no single institution which teaches railway engineering per say. Recently, a course has been started in the IIT Delhi on Metro rail. This is perhaps the first step taken in making a shift from the present branch-wise engineering education to sector specific engineering education.

We can see very clearly that it is the strength in basic R&D which has made the USA, UK or Germany the leading technology suppliers in the world. As against this, India continues to be a dependent country for technologies. India cannot realize its vision 2030 by remaining dependent for technologies from these countries. This will have to change , if India wants to become both an economic and military power in the world. For this, as Shri Shali has said in his theme address, we should produce more PhDs in engineering sciences as well as in the basic sciences; and we should produce world- class design engineers. The Indian industry should look for future businesses in advance and latest technologies ; spend more money in the R&D as well as creating more PhDs based on industrial research.

Finally, as a matter of reform of engineering education, we should have additional courses in the engineering curriculum from other than engineering subjects such as, economics, statistics, communication, some basic courses from the management sciences. We can think of having an engineering degree of general engineering comprising of basic courses from all important branches of engineering with additional courses from the social sciences and in specialisations to choose from. Additional time that we may need over and above the present time duration of the engineering course needs consideration for accommodating the additionalities in the curricula that we may decide. But any reform that we may think of in engineering education should be undertaken with caution and as required. We should also try to inculcate passion for engineering profession in the students.

Keynote Presentation : Prof. Y. P. Kathuria

The education system in countries abroad including the USA, UK, Japan , Germany, etc, is very robust. Engineers, when they come out of engineering educational institutions, they are mature and know full well what is happening in the industry. As against this, when engineers come out of engineering colleges in India, by and large, they are not mature enough to face the industry. They do not know what is harpooning in the industry and elsewhere. When they are fresh graduates they do not know what to do. As a matter of fact, their specialization commences when they enter the job market. I have noted that engineers from the German universities are much more mature and know full well what is happening in the markets; what is happening in the industry over there. I think, we have to bring in some changes - may be not that drastic- in our engineering curricula. I found in Japan connectivity between the industry and academic institutions much deeper than what it is in Germany. I find this connectivity very week in the chain of engineering education in India. This is one important grey area which needs to be addressed.

The basic difference between say Japan or Germany and Indian engineering education system is that in those countries, a very effective and efficient seminar system is working there. In other words it means that in this system in Germany, some news will come from the industry- may be it is on some production problem or some R&D problem or prospect or some such thing- to the educational institutions, it will be discussed by the students mostly in groups. The faculty will also note it and take part in these discussions. The news is transferred later after discussions in the possible explanatory mode via the curricula to be delivered to the students. By this method, many theoretical concepts get clarified, conceptually. The output of this seminar system, which is a regular feature of the engineering education mechanism in these countries, is that the students when they pass out are familiar with what is happening in the industry and outside it. This is missing in India. Similarly the other set of news that may come from the industry will be passed on to the other group. After this, both these groups will exchange the information and the output that will be generated from a through discussion of these news inputs from the industry or, say from the other sources of the market. A similar system should be incorporated the curriculum of engineering education.

I think a regular interaction between the industry and academic institutions is very much needed in India for keeping the engineering education in pace with demands of the industry. This can better be done through a standing and efficiently and effectively working institutional mechanism. Though AICTE is supposed to have this mechanism in its structure, it is a general perception that it has not been effective, as it was supposed to be. I may be off mark here, but I think it is so. Such a mechanism can be better built through an independent body comprising the industry and engineering institutions. ECI should create such a mechanism in India, sooner the better. It is very much there in countries such as Japan, Germany, etc. The Indian industry should play a role here. This mechanism should also enable the students to get exposed to the industry and to the problems that it faces from time-to-time during the time of their training in engineering institutions.

I think in plant industrial training during the course should be made mandatory. And further, internship with an industrial unit after the course is over of some duration say six months to one year should also be made mandatory. Both these trainings should be assessed and marks obtained by a

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student should be included in the total credit and the degree should be awarded only after this. The industry should be compensated for any expenditure that it may incur, which most likely it will incur the expenditure, via the tax route or as it is deemed appropriate by the competent authority.

I think in the third year and the fourth or final year of the engineering training, engineering students should undertake projects with the industry on industrial problems and not on theoretical subjects which the students have been taught during the course- which is, by and large, normally the position today. The project (s) could be such as its output could go to the industry. This way industry will also gain and students in turn will also gain. It will be a win win situation for both the stake holders. This is normal the practise in Japan and Germany. The projects could also be on some innovations suggested by the engineering educational institutions to the industry. The industry will readily take up such projects and it should be the students who should work on such projects under the supervision of their faculty guide. It will be very important here if the students are facilitated to suggest the innovation in the first place. Besides that in the last semester, the students should also be given a few lectures on how to start the small scale industry and become a successful entrepreneur.

I have been interacting with the faculty and the students in many engineerng institutions in India.I found from these interactions that many students and the faculty had many innovative ideas, but I noticed that these ideas were not taking shape to get into the mode of their application by the industry. This is the biggest problem here. There has to be a mechanism for this to happen. Many learned speakers mentioned about the institutional mechanism of industry- academia interface, which is not there at present in India. I think we should have such a mechanism in position for getting inter alia the innovative ideas to flow for implementation to the industry.

Further, the central government or the state governments or the industry itself should finance projects based on innovative ideas emanating from engineering students or the faculty or both. It will be a sure way to develop new technologies or innovate technologies that are already in use for better results. I have found during my travels and work in countries such as Germany, Japan and the USA that how fast innovative ideas get converted to R&D proposals or get straight into production of goods or services. There are facilitating institutions in these countries who enable it to happen. We also need to create such a mechanism in India. In Japan this process works faster. The chain is innovative idea-further R&D-production and then on to the market. Some times it has been seen that the idea is generated in the US, from there its application is in Japan and it is marketed from there. Every thing happens very fast. Are Indian students aware of this? So far I know, the answer is simply no. Indian engineering students should be allowed to attend seminars, conferences, symposia and encouraged to present papers in these events on innovative ideas that they have and want to present papers on these at these events. You all know that it is these events which give us information on innovative ideas that come from outside. When we are talking on the reform of our engineering education, we must include in this the desirabilty of the students to attend technical events; and it should be made compulsory in the education process. The minimum number can, however, be fixed.

Keynote Presentation: Prof. P. Thareja

We - at this convention - are discussing engineering education for better employability of engineers. But why are we considering employability issue? Are we not sure of our performance so far? Or has there been tremendous Change with time? Well! we academicians have a role to play for training

student engineers such that when they go out after completing the course, they are found employable by the industry. Industry implies hard work, and it includes entrepreneurial deployment. But there is a caveat in this. Are we really expecting to improve their serviceability, which is a function of their competence and usefulness? Should we not have looked at the aptitude for engineering in a person wanting to go for engineering. His / her attitude to the society and the nation? I believe a person should go for engineering; only if such a person intends to serve the society and the nation. If there is no aptitude for engineering and attitude to serve the society, such a person cannot turn out to be an employable engineer whatsoever we may do? In the present selection process for engineering , aptitude and attitude are not assessed, as a system, in a person wanting to go for engineering. We will have to reform the selection processes for admission of students to the engineering profession and include in the process the required inputs for analyzing these two attributes in a person vying for this profession.

Coming to the faculty side of the process of engineering education, here also we need aptitude and attitude for teaching - and particularly engineering; to install in them as a protocol. Also installing a life long 'altitude' to serve the society and the nation while performing conventional duties should be the prerogative. A Life - long learning and of teaching quality engineering to the students is the contemporary requirement of Change. Keeping the right attitude for continually developing and professionally equipping apprentices, and remaining committed to serving the students as a dedicated engineering faculty is vital. If this is realised, two-third battle will be won.The remaining goes with delivering the right curricula to the students. But if one decides to go for teaching, san the aptitude and positive attitude towards what one has to equip as a teacher, it sure fulfills one's requirement of employability, but no more to the profession of a teacher. It implies that employability and competence are the two ends of a purpose, and we chose which one to give precedence. That's how, as I said earlier, employability is not a big consideration. Aptitude and attitude certainly are. To day we have this problem to consider and, thereso, because we still do not have quality teachers,. this should be dealt with vitally and due caution.After we have dealt with these cited dual issues, it should become a lot easier to reform the engineering curricula and impart the right 'course' to the engineering students so that they get required engineering 'education and training' for making them employable. The 'course' here is a 'direction'-like a compass, and not to be demeaned as an engineering course work.

Economic consideration is always paramount when one decides about the professional career that one should pursue. When it comes to engineering teachers in particular, lack of attractive compensation is normally on offer to the most of the best teachers. If a few are not putting in their best in the job, then why should all support the blame, when the cause is in the compensatory system. Another cause is the fact that the students get promised better packages in 'campus placements', than what their teachers are drawing and if they start feeling while at college that they are smarter than their educators, there is no altitude gained by teachers (necessary for coveted knowledge flow)? Heavy initial packages should also induce them to steer away from academics, consequently from the possibility of a self employment later, as risking a remunerative job career is foul game.

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Various other factors which dominate decisions in academics include 'perception of extra load', low personal accountability to student failures, lack of accreditation, no emphasis on quality control, etc. The new mushrooming of private engineering institutions today, who offer teaching jobs even to just pass out engineers, is a bigger corollary to the poor (unsuitable) employability of our engineers. If they were not suitable elsewhere, should they contribute for preparing more of engineering graduates like them? For the consideration of net deficit in the availability of highly qualified engineering teachers, vis-a-vis better avenues in the corporate sector etc., the scenario is quite precarious today.

We should include within the reform process the onus of making students innovative via the training process. We need to produce thinking engineers and for that we need thinking faculty. For the right (thinking) people, we should make faculty jobs attractive enough so that they take up these jobs and not opt for the corporate jobs for which they may have no liking and a financial package may have overruled their aptitude call for the teaching jobs.

Further, we need to reform the curricula whereby the students get interested to be self learners and innovators. To draw some words of wisdom that Prof Y.P Kathuria said a short while ago for making students self learners and innovators, the preparedness of teachers today is called upon. Faulty should facilitate achievement by reforming the attitude and mind set of both teacher and taught; and move out of this blind to the realm of flexibility and openness. To be innovative in the attitude towards teaching and dealing with the students is a newer challenge of the competitive quality. The curricula should be such as would facilitates innovation and learning and not on the rating process. Our student and faculty rating is rote (marks) based- meaning bland reproduction without innovation. The itinerary driven engineering courses, may be well conducted, thanks to accreditations, but as it is not based upon sound foundation, it is damaging the real potential of the students. We should move out of it to a wholesome inclusive & participative engineering education.

We need to create learning experiments that encourage creativity and experimentation for further fine tuning the whole system in which we are working. We need to create such an environment in engineering colleges that would encourage the students to speak freely and take risks. Emphasis should be not on quantity but importantly on'Quality'. For Quality we need to encourage collaborations between the industry, and engineering educational institutions, and empower the society for ensuring the quality of engineering education, especially where mushrooming tend to outgrow to a wilder growth. .

Keynote Presentation: Dr Deepak Bhatnagar

Increasing the 'relevance' and 'excellence' of engineering education in India was one of the key focus areas of the implementation programme of Technology Vision 2020 launched by TIFAC under the overall guidance of Dr. A.P.J. Abdul Kalam. TIFAC has set up around 36 such centres in emerging areas of technology across the country. These centres are called "TIFAC-COREs".

Engineering education of the 21st century should include areas like technology trade, WTO and IPR issues, technology foresight, etc. A study was sponsored by Continental group and was titled "In Search of Global Engineering Excellence-Educating the next generation of Engineers for the global

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workplace". This study was conducted by top technological universities from the US, Germany, Japan and Brazil. The study highlighted the need for developing global competence as one of the key qualifications for engineering graduates of the 21st century. The study also laid emphasis on trans-national mobility for engineers and link engineering education to professional practice. The study stressed on the urgent need for research on engineering in a global context.

FROM THE FLOOR

K.L. Mehrotra

Mining engineers are now being recruited by the information technology majors in large numbers. Why it is happening is not clear. In mining sector it is the qualified mining engineer who can work and if qualified mining engineers move on to the IT sector, as is a happening, there will be o mining engineer available for mining. The manufacturing, power and construction sectors depend on mining sector for their basic inputs. So, if there is no mining, there will not be any manufacturing or power generation, etc. This is an important issue, which needs s serious attention and tackling. We need to take measures for stopping mining engineers to hop on to information technology sector. The second point that I will like to make is that, as a matter of reform of engineering education, we should produce engineers for the manufacturing sector, for the power sector, petroleum sector. This is another words mean that we should produce sector-specific engineers.

B.D. Jethra

We are facing considerable deficit in the availability of engineering faculty, both in numbers and quality. This is primarily because the teaching profession does not offer as good salary and perks as the jobs in Industry, with the result that the best brains are attracted to Industry (and not to teaching profession). For the same reason, many engineers migrate to IT, civil services and management sectors, which is a colossal waste of the national resources used in producing those engineers. It is imperative to tackle this problem at the earliest. The only lasting solution to this problem is to offer better salary and perks to engineers / technologists and even better compensation to the faculty. The third point that I would like to make is that without having the aptitude for a profession, one cannot do justice to that profession, Today, our common admission test (CAT) does not assess aptitude in a student for engineering . We need to reform the CAT so that it picks up only those students for admission to engineering courses who have the aptitude for engineering.

A Delegate

While a sharp upword growth has been witnessed in the engineering colleges, the growth in the avilablity of trained faculty has not been commensurate to the growth of engineering colleges. So, there is a net defecit in the avilability of engineering faculty. We will have to bridge this gap by making faculty jobs attractive and by training teachers before they take up teaching in enginerring colleges.We must also consider involving practising engineers in teaching by suitable measures including by motivating the faculty to enable it.What engineers should read and know so that the industry find

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them employable should be assessed. After this is done and as a matter of response to the requirment of the industry, engineering curricula should be reformed.The faculty should also be encouraged from the policy point of view to work for the industry so that they can know what exactly the industry needs in engineers. With this, it will be possible for the academicians to bring up an appropriate curricula. For this aso we ned an effcetive and working institutional mechanism on indusstry- acdemia interface. We should create such a mechanism.

Prof. P Thareja

We should find out what measures need to be taken for arresting job hopping by engineers to sectors such as IT, management, civil services, etc. It is not a healthy trend for our economy. One of the measures could be making the industry jobs quite attractive for engineers, making teaching jobs attractive for engineers and making engineering R&D and design jobs attractive for engineers. It may need policy intervention which should be considered as a matter of overall reform of the engineering education and training.

Session Co Chairman's Concluding Remarks: Dr. P. K. Sarkar

Indian economy is growing. Recent fall in the GDP is not on the trend line, which has been steep-upward. The recent distortion of the trend line is primarily because of the externalities. Otherwise our economic fundamentals have been sound and will continue to be so. So we are growing and would also continue growing in future. We need quality engineers for realizing the higher growth target that has been set for the XI Plan and beyond. A massive investment of US $ 300-400 is expected to be made in creating world-class infrastructure in the country. We need quality engineers to build this infrastructure. On the one hand we notice that from out of the present output of engineers, only 25 % are found employable by the industry. On the other hand we find the remaining 75 % of the output of engineers is not employable. For realizing the higher growth rate of our economy, we will have to also make the remaining 75 % of engineers employable. In essence, this is the issue that we are discussing today. The major responsibility in tackling this important issue primarily rests with the AICTE- as it is accrediting and constantly monitoring the engineering education in India. It has to, therefore, ensure that the remaining 75 % of the output of engineers is also found employable by the industry. So far it has not been able to do this. It should. Perhaps, it needs some pulling up.

There has been a sharp growth in accreditation of engineering colleges in the recent past. It has been noticed that many of these colleges neither have the quality infrastructure nor they have the quality faculty. We will have to address this important issue. I would like to suggest that a small committee may be constituted from among the faculty of IITs and NITs and Some of the large professional engineering associations which should deal with this issue and make recommendations to the statutory body for implementation so that the quality of infrastructure and faculty of these large body of engineering colleges are brought at par with that of the standards of IITs and NITs.

There is a mismatch today with what is taught by the engineering colleges and what is required by the industries. We need to remove this mismatch through reforming the engineering curricula. We need multi-skilled engineers for building world-class infrastructure and manufacturing; world-class R&D

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and engineering designs. We need today, therefore, multi disciplinary engineering education. The additional courses that need to be included in the curricula should be on personality development, on communication, report presentation, economics, etc. We should have the same curricula and standard of its delivery in all the engineering colleges including IITs and NITS for producing engineers of the same quality. We will have to address this issue. This can better be done by bringing in a major reform in the curricula and delivery of engineering education. The contours of this reform have been discussed at the previous four national conventions that the ECI has organized so far on this subject. The recommendations that have come up at these conventions have been circulated to the concerned quarters. We need to take action on these recommendations.

We also need to monitor the quality of engineering faculty and take steps to remove the grey areas under a concrete and time bound action plan. This has to be a regular feature and not once- a - while case. We need institutional mechanism on industry-academia interface or facilitating to bring up industry-specific engineering curricula and keeping it updated through its regular revision after every three or four years.

Coming to the point of faculty shortage, I would suggest that this shortage can be filled up to some extent by inviting those practising engineers and engineering consultants, who have demonstrated their contribution through their work, to teach engineering. This is the practice in the developed countries. We should encourage it as a matter of policy.

There should be one common admission test for admission to engineering colleges including IITs and NITs throughout India. There should be a regular and assessed industrial training during the course. Further, there should be a mandatory internship of at least six months after the course is over with an industrial and consulting organizations which should also be assessed and credits included in the credit system that have been obtained from examinations and during the course industrial training. Final result should be declared only after that. During in course industrial training, students should be given industrial projects which may also include some industrial problem to work on under the supervision of the faculty. This can be on a single- student basis or a group - of - students basis. The industry should provide some form of incentives in terms of stipend, etc, to the students and in turn the industry should be compensated for the expenditure that they may incur via the tax route depending on the output generated through the learning process.

Tchnical Session-II

Expert Intervention: L. Pugazhenthy

The issue of quality engineering education, which is directly related to issue of employability of engineers, has been receiving attention at the various fora in the country. ECI has also organised four national conventions , a national conference and a national workshop on this subject. I attended a couple of these programmes.India is emerging as a major economic power due to a faster growth of its economy.But there is a cause for worry for sustaining the high growth of the economy in the immediate future and in the long-term . In order to maintain a constant high growth rate, apart from other resources, we need technical workforce of high quality.Apprehension on its availability's has already been expressed by our planners.It is even being seen happening today in the construction and other sectors of our industry.

Today, innovative and quality engineers are not normally produced by the engineering educational institutions, exceptions , however, of IITs and some of the NITs producing such engineers only supports this contention. This position needs to change , and faster it changes, better it will be for us. It will be path breaking engineering innovations which will only meet the current and emerging challenges and hence take India forward.It is not totally absent to day, sectors such as space, atomic energy, defense science,aeronautical engineering and some others are depicting innovative engineering. India has achieved comparative advantage in these sectors. What we need is a spread of the innovating engineering to the other sectors of our economy.For this, we need engineers of calibre with innovative multi-skills for meeting the current and emerging challenges of the Indian economy in general and the Indian industry in particular. Now that the trade in engineering services is opening up, which is round the corner, we will get the opportunity to trade in engineering services in the world. For maximising our share in the world market of engineering-based goods and services, therefore, we need to produce innovative engineers of calibre in large numbers from our engineering educational infrastructure that we have. It is for this objective that we should re engineer our engineering education and training system.This can be only done by reforming our engineering education system so that we are able to produce quality innovative engineers who not only have clear concepts of their field of specialisations, but also have multi-skills.In other words, we need to produce multi-disciplinary and multi-skilled engineers from every single engineering educational institute that we have in the country.

Unfortunately, today engineers look for pay packets rather than professional satisfaction or satisfaction of their aptitude for a job.This is not good and needs reversing , if we have to ensure that engineering resources created with hard labour and scarce financial resources are used at places where they should be used as such. Perhaps, policy intervention can reverse this trend. We have today teachers who have no passion or love for teaching. They have landed in the teaching field primarily because they did not get jobs in the field and at places where they would have been more useful and there is net shortage of engineering faculty due to rather a sharp growth in engineering colleges during the last around 15 years time frame.It is because of the faculty comprising of such engineers,

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passion for engineering does get developed in the students and the delivery of the curricula is also not of the desired quality. It is a well recognised fault with our engineering education.We need to address this issue.

Keynote Presentation: Dr. Gur Iqbal S Chauhan

Reform in engineering education for better employability is a burning issue in the society & is being debated time and again with a view to finding an appropriate answer as to: how to reform it,, what mechanism is to be adopted, what policy is to be pursued. Discussion Paper on this issue prepared by the Engineering Council of India has highlighted various problems and issues as well as some directions for reforms. I take a due note of it. I would like to place on record the following points towards reforming engineering education for better employability of engineering.

World Bank Report predicted that India can trigger a rapid increase in its GDP. Though due to recession, it has slowed down from 9% to 6.3 %, but there is going to be massive investment of US $ 300 - 400 billion in the next five years in infrastructure alone. Recently, Shri Kamal Nath, Honorable Minister of Road, Transport and Highways has announced the country's road development programme from 2 km per day to 20 km per day amounting to 7300 kms of road per annum. In addition, 10,000 kms of expressways are also to be built in the country. Now the question is how to meet the challenge for massive infrastructure development with only additional 25 % employable engineers passing out from the colleges every year. The 25 % turn out to be slightly more that 100,000 engineers per year which is much lower than the present demand the country is looking for.

In order to develop quality and employable engineers in the country, it is extremely necessary that AICT / UGC should take the additional responsibility to effectively monitor the performances of new and old institutions with respect to teachers': students' ratio, academic qualifications and experiences of the teachers, the extent of shortages of teachers, actions initiated to recruit the qualified teachers etc. Along with this, the students' views should be taken to assess their perception and satisfaction towards academic and other development programme. The Institutes with poor performances should be warned and advised to take their corrective measures failing which suitable actions should be taken.

Some Institutes have already started additional classes for personality development along with yoga for the engineering students. This is a good effort. This kind of programme should be initiated for all engineering institutions. Besides, there is a need for revision of syllabus in order to enable the engineering students to cope up with meeting the present needs of the industries. For example, a subject like biology being taught in the first year of engineering colleges should be discarded.

Like Architectural, Medical Courses, engineering students must be engaged in the industry and consultancy organizations at least for a period of 3 months while studying engineering courses so as to enable them to handle real life projects as well as get acquainted with working in a team. This would give them confidence and make them true engineers as required in the industries.

For monitoring the academic performances, reputed faculty members from IITs and NITs may be nominated in their respective regions to be a part of the monitoring team of AICTE and UGC.

Dr. Gur Iqbal S Chauhan is the former Executive Director of the Steel Authority of India.

Academically poor students, the students from backward classes and students admitted under management quota should be provided with additional coaching, extra facilities by the faculty members and administration so that they can improve their academic performances for better employability in the engineering profession.

It is imperative to develop capacity building programme not only to develop good teachers but also 100 percent good quality students with a professional bent up mind who could be easily absorbed in the industries due to their skill and suitability in the engineering profession.

In view of the development of skilled engineers, it is also equally important to produce high quality engineers with PhD and M Tech to meet the requirement of 10,000 engineers with PhD as against 400 engineers with PhD being produced per year presently and 20,000 engineers with M Tech as required by the country. It therefore calls for enhancement as well as expansion of the Postgraduate and Doctoral Programmes as a part of the capacity development programme.

Though there is a high demand for engineers of various engineering disciplines in the country in general, in particular, the demand for skilled engineers in highways and transport sectors is significantly high. It is long felt desire that a programme on Diploma in Highway and Transport Engineering for a period of one year may be initiated for practicing engineers at various reputed institutes in the country so as to facilitate on- going programmes of highway infrastructure.

Industry should be associated at the time of finalizing the course curriculum, In turn, it should give an assurance for the absorption of engineers after they pass out - which should be based on their long-term plans. The number of seats should be limited to the specific requirements, as surplus graduates will find it very difficult to be absorbed, elsewhere. Industry should regularly organize conferences / seminars / workshops / lectures in the engineering colleges falling in their areas at which problems that it has met should be discussed with the invited students and the faculty.

A Delegate from the Floor

Unemployability is a burning issue before us.Engineers who are found employable are from the IITs and NITs and not , by and large, from a large body of engineering colleges that have come up during the last 15 years or so and mostly in the private sector.It is also now well known that the infrastructure and the faculty that these colleges have are not of required standards. So, we know the problem that is before us and we should find the solution for this problem, I would also suggest that no more engineering colleges should be set up till we have made a long - term assessment of engineers that we may need for the fast growing economy say during the next 20 years. We must allow only new colleges to come up, if we find from this study that we need these additional colleges. Further, the new colleges should be only approved if they have made a provision for the quality infrastructure and the faculty.This must be ensured. If we have done this, we will solve the problem to a large extent. Then, we should also reform the curricula and make it such as would meet the needs of the industry and also of the R&D sector.

Session Co Chairman's Remarks: Dr G.P. Karmakar

As far as I remember, we had industrial training and the curricula used to be revised after every four years but not in consultation with the industry as such. The industrial training was optional and not

compulsory; and it was confined only to visits and not doing any project with the industry. The curricula, though it was revised after every four years, did not reflect such changes as would have met the demands of the industry because the industry was not consulted while undertaking the revision of the curricula. The changes that were incorporated in the curricula were mostly of theoretical nature. What we are talking about today is that there should be some kind of mandatory industry training and that too not confined only to visits, but also for undertaking some projects on industry problems during this training. I think it a suggestion of wisdom and what is required for giving a sufficient idea to the students regarding what they are expected to do in the industry when they join it after passing out. I also agree with the suggestion made that there should be a mandatory and paid internship of six months with an industrial unit after the theoretical course is over and this should also be assessed. This would be just on the lines of the medical education. It should be implemented by the competent authority, sooner the better. Any revision that is made to the curricula should reflect the concerns of the industry. The engineering curricula should be such as would meet the demands of the industry and concerns of environment sustainability.

Session Chairman's Remarks: Dr Baldev Raj

The initiative taken by the Engineering Council of India (ECI) on the reform of engineering education and training is apt and timely. It is an attempt to innovate our engineering education. It is also happening in the advanced countries. If we will not take this seriously, as it should be taken, I think we will fall back rather by a distance. So we must innovate. Second, we have issues here to tackle. These include, the quality of the faculty, the poor quality of infrastructure that many of the engineering institutions have and the engineering curricula itself. We are present here in this 5th convention as professional engineers to discuss how the seamless engineering education can be introduced, what kind of faculty we should have and what should be the curricula that will give us multi-skilled engineers for meeting the current and emerging challenges of the industry and R&D and also resolve the issue of employability of engineers.

Let me emphasize, we have got to built on what has been concluded in the previous four national conventions that the ECI has organized on the theme of seamless engineering education for better employability of engineers. We cannot afford to continue talking on the same thing every time that we get this opportunity to meet. We have to reach somewhere. Unfortunately today, engineering profession is not inspiring students. They should draw inspiration from those people who have enabled us to reach to this stage when we have send our Chandryan to the moon, made India an atomic and space power and are also advancing fast on the defence technologies. This should inspire students to engineering profession. But unfortunately this is not happening. We should have an in-depth look at this and create such conditions as would inspire brilliant students to engineering profession.

We should also examine how we can introduce this seamless engineering education in the country which, I think, has the merit today and what kid of faculty we should have to teach students engineering in the seamless format. Should we go step by step or in one go for this seamless engineering format as against the current discipline-wise format? Should we introduce this format in a few colleges in the first place and move forward only after gaining some experience and evaluating the

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results that this move may throw up? Should we also introduce sector-specific seamless engineering and also specify the sectors, say construction, oil exploration, development and production or simply oil engineering, Infrastructure engineering and so on? These are some of the important questions that we should consider. In sum, I would like to say that while there is the need for the change, we cannot go for this change in one step, we will have to consider taking many steps for bringing this change, evaluating very carefully every single step that we mat take as we go along for this change. We have got to consider all these issues and answer these questions before we take the first step.

Unfortunately today, we are not attracting the best students to the engineering profession, some exceptions here and there notwithstanding. There may be reasons for this. We must identify these reasons. After carefully studying these reasons, we must find a way out for this so that the best students are attracted to the profession. We should keep in view this issue while moving ahead with our reform endeavour of engineering education.

I agree with what has been suggested by the previous speakers and by some of the delegates intervening from the floor that we should have a uniform quality of engineering education in IITs, NITs and all other engineering colleges in the country. For this we need to have one standard curriculum for all the engineering education providers including IITs, NITs and the other engineering colleges.

For ensuring at least a minimum standard for admission to engineering colleges, we should have one common admission test (CAT) for the engineering courses in the country. This could be recommended from this convention. For selecting the right persons to engineering profession, we could also recommend that there should be a provision in the common admission test for the engineering courses for assessing the aptitude for engineering like that of the common admission test for admission to the management course has.

I also agree that we need today multi-skilled engineers and the current engineering education is not producing such engineers. We need to reform our engineering system including its curricula and delivery mechanism. We should modify the curricula by removing subjects that have become obsolete, amalgamating the curricula of the different engineering disciplines and then adding to the curricula subjects from the other than engineering disciplines such as economics, statistics, geology, communications and subjects from the management science. I also support the suggestion made by many delegates and keynote speakers that we can consider having a five- year course as against the current four years, out of which we should keep at least six months for a mandatory internship with an industrial unit which should be paid intern ship so that the student is not burdened further and we can also accommodate subjects from the other than engineering discipline in the course. The industry should be compensated for the expenditure that it may incur on the paid internship via the tax route as a matter of policy. Understandably, this recommendation has also come up unanimously at the previous four conventions that the ECI has organised on this subject. We should, however, evaluate very carefully all the changes that we want to make in the curricula of the engineering education so that it becomes feasible to make the changes.

I also recommend that the in course industrial training and six months internship should be assessed and scores obtained by this assessment should be added to the total score. The final results should be declared only after this is done.

As I have stated earlier that we should work forward now on what we have done in the earlier four conventions that the ECI has organised on this apt and timely initiative. We should develop a road map with very carefully identified milestones that we have to reach to which should also include the curricula that we should have for producing engineers that the industry needs and are also suitable to R&D sector. There could be two types of the curricula one for the industry specific engineers and the second for those who will like to go for R& D stream.

I suggest that the ECI should prepare a discussion note on the consensus recommendations of all the five national conventions that it has organized on this subject of seamless engineering education for better employability of engineers and circulate it to the industry bodies, academia and policy makers for comments. After these comments are received, ECI may constitute a small group of five-six people drawn from the industry, academia and the regulatory bodies- AICTE & UGC which should take up the work of preparing a road map and time-bound action plan on the reform of engineering education and training and submit it to the competent authority of the government for consideration and implementation. The committee should do this work in consultation with the stake holders- the industry, academia and the students.

Col. Arun Sharma

We have a young Engineers Forum. Our Chairman, Shri K.K. Kapila - a internationally reputed engineer consultant is the chairman of this forum; and he is also associated with similar forums at the international level. The forum regularly organizes programmes for the young engineers. The Indian National Academy of Engineering (INAE) also has a similar forum.

A Delegate from the Floor

We have a case of a large body of engineering colleges of poor quality infrastructure and the faculty; and these colleges are mushrooming. We need to check this if we want to better our engineering education.

Dr Baldev Raj

Yes this problem is very much there and is well known. Unless we have a very transparent accreditation system, we cannot check this menace. The educational institutions should not be run on pure commercial considerations. AICTE was supposed to be ensuring accreditation of engineering colleges with required quality infrastructure and the faculty. But in actual practice, it has not been so. This is a well recognized issue. Perhaps, the competent authority in the Government of India is also seized of this issue. This convention should also flag it.

A Delegate from the Floor

We can create quality faculty only by motivating people with aptitude and passion for teaching and research. The issue is how we can do this. Presently, teaching in general and professional teaching in particular is not an attractive choice for a career for reasons of poor pay and perquisites that are there when compared with the other career choices like IT industry, management, civil services, industry, etc.We will have to make teaching an attractive career option for the right people.

Col. Arun Sharma is the Director of the Consulting Engineers Association of India (CEAI) .

Panel Session

Session Chairman's Opening Remarks: Prof. S.S. Chakraborty

To my mind without the basic applied sciences and convergence of various other aspects of sciences, engineering will not go too far. Engineering without practice is as bad as the practice without sound engineering knowledge. Coming from the industry, I feel that most of the fresh engineers are not employable as such and they have to be trained before they can be put on their jobs in the industry. It is so perhaps because the present engineering education lacks in industrial orientation. Engineering education has remained in its branch-specific jackets. It is not producing engineers having industrial orientation built in and not imparting required multi skills in the students. This is the major reasons why the present engineering education and training is not producing engineers needed by the industry. If somebody wants to be a very good highway enginee4r, he / she should have a very good knowledge not only of the basic civil engineering, but also of the other subjects such as material science and engineering, economics, statistics, thermodynamics, management sciences, etc. In short, he / she should be a multi-skilled engineer- manager.

In order to bring in excellence in the engineering profession, which we need to do for meeting the emerging challenges and seizing the opportunities that are coming up today at a very fast pace, we need to have a cross-fertilization of the knowledge and skills and, therefore, we need to reform engineering education in such a manner as would lead to this objective. Understandably, there has been almost a consensus on this view point at all the previous four national conventions that the ECI has organized on this subject. We need to reform engineering curricula, therefore, for producing multi-skilled engineers that we need today by cross fertilizing them with a curricula which is an optimum mix of the various engineering disciplines and some of the basic features of other than engineering disciplines.

We do not have the teachers both in numbers and of the required quality. The teacher : student ratio in most of the engineering colleges is low. The teaching profession in general and engineering in particular is not considered attractive. The people of the right caliber, aptitude and passion are not getting to the engineering teaching profession. There are many well-known reasons for this. We have got to deal with this important issue concerning the engineering education. We should resolve this issue, sooner the better.

I also support fully the point that has been made here regarding introducing in the curricula mandatory industrial-projects based in -course training which should also be assessed and credits included in the credits that a student gets from the theory papers. I also support the point on at least six months of paid internship with an industrial unit after the main course is over and this training should also be assessed and credits thus obtained by a student should also be included in the total credits obtained from the written tests plus in-course industrial training. The final result should be declared only after this assessment is completed and not before that. The industry should be compensated for any expenditure that it may incur during the internship via the tax route.

Prof. S.S. Chakraborty is the Chairman and Managing Director, Consulting Engineering Services (India) Pvt. Ltd.

I also agree with the point of raising the duration of the engineering course to five years from the present four years for accommodating the additional subjects from other than engineering disciplines and six months of paid internship with the industry.

Dr. Abha Kumari

I fully agree with the views that have been expressed in the convention by the learned keynote speakers and delegates that the engineering education that we have today is not producing, by and large, quality engineers and hence the industry does not find them employable. Many of the engineering colleges do not have a quality infrastructure and the faculty. We need to address these issues with an urgency that it demands. The current engineering education does not produce multi-skilled engineers required by the industry. Engineers do not find teaching attractive as a career even though they may have an aptitude, passion and liking for teaching. Engineers even do not find industry jobs also attractive as the alternative of high-paid jobs in the IT sector is there which attracts them. These jobs do not need engineering skills as such. This is a share waste of our trained human resources. We need to make industry and teaching jobs attractive for engineers. We should address these issues.

Coming to the curricula, I fully agree that the current engineering discipline-wise engineering education needs a reform so that the engineering education and training produces multi-skilled engineers. For this, we can consider amalgamation of the basic courses of branches such as mechanical, civil, electrical, electronics and metals and material engineering and adding to the curricula thus created required courses from other than engineering subjects such that of economics, communication, statistics, management sciences, law, etc. We should develop in the students communication skills - both in writing and oral. They should also be taught how to present technical and the other reports. The oratory skills also needs to be developed.

Second, we should also have a mandatory industrial training during the course which should be on some industrial problems. This training should be separately assessed. The students will be able to better understand the theoretical concepts that they have learned with this kind of training. This training should be under the direct supervision of their teachers. The assignments that are given to the students during the course should also be on some industrial problems and these should be done under the supervision of and in consultation with their teachers. It should involve a referral to what has been theoretically learned during the course. There should be some understanding between the engineering institutions and the industry on the industrial training. We should think of a tri semester course. One semester can be set aside for the project-based training. In the other semesters we can introduce some minor or major projects. In other words, it means that we should develop project-based teaching curricula - a practice normally followed in the developed countries. The curricula and its delivery mechanism should be such as it would develop culture of research at the undergraduate stage of the engineering training.

Dr. Abha Kumari is the Assistant Professor, Dept. of Biotechnology, Delhi Technological University (Formerly Delhi College of Engineering) Delhi.

After the course is over, I also agree that there should be a mandatory six months of a paid industrial internship with an industrial unit and it should also be assessed. The final result should be declared only after all the assessments have been made- written exams Plus in course industrial training Plus internship with an industrial unit. There should be also more emphasis on the laboratory work.

The quality of the faculty can be ensured if we are able to make the teaching profession attractive; and by creating a mandatory continuing professional development mechanism for the faculty which also includes its regular monitoring.

New engineering college should be accredited only with the required infrastructure and the faculty. Many of the engineering colleges are not meeting these two important requirements. They should be directed to upgrade their infrastructure and the faculty as is required within a definite time frame. Should they fail in this, they should be directed to close down their colleges, but after ensuring alternative place for placement of the students undertaking training in such institutions.

The students should be able to select the course for which they have the passion and liking. Today, due to variety of reasons this is not happening. This issue also needs to be addressed. Parents and the society at large can play a significant role in resolving this issue.

Dalip Singh

There are two types of institutions of engineering education in India- one is for 25 % of students who get employment in the industry after they pass out and the second is for the rest of the 75 % of the students who don't get employment easily in the industry after they pass out. It means that the former type of the institutions of engineering education are already almost seamless and may still require a marginal improvement which they should be able to do. The problem lies in the later type of the institutions of engineering education. These institutions include all those engineering colleges which do not have a required quality of infrastructure and the faculty in position. We can no longer afford to allow these colleges to go on as they are. We need to address this important issue first in our reform movement of the engineering education that the ECI seem s to have launched with organizing these national conventions in the country.

The other issue is of the aptitude for engineering profession. We know full well that without an aptitude for a profession, we cannot have quality professionals in any field- it may be engineering, medical, legal, etc. The current common admission test held for engineering lacks in assessing the aptitude for engineering profession. We should remove this grey area. Second we should have one common admission test for engineering in the entire country for having the same standard of the out put of engineers. We need to address these important issues.

We need to reform the current curricula of engineering education so that it is made right for producing multi-skilled engineers who are in demand today. Suggestions have been made how this can better done. I agree with these suggestions. We also need to deal with the issue of attracting people of right caliber, aptitude, liking and passion for teaching, which also needs to be made quite attractive as a

Shri Dalip Singh is the President, Society of Energy Engineers and Managers (SEEM), Thiruvananthpuram, Kerala.

career. This is the basic issue which needs to be addressed for improving the quality of engineering faculty, apart from developing a mechanism which will monitor continuing professional development of the faculty and their performance regularly for taking corrective steps that are required to be taken from time-to-time. This mechanism can be a part of the regulatory mechanism of the engineering education and training in the country.

I fully agree with the suggestion that there should be only one common admission test in the country for admission to the engineering courses run by IITs,NITs and the other a large body of engineering colleges. The test should also access the aptitude for engineering profession. Intra University or intra college transfers should be facilitated, as is the practice abroad. This will enable a student to study a particular course under a particular recognized specialist of that particular subject.

A Delegate from the Floor

I fully agree with Shri Dalip Singh that the intra university or intra college transfer should be allowed as a matter of policy. Moving from one IIT to the other during the course is becoming possible; and moving from one NIT to the other during the course is likely to follow. This should also be facilitated in the other large body of engineering colleges as a matter of policy via the route of regulation of engineering education and training in the country.

Co-Session Chairman's Concluding Remarks: Dr. R. P. Verma

The reason stated for organizing these national conventions by the ECI is the burning issue of employability of engineers. It means that the present engineering education is not producing engineers who the industry do not find employable as such without further training, which involves avoidable expenditure. What we need to do is to understand why it is so, if it is so. Today, we are in a challenging and changed scenario. We have today national competition, regional competition and international competition. Today, the quality of out put of engineers is very important for meeting these competitions. Second, the quality of faculty who teach engineering is also important today. The quality of out put of engineers and the quality of faculty producing this out put both, by and large, are not of the international standards. We have a large body of engineering colleges which do not have required quality of infrastructure. Our engineering curriculum is not producing employable engineers. We should address these issues. We should give a look at our curricula and method of its delivery and reform these so that these come up to the level of the developed countries. We should clearly identify what kind of skills we need to have in an engineer for jobs in the industry, teaching and R&D. We should than work back and lay down the curricula that we need to have for producing engineers with these identified skills. While delivering the curricula, we should ensure that the concepts involved are cleared with appropriately designed in - course industrial training programme based on some industrial problems.

I fully agree with the view that has been expressed by many learned speakers that we need to develop curricula which will produce multi - skilled practical engineers. The current domain-specific engineers

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are not found adequately skilled as it would have made it possible for the industry to employ them. We need to modify the curricula and innovate its delivery so that it is moved on to do- it - yourself mode. A mandatory in -course industrial project-based industrial training and after- the- course mandatory paid internship of at least six months, if not one year, are the desirable components of the reform of engineering education. The duration of the course also needs to be increased to five years from the present four years for inclusion of the subjects in the curricula from among the other than engineering disciplines such as economics, statistics, management, etc., and paid internship with an industrial unit. We should also think of creating sector-specific branches like infrastructure, construction, ports and harbours, highways and so on.

We have another problem today that a little more than 50 % of our engineers of all branches including even mining engineers are sucked by the IT industry because they are giving these engineers high paid jobs for the work which do not need specifically engineering qualification as such. This is share waste of our human resources. If the industry was job-wise equally attractive for engineers, there would not have been this job-hopping by engineers. Our industry must, therefore, make jobs very attractive for engineers.

Delegate List

1. Shri A. K. Badola
   Sc. 'E', Defence Research & Dev. Org.
   Directorate of Public Interface

2. Shri A. K. Gupta
   Executive Director, Metal Research Centre

3. Shri A. K. Sehgal
   Board of Governor of ECI &
   Member, Institute of Marine Engineers (India)

4. Dr. Abha Kumari
   (Ph.D., M.Sc. (Engg.) IISc, Bangalore)
   Assistant Professor, Dept. of Biotechnology
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5. Shri Anshul Gupta
   Officer-Customer Care,
   Pyroflix (India) Pvt. Ltd.

6. Col. (Retd.) Arun Sharma
   Executive Director
   Consulting Engineers Association of India

7. Shri B. D. Jethra
   Former Adviser (Industry & Minerals),
   Planning Commission of India &
   EC Member, IIM, DC

8. Shri B. Mazumdar
   Advisor, CIDC

9. Dr. B. Bodeiah
   Ex. CMD (BVFCL)

10. Dr. Baldev Raj
    Distinguished Scientist & DIRECTOR
    Indira Gandhi Centre for Atomic Research

11. Prof. Bimal Chaudhuri
    Retd. Pro. Jadavpur University &
    Vice-Principle (Admin.)

12. Shri Chander Verma
    Chairman, Continental Construction Projects Limited & Treasurer, ECI

13. Dr. D. G. Kadkade
    Chief Adviser
    Jaiprakash Associates Ltd

14. Dr. D. G. Roy Chowdhury
    Dean - Mechanical Sciences
    Hindustan Institute of Technology & Science
    (Hindustan University)

15. Shri D. Mazumdar
    Manager-Events,CIDC

16. Shri D. P. Dhal
    Advisor, CIDC

17. Shri Dalip Singh
    President
    Society of Energy Engineers

18. Ms. Deepa
    CIDC

19. Dr. Deepak Bhatnagar
    Head, Centre for International Trade in Technology(CITT),

20. Shri Deepak Singhal
    Officer - Administration & Systems
    Engineering Council of India

21. Lt. Col. Dev Raj (T.A.) (Retired)
    Member,
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22. Shri G. Mishra
    National Project Coordinator (I / c)
    Project Management Cell,
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23. Prof. G. N. Mohanty

24. Dr. G. P. Karmakar
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25. Shri G. P. Raju
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26. Dr. Gur Iqbal S Chauhan

27. Shri H.C. Bhatia
Secretary(Admn.),ASI

28. Dr. Hemant B Naik
Dean, Post Graduate Programmes &
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S. V. National Institute of Technology, Surat

29. Shri J. J. Lal
Chief Engg. (Retd.), CPWD

30. Shri J. N. Goswami

31. Shri J. S. Saluja
National Vice President
Indian Institution of Plant Engineers

32. Prof. K. K. Pande

33. Shri K. L. Mahrotra
Ex. CMD, MOIL

34. Shri K. Lal Kishore
Rectore
JNTUH, Kukatpally

35. Prof. Kaushik Mukherjee
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36. Krisna Kant
Managing Director
Abhhinav Engineering Consultant

37. Shri L. Pugazhenthy
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ILZDA

38. Shri L.R. Bhatia
Member, ICC

39. Dr. M. Imran
Jt. Director, National Council for Cement and Building Materials

40. Shri M. L. Maurya
Sr. Executive Engineer
SCOPE

41. Shri Mahendra Raj
President, IASE &
Vice Chairman, ECI

42. Shri Mukesh Dham

43. Shri Neeraj Gupta
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44. Shri O. P. Gupta
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45. Shri P. K. Chatterjee
Member, IIM

46. Prof. (Col.) P. K. Das
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47. Shri P. Kanthasamy
CSIR, New Delhi

48. Shri P. N. Shali
Director
Engineering Council of India

49. Shri P. R. Swarup
Director General
Construction Industry Development Council

50. Prof. P.B.Sharma
Founder Vice Chancellor
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51. Dr. P.K. Sarkar
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54. Shri Prithpal Singh
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Chairman - Indian Oil Technologies Limited

56. Shri Ramesh C. Satija

57. Prof. S. S. Chakraborty
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58. Shri S. A. Khader

59. Shri S. C. Zutshi
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60. Prof. S. K. Mazumder

61. Shri S. K. Vij
President, Indian Buildings Congress

62. Shri S. N. Murthy
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63. Ms. Sandhya
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64. Shri Santosh Kumar
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65. Shri Satish Kumar
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66. Shama Hyder
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67. Shri U. K. Gupta
General Manager
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68. Shri Udayan Sen
Consultant, SS Associates &
EC Member, IIM Delhi Chapter

69. Dr. Uddesh Kohli
Chairman
Engineering Council of India

70. Prof. V. K. Srivastava
Council Member
Indian Institute of Chemical Engineers

71. Shri V. P. Sardana

72. Shri Vijay Gupta
Sr. Highway Consultant

73. Shri Vinod Kumar Tyagi
Chief Engineer
M.N. Dastur & Company (P) Ltd

74. Prof. Y. Kathuria

75. Shri Yograj Singh
Engineering Council of India

Engineering Council of India (ECI)

Engineering Council of India (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 and 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. It is focusing on the following role and tasks.

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.

ENGINEER'S BILL

ECI has prepared a draft Engineer's Bill for the Consideration of the Government 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	President, Indian Association of Structural Engineers
Treasurer	
Shri Chander Verma	President, International Council of Consultants
Members	
Shri S. Ratnavel	Member, Association of Consulting Civil Engineers (India)
Shri P. S. Sundaram	President, Broadcast Engineering Society (India)
Dr. Naresh Kumar	Advisor, Head - RDPD, Council of Scientific and Industrial Research
Dr. P. R. Swarup	Director General, Construction Industry Development Council
Shri K. K. Kapila	President, Consulting Engineers Association of India
Shri Bharti Siwaswamy Sihag	Joint Secretary, Dept. of Commerce, Ministry of Commerce and Industry
Prof. C. V. Ramakrishnan	Member, Indian National Academy of Engineers
Shri K. K. Kapila	President, Indian Buildings Congress
Shri D. P. Misra	Past President, Indian Institute of Chemical Engineers
Lt. Gen. (Retd.) A. K. Puri PVSM, AVSMI	Chairman, Indian Institution of Bridge Engineers (DSC)
Dr. K. K. Padmanabhan	Chairman, Indian Institution of Industrial Engineering
Shri J. S. Saluja	Member, Indian Institution of Plant Engineers
Shri Dilip Takbhate	President, Indian Society for Non Destructive Testing
Prof. Niranjan Swarup	Executive Director, Indian Society for Trenchless Technology
Shri B. N. Puri	Principal Advisor (Transport), Planning Commission
Shri R. S. Prasad	ADG (Trg), CPWD, Ministry of Urban Development & Poverty Alleviation
Gp. Capt. (Retd). H.C. Bhatia	Secretary (Admin), The Aeronautical Society of India
Dr. Baldev Raj	Past President, The Indian Institute of Metals
Prof. K. Rajgopal	Chairman, The Institute of Electrical and Electronics Engineers Inc.
Lt. Gen. (Retd.) Ashok Agarwal PVSM	President, The Institution of Electronics and Telecommunication Engineers
Shri Ashok K. Sehgal	Member, The Institute of Marine Engineers (India)

(As in November, 2009)

Executive Committee

Dr. Uddesh Kohli *Chairman*	Chairman Emeritus Construction Industry Development Council
Shri Mahendra Raj *Vice Chairman*	President Indian Association of Structural Engineers
Shri Chander Verma *Treasurer*	President International Council of Consultants
	Chairman Construction Industry Development Council & Indian Society for Trenchless Technology
Members	
Shri K. K. Kapila	President Consulting Engineers Association of India & Indian Buildings Congress
Shri P. R. Swarup	Director General Construction Industry Development Council
Lt. Gen. A.K. Puri, PVSM, AVSM (Retd.)	Chairman Indian Institution of Bridge Engineers (DSC)
	Invitee
Lt. Gen. Ashok Agarwal, PVSM (Retd.)	President The Institution of Electronics and Telecommunication Engineers
Shri P. N. Shali	Director Engineering Council of India

Glimpses of 5th National Convention

Dr. Uddesh Kohlui, Chairman, ECI delivering the Welcome Address

Prof. P.B. Sharma, Vice Chancellor Delhi Technological University delivering the Inaugural Address

Dr Baldev Raj, distinguished Nuclear Engineer-Scientist & Director, IGCAR, Kalpakam,TN addressing the delegates

Shri S.K. Vij, President, Indian Building Congress Chairing the Session - I

Dr. G.P.Karmakar,Professor in Petroleum Engineering Rajiv Gandhi Institute of Petroleum Technology, Raebareli addressing the delegates

P.N.Shali, Director, ECI delivering the theme address

A view of the audience

A delegate making his points during the open session.

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. Consultancy Development Centre
5. Construction Industry Development Council
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 The IABSE
16. Indian Society for Non Destructive Testing
17. Indian Society for Trenchless Technology
18. Institute of Urban Transport (India)
19. International Council of Consultants
20. Institution of Mechanical Engineers (India)
21. The Aeronautical Society of India
22. The Indian Institute of Metals
23. The Institute of Electrical and Electronics Engineers. Inc., India Council
24. The Institute of Marine Engineers (India)
25. The Institution of Civil Engineers (India)
26. The Institution of Electronics and Telecommunication Engineers
27. The Institution of Surveyors