Engineering Council of India

6th National Conference on Re-engineering Engineers

November 28, 2008

Main Auditorium
India Habitat Centre, Lodhi Road, New Delhi

Proceedings

Organised by :

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6th National Conference on Re-engineering Engineers

Introduction

It is often said that the current engineering education system does not prepare engineers for the role of project engineers and managers. Engineers need a familiarity with the world of business and commerce, dealing with people and resources, environmental, health and safety aspects, legal aspects, project, logistics and procurement engineering, application of IT and communication technology, learning the finer elements of contracts and claims, apart from the changing world of technology itself. All engineering activities have economic implications. Engineers need to be able to analyse the economic aspects of engineering applications. This empowers engineers to make well-reasoned decisions in analyzing personal decisions as well as business, technology and informed conclusions about public policy based on a comprehensive analysis of costs and benefits of alternatives. The present and constantly evolving economic and business environment need project leaders. For this, engineers today have to be multi-skilled. Trends across the world depict the rise in demand for reengineering engineers for meeting the needs of the industry.A greater impetus to this cause can be provided if the leaders of Indian industry, professional associations / societies / institutions coupled with academic establishments like IITs, NITs, etc, join hands for tackling these issues.

Engineers, who come out of engineering colleges, are engineering discipline-specific and do not have sufficient knowledge to start working straightway on their jobs in an industrial unit. We have working engineers who often get stuck up in the domain-specific jobs and do not move out to acquie multiskills required today for meeting the changing needs of the engineering profession. We, therefore, need re-engineering of both working engineers and graduate engineers. We also have potential engineers in persons holding diploma in engineering. They need re-engineering to tap their engineering potential for meeting the rising demand of engineers. We have, at the base level, engineer technicians. They are also individuals with engineering potential. We need to re-engineer them as well.

The 6th National Conference on the theme Re-engineering Engineers was organized to consider these issues in depth for evolving a working strategy and system for Re-engineering of Engineers.

PROGRAMME

0830 - 1000 Hrs	:	Registration
1000 - 1100 Hrs	:	Opening Session
Welcome Address	:	Dr. Uddesh Kohli
Theme Address	:	*K. K. Kapila*, President, CEAI, President Indian Buildings Congress and Managing Director, ICT Pvt Ltd, New Delhi
Address by the Guest of Honour	:	*Dr. Ashok K. Chauhan*, Founder President, Ritnand Balved Education Foundation (RBEF), the Foundation of Amity Institutions and Chairman, AKC Group of Companies
Address by the Chief Guest	:	*Dr. Bhalchandra Mungekar*, Member Planning Commission, Government of India
Vote of Thanks	:	*S. Ratnavel*, CEO, Sceba Consultancy Services, Madurai and Member Board of Governors, Engineering Council of India
1130 -1230 Hrs	:	TECHNICAL SESSION - I
Theme	:	*Re-engineering Engineers - Views from the Industry*
Chairman	:	*Mahendra Raj*, President Indian Association of Structural Engineers
Co-Chairman	:	*Lalitha K Prasad*, Head , Delivery Centre, Tata Consultancy Services, Trivandrum
Keynote Speakers	:	*Ajay Poddar*, Senior Member of PHD Chamber Managing Committee and Managing Director, JCL International Ltd, New Delhi
	:	*Dr. Ing. N. Rajagopalan*, Head Technology Development & Chief Technical Advisor-Bridges, L&T-Ramboll Consulting Engineers Limited, Chennai
	:	*Suresh Panampilly*, Senior Consultant and Head, the Initial Learning Programme at Tata Consultancy Services, Trivandrum
		Discussions

1230-1330 Hrs	:	TECHNICAL SESSION-II
Theme	:	*Re-engineering Engineers - Views from Academia*
Chairman	:	*G. Sharan*, Chairman, Indian National Group of IABSE & DG (RD), Min. of Shipping, Road Transport & Highways
Co-Chairman	:	*Dr. P. K. Sarkar*, Hony. Secy., IUT, New Delhi
Keynote Speakers	:	*Prof. B. B. Dhar,* Senior Vice President, Ritnand Balved Education Foundation , former Director Research AIU, former Head of the Department of Mining and Metallurgy, BHU and Director, CSIR
	:	*Prof. Priyavrat Thareja*, Punjab Engineering College, Chandigadh (Deemed University)
	:	*Prof. Javed Husain*, Department of Applied Physics, Zhakir Husain College of Engineering And Technology and Head Business Development Group
	:	*Alok K. Ghosal*, Projects (VE), Engineering & Projects Division , Tata Steel
		Discussions
1330–1430 Hrs	:	Lunch
1430–1530 Hrs		TECHNICAL SESSION-III
Theme	:	*Re-Engineering Engineers - Views from Professional Associations*
Chairman	:	*Lt. Gen A. K. Puri*, PVSM, AVSM (Retd.), the Chairman, Indian Institute of Bridge Engineers (IIBE), DSC and former Director General, Boarder Roads Organization
Co-Chairman	:	*Group Captain H. C. Bhatia*, the Secretary (Admin), the Aeronautical Society of India
Keynote Speakers	:	*L. Pugazhenthy*, President, Indian Institute of Metals and Executive Director, ILZDA
	:	*S. Ghosh*, Vice-President of Indian Association of Structural Engineers & Managing Director, Consulting Engineering Services P. Ltd, New Delhi

		: *K. K. Agrawal*, Chairman and Managing Director, K. K. Agrawal & Associates Pvt. Ltd. and Member, CEAI.
		Discussions
1530 – 1630 Hrs.		PANEL SESSION
	Chairman	: *L. Pugazhenthy*, President, Indian Institute of Metals and Executive Director, ILZDA
	Co-Chairman	: *Dr. Jose Kurian*, Vice President, ICI(N) & Chief Engineer,DTTDC, New Delhi
	Panelists	: *Prof. Ambuj Sagar*, IIT, Delhi
		: *S. S. Chakraborty*, Chairman & Managing Director, Consulting Engineering Services (India) Private Ltd.
		: *Dr. Deepak Bhatnagar*, Adviser, Technology Information, Forecasting & Assessment Council (TIFAC)(Department of Science & Technology, Government of India)
		: *Dr. K. G. Bhatia*, CEO, Delhi CAD Technology
		: *Vijay. K. Saluja*, Senior Fellow Urban Studies Institute of Social Sciences, New Delhi and former Chief Engineer (Civil), NDMC
	Concluding Remarks	: *P. R. Swarup*, Director General, CIDC
1630 - 1700		: Coffee / Tea

Recommendations

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Recommendations

1. Re-engineering of engineers implies to re-engineer their skills for meeting the challenges of emerging global scenario and taking part in trade in engineering services opening up of which is round the corner. Today, a person, who acquires a degree in engineering from an engineering college or university, does not become an engineer with skills that the present global scenario demands. All engineers involved in practices such as teaching, research or working in industries or in the governmental or regulatory bodies need re-engineering.
2. Just like other professions, engineering has now-a-days become multi-disciplined and multi-directional. Today, engineering involves men, materials, machines and energy. Engineering, therefore, requires the creative imagination to innovate useful applications of the natural phenomena. Creativity or innovation in engineers is today's need. They are required to optimize on using natural resources of energy and materials to meet the growing competition. They have to handle mega-projects of integrated technologies and designs.
3. Today, engineers need to have visualization / spatial ability skill through their cognitive lateralization which increases creative and innovative capability, enhances performance encompassing engineering design, mathematical and CAD activities.
4. Development of communication skills among engineering students / engineers should be attached topmost priority as their workplace requires it for their effective functioning. Likewise, group working skills assume priority over academic ability.
5. For better employability of engineers, curricula at the undergraduate level need to be re-engineered by introducing courses on communication and information technology, interpersonal skills such as working with others, problem-solving including critical and lateral thinking, reflection and objective reasoning, positive attitude to change including understanding of the arena of work, group- and team-working abilities, project management and other generic skills coupled with the development of a flexible learning environment leading to inculcation of pedagogic integrity, etc.
6. The engineering curricula also need to be re-engineered for making them purposeful in the field-application by incorporating skills and experience concerning environmental sustainability and social concerns. Disaster management needs to be incorporated in the engineering curricula.
7. The engineering courses should address important issues such as unsatisfactory attrition rates between the various engineering programmes, the national changing requirements for registration as a Professional or Chartered Engineer, need to manage and control faculty input to course delivery.
8. Engineering students and aspiring young engineers should be given increasing responsibility for taking charge of their own studies and the engineering courses should be open-ended, constructive, inventive and investigative coupled with assignment-work involving groups of students.
9. Commitment to life-long learning and continuing professional development assumes priority over the theoretical contribution to research-focused projects.
10. Efforts should be made to restrain the engineers from moving out of engineering into areas like finance, marketing, human resource development and so on.

11. As a part of re-engineering engineering education, one may also consider the need for having one composite degree in engineering and management.

12. The associate membership certificates awarded by the various member associations of the ECI need to be recognized by some university so that persons having these certificates become equal in academic sense with that of a degree-holder in engineering from a recognized university.

13. The engineering consultancy should be attached importance by bringing about a change in the Indian mindset. Practising engineers and engineer-consultants should also be involved in teaching. They will bring a very rich experience in teaching and setting syllabus and will not be competitors of the main faculty. It will help in building up of the much needed Industry-Academia partnership.

14. India should become a leader of knowledge economy through enhancing the standards of the engineering education in the country.

15. The culture of accountability, leading to the culture of sincerity in the profession, must be infused in the engineering institutions.

16. The foreign direct investment in the field of Indian engineering education system should be encouraged with a view to reducing the high financial expenses involved in it.

17. The indigenous engineering education system should also be consistent with the requirements of the developing and growing economy and the emerging democratic polity.

18. There is a clear requirement for a significant staff development initiative so as to cope up with the industry challenges. The staff development initiative, therefore, needs to move away from teacher-led activity to facilitating and supporting the learning process, encouraging and developing skills within students thereby allowing them to become independent learners, promoting and developing generic key aspects of sustainable employability and accommodating the realization that the student expectations will increase as and when they are required to contribute financially towards the cost of their higher education.

19. Engineers must be able to understand and have appreciation of the legal and statutory provisions guiding his / her work, obligation to the society and accountability, risks and rewards of his / her work, codal provisions – IS / BS / NB Code / ISO, quality assurance needs and safety and health requirements.

20. Acquisition of additional skills concerning the core professional value such as creativity, clean environmental sustainability-cum-development, societal benefits, etc. is essential for all professionals before they can start practising their profession.

21. Re-engineering engineers requires the immediate attention of the various statutory bodies, academics and bureaucrats involved in the engineering education with a view to considerably enhancing the employability of the passing-out engineers.

22. The Draft Engineers' Bill should be converted into an Act without further lapse of time in order to provide necessary statutory backing to the engineering profession.

23. A mechanism for facilitating the exchange of professionals for short periods between academic institutions and industry should be worked out so as to provide an opportunity for the them to have a hands-on experience of the "other side of the fence". For this purpose, a cross-functional team should be constituted to work out the modus operandii.

Executive Summary

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Executive Summary

India has the unique distinction of having a large stock of engineers. After passing out when engineers come to the industry, they lack in the desired engineering and other skills; they have hardly any knowledge and, therefore, they are not able to give to the industry what is expected out of them. They lack in managerial part, strategic approach, and behavioural sciences approach. No institution in the country teaches them foreign languages.

Engineers, as professionals, continue to remain focused in their chosen areas of specialization and complacent meeting the production or quality targets only, keeping their eyes completely closed to the other areas. Engineers remain insulated, by and large, from the modern and emerging subjects and techniques in HR development, financial management, business management, marketing and sales management. They lack, by and large, the basic knowledge in finances and a large number among them cannot not even read and interpret the balance sheets. Today, a fresh engineering graduate does not know what is an economy and what is meant by society and he / she suddenly gets absorbed in an industry which has to deal with the shareholders, suppliers and customers, etc. As such, they are not ready to take up various assignments. Mckinsey Report presents the startling reality that nearly 25% of the graduate engineers coming out of the engineering colleges in India are employable. Primarily, this is because of the quality of engineers that are coming out of engineering colleges. What is happening in engineering is a reflection of what is happening to the education system as a whole in the country.

Today, we are in a different kind of world economic order, which is wide open and of competition from overseas suppliers. In this economic environment, engineers must be able to understand, appreciate and have full knowledge of the usage of the end products (functional requirements of what they have to produce), financial constraints - budgets and other commercial requirements, project execution time, legal and statutory provisions guiding their work, obligations to the society and accountability, risks and rewards of their work, codal provisions - IS / BS / NB Code / ISO, et. al., ISO – quality assurance needs and safety and health requirements, knowledge of formulating projects, conducting feasibility studies, detailed project reports, managing construction of mega and multi dimensional projects ,etc.

Engineers should also have or acquire full knowledge on sustainable use of materials, relevant environmental concerns, construction techniques, skills for programming and control of project implementation and the routes and forms of construction contracts and, most importantly, they must have communication and inter-personnel skills -which are a must to be able to express their viewpoints and make others understand and appreciate the same. Further, an engineer should understand the project environment and the project-sponsor's needs. For example, when talking from structural engineer's point of view, a structural engineer should know structural stability, durability, aesthetics, analysis and design of structures – software applications and follow the global shift from deterministic models to probabilistic models and reliability-based design criteria.

Recounting the sins in educational system, it evidences that the largest and the most dominant in-competency in engineering education is that the inputs are not aligned with the outcomes. Traditional engineering programmes contain significant elements of the curriculum which the

graduate engineer will seldom use. The educational and merit evaluation systems that we have inherited have not been revalidated with the ever changing needs of the economy and society, which demands today multi-disciplined, multi-skilled and multi-directional engineers. Engineers, therefore, need to change their attitude and thinking and embrace the change that needs to be embraced. The policy should encourage it.

The engineering graduates today are, therefore, expected to exhibit totally different range of skills from their fore-bearers. The workplace for engineers often demands high communication skills more often than high level of mathematics, group working skills more importantly than academic individuality, and a commitment to lifelong learning and continuing professional development, in most cases, offers more to employers' than a theoretical contribution to research focused projects and developments. The engineer must also exhibit a range of skills and experience which differ immensely from those of the past.

It has been observed by many that instead of narrow specialization in specific areas of engineering, there is a need for multi-skill approach so that engineers can do several tasks as required by the industry. Today, the engineering education system needs to consider multi-tasking and multi-disciplinary curriculum for the engineers. Merely, the basic knowledge of physics, material science, theory of structures, machines, multiplicity of analytical models and the like will not do.

The present education system does not give knowledge for the economically viable, aesthetically pleasing and socially acceptable solutions to the practical industrial problems as the curriculum is prepared by the academicians who are not bothered about the practical industrial aspects. The academicians do not normally see the industry right from the day one. In foreign countries, it is not so.

Today, engineering colleges, particularly after privatization, have mushroomed in many cities and towns of the country. Many of these colleges do not have the required infrastructural facilities like machines, computers and even roof, etc. Many engineering colleges operate without requisite strength and quality of faculty. For improving the education effectiveness, therefore, we must have an evaluation system. We don't have an evaluation system.

We should also look at the deficiencies that are there in our higher educational system, particularly higher technical education. Perhaps, these deficiencies have crept in partly from the current regulatory mechanism represented by the government bodies like the UGC, AICTE and multi-level state government bodies. Perhaps, time today demands that the education sector should not remain in the hands of the government. If Amity and other educational institutions in the private sector are doing well today, it is because they are free enterprises. A minimal intervention in the process of education, however, is desirable. We need to spell this out clearly and implement it.

There is, therefore, an urgent need to re-engineer engineers with a view to producing holistic engineers, who are masters of all required trades, by programming the optimal utilization of the resources of the educational institutions. It is very important to make engineers employable and giving just a degree of engineering to them will not do. More so, the Employees Federation of India (EFI) foresees a severe shortage of skilled workforce (read engineers) a few years ahead which would seriously retard growth if left unaddressed. The only way to forestall this possibility is a complete overhaul of the present engineering education system to synchronize it with the growth of global

technological developments. Re-engineering engineers is hence essential, to enable them deliver the goods in the current global scenario.

Re-engineering has emerged as the basis for many recent developments in management. The cross-functional team, for example, has become popular because of the desire to re-engineer separate functional tasks into complete cross-functional processes. Re-engineering conceptually empowers new creativity in problem solving using radical rethinking to meet stated objectives optimizing current technologies. While the engineering graduates accurately foresee compelling requirements of near future and determine requisites to realize them, re-engineering presents itself as the preamble to conform the students to forecasted requirements. How should we go about it is the important question.

The subjects which are not found in the current engineering curricula at all include subjects such as project proposals & feasibility study, preliminary surveys, socio-economic aspects in project planning, environment assessment and management, construction methodology, planning & equipment, construction management, logistics of works and inventory management, human resources planning and management, cost analysis of projects, project monitoring with MIS, finance engineering together with rules and regulations of the country to ensure safe design for safety, statutory regulations for companies with labour involvement and contracts, contract management inclusive of legal issues.These are the subjects which should be taught in the every engineering branch. Specifically, engineering colleges, as a part of their teaching, need to introduce additional curricula for the development of new skills such as communication, information technology, economics, statistics, interpersonal skills , problem solving skills, critical and lateral thinking skills, presentation skills, reflective and objective reasoning skills, positive attitude to change including understanding of the arena of work, politics and society and so on and develop the urge to keep learning even after leaving the portals of the institute.

The other skills an engineer is supposed to be conversant with include logical reasoning, problem-solving, process-orientation, communication and programming fundamentals, knowledge of economics and law, etc. The subjects to be introduced and emphasized should be such as are relevant and purposeful in field applications. Developing group and team working abilities, project management and other generic skills in engineers should be the central focus of our engineering education for their better employability. There should be active interaction with the teaching institutions and the industry with a view to imparting the required skills to the engineering students.

The present engineering curricula (syllabus) tries to provide only the knowledge base and the professional part is left to the candidates to learn it during professional experience itself. It is desirable to give an insight of the same even when the candidates complete their programme and enter into the profession. We need to integrate engineering disciplines and also adding to the syllabus subjects from the social disciplines. The courses from the other specializations like law, economics, project management, finance management, communication, accountancy, managerial economics, production management, investment management, international marketing of engineering products, etc, need to be included at the level of undergraduate engineering education which will enable the students acquire desired additional skills at the college level itself. With this done, engineers will straightway become suitable for their jobs in the industry. There is a need, therefore, to re-

engineer the engineering curriculum and bring in more flexibility, inter-disciplinary perspective and choice of electives in it. The engineering curricula need to be updated on a regular basis.

The engineering students should be required to work on the practical projects involving also collecting the data from the field. When after doing such type of exercises during the course, the engineering students will feel very comfortable when after passing out they go to the industry, which will find them employable. When the doctors can go for internship in order to have the sound knowledge of their profession, why should not engineers go in for practice from day one? Why do we not allow that because there is dearth of engineers? Universities must be able to take care of all these by introducing the concept of professional engineering. Internship should be introduced in engineering. It should be made compulsory before granting the degree. The period can be discussed and decided.

Engineering curricula were earlier modified by introducing space and information technology at the cost of some deletions and dilutions. It is better to introduce special level courses for serving engineers which could be termed as a professional engineering programme leading to a diploma in P.E. (Professional Engineering). All professionals should have to have a qualification called P.E. which covers up the relevant topics. Those with only the basic engineering degree may be allowed to practice the profession but only under these professional engineers. The syllabus could be drawn, discussed and agreed to.

The curricula for engineering education should be based on a consensus of academics and industry and practising engineers. The learning pedagogy needs to be modified to place more emphasis on self-learning and problem-solving. Fresh graduates lack a strong ethical foundation. Introduction of ethics as a subject in engineering education in universities needs a serious consideration. There is a need for close interaction between Industry and academia to bridge the gap between the industry needs and the competency level of fresh graduates.

Tata Consultancy Services (TCS) has regular interactions with academic institutions. These interactions cover feedback on performance of their graduates. Possible lines of action of mutual benefit are discussed. The parameters on which the performance is measured are common training (which measures the ability to assimilate programming and software engineering concepts), oral and written communication skills (before and after induction) and stream training (which measure the ability to grasp technology concepts). There is a strong need to improve the ability to communicate (oral & written) and there are no major differences in the communication ability of graduates across different regions.

In the Indian context, theory and practice are totally divorced; and that is why, it is necessary that the practitioners in industry are actually involved in the teaching profession. Industry-Academia partnership does not necessarily mean only investment in finance but it means involvement and partnership at all levels of the educational process. Inter-disciplinary approach to engineering education is extremely important. The consultancy in India is not very much regarded or recognized. We are doing a lot of consultancy overseas. Because in foreign countries they know what consultancy brings but in India, this mentality / aptitude is not there.

Teaching and training procedures and practices followed till now by the institutions have become out dated. The emphasis on too much theory and little practical will not work now. It will have to change. The teaching should not remain confined to the classrooms only, as is the case generally at present.

Industry must play the proper role in the area of engineering education. The professors must teach what the industry wants. The industry must, therefore, take the initiative in deciding the framework of the syllabi of the engineering courses with a view to delivering the proper output. The practical conditions, in which the students will be working after passing out, must be taken into consideration. Besides, engineers should get the degree after working for at least six months in the industry.

In order to be able to correctly visualize what is needed by the industry, the teachers must be more than competent. If he / she has practical experience of the industry, it is only then that he / she can prepare his / her students according to their systemic needs. If the product from education sector is required to emerge as robust, the academic process must be strengthened for its design-abilities. We must include some questions in the common entrance test for students aspiring for engineering profession which will find whether they have aptitude and liking for the profession. We have to have an effective and efficient interface in research between educational institution and industry.

The county has different scales, but no real scale to measure the competency of the engineers that we produce. Merely opening of an institution with the license does not fulfill the requirement of the growing demand for good, competent engineers. We need an organization like the Engineering Council of India (ECI), therefore, that can take up this challenge of the performance evaluation of the engineering graduates and provide: (a) feedback to the academic institutions across the country, (b) take critical decisions regarding the process of hiring in the professional field, (c) keep on helping and updating the various training programmes on a national base. An organization like ECI should, therefore, help in the development of modern curriculum at higher and senior levels after creating an engineering base for the students so that the stakeholders can be benefited both in terms of talent and utility. It is high time that something like professional engineer's license like the one prevailing in North America be introduced in India, but not on the state – to -state basis, only on all India basis across the country. This will help to produce a uniform code of dedicated capability and professionalism in our engineering graduates and the profession. Both aspects of lateral and vertical grooming of students in engineering and emotional intelligence (elevation) should be catered to in the new state of educational process. There is thus a need to re-engineer our engineering educational schemes such that the system is robust and potent. The teachers must also develop all-round competence.

There should be a change in the technical books. All technical books contain theoretical problems. There is hardly any book which really talks of real-life technical problems. Books should be there on real life case studies from the industry. Engineering curricula should also have subjects on real life problem solving through case studies. Engineers from the industry can better teach this subject. The faculty for this should, therefore, be of practicing engineers from industry and eminent individual engineering consultants.

The advent of nanotechnology can lead to a major re-engineering paradigm shift. It involves manipulation at the molecular or nano-particles. The finished product based on this approach is of far

superior quality and there is minimum wastage of the raw materials as well as energy. It would be wise for different Indian organizations to introduce emergent technologies courses consisting of almost fifty percent of nanotechnology while also covering some other areas as well. It would be wise for different Indian organizations to introduce emergent technologies courses consisting of almost fifty percent of nanotechnology while also covering some other areas as well. Our engineering colleges and polytechnics need to take the initiative in developing these needed courses.

The All India Council for Technical Education Council (AICTE) should conduct only one entrance examination for admission in engineering colleges throughout the whole country. It may, however, consider giving the franchise to the engineering Council of India.

Opening Session

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Welcome Address

Dr. Uddesh Kohli

This conference is the Sixth National Conference of the Engineering Council of India. I will recollect how ECI was formed in April, 2002 as an apex body or a federation of the Engineering Associations and Societies in the country. The initiative for formation of this Council was taken by Shri K. C. Pant, who is also an engineer and who was then the Deputy Chairman, Planning Commission who took a meeting where the formation of this Council was discussed. It was observed that there are several professional institutions of engineers but we do not have one body to represent all of them. It was felt that we should have an apex body of engineers which can take up several tasks identified at that time, such as how to bring accountability, how to make engineers responsible and how to make sure that the society does not suffer because of any engineering problem or mistake. For example, the earthquake in Gujarat saw the collapse of many buildings leading to major destruction / loss, some of which was attributed to faulty design and so on and there was no mechanism to hold engineers accountable and take action. A parallel was drawn from other professions like Medical, Architecture, Dentistry, Chartered Accountancy, etc., which had statutory bodies to take care of such aspects. The second aspect, which is very relevant even today, is that there is no legal recognition of the engineering profession and statutory regulation of engineering practice in the country as such. Therefore, engineers from other countries 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 we thought that we have to join international agreements like the EMF and Washington Accord. It was felt, therefore, that a 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. It was in response to these needs that it was decided to form the Engineering Council of India (ECI).

For the last six years, ECI has been working on many of these aspects. For the legal recognition of the Indian engineers, we had intensive consultations and drafted the Engineers Bill which was submitted to the Ministry of HRD in September, 2004. The Ministry constituted a Committee which went through the draft Bill and submitted a report to the Ministry. The Ministry later said that there must be wider consensus amongst the engineers on the subject. So, more meetings took place and we also had the involvement of Mr R V Shahi, former Power Secretary. After a lot of consultations, another draft of the Engineers Bill was submitted to the Ministry in May 2007. We are still awaiting the consideration of the Bill by the Parliament.

In the meantime, ECI has been working on other issues. It has been observed by many that instead of narrow specialization in specific areas of engineering, there is a need for multi-skill approach so that engineers can do several tasks as required by the industry. So, the education system needs to consider multi-tasking and multi-disciplinary curriculum for the engineers today. We had three national conventions on the seamless engineering education for the better employability of engineers at Kolkata, Baroda and Hyderabad where representatives from the industry and the academia took part very actively. They felt that the engineering education curriculum needed a re-look with a view to meeting the requirements of the industry and the society. It is in this context, that this conference with

Dr. Uddesh Kohli is the Chairman, Engineering Council of India & Chairman Emeritus, Construction Industry Development Council and Chairman, Construction Industry Arbitration Council.

the theme Re-engineering Engineers has been organized, with focus on both the fresh as well as the working engineers.

We are really grateful to Dr Mungekar, Member, Planning Commission, who has very kindly agreed to be the Chief Guest and to inaugurate the conference. We are also grateful to Dr Chauhan who has kindly agreed to be here on a short notice. Dr Chauhan has a very good influencing factor on the engineering education in the country. We are confident that we would be able to work on the changes in the engineering education and profession needed by our country and the society.

Theme Address

K. K. Kapila

India has the unique distinction of having a large stock of engineers. However, they lack the desired engineering skills because of lack of facilities and appropriate faculty in a number of colleges. As such, they are not ready to take up various assignments. This is a reality. Re-engineering them is hence essential, to enable them deliver the goods in the current global scenario. Re-engineering can be described as the fundamental rethinking and radical redesigning of operations, manufacturing and business processes, in order to achieve significant improvements in performance, efficiency and quality. To improve efficiency and performance in engineering design and manufacture, a variety of strategies may need to be employed. These strategies will normally scrutinize the weak areas and redesign all the contributing elements of an engineering activity, except the engineer. Re-engineering has emerged as the basis for many recent developments in management. The cross-functional team, for example, has become popular because of the desire to re-engineer separate functional tasks into complete cross-functional processes. Also, with the advent of developments in the information system, it has become possible to integrate a wide number of business functions, such as:- Enterprise Resource Planning, Supply Chain Management, Knowledge Management Systems, Groupware and Collaborative Systems, Human Resource Management System and Customer Relationship Management systems, all stemming out from the re-engineering theory.

When the fresh engineer goes to the field after coming out of the college, he / she finds himself / herself lost due to the lack of engineering skills. There is a need to teach him / her about the today's working strategy, interpersonal skills and so many other things. The engineering graduates of the future are expected to exhibit totally different range of skills from their fore-bearers. The workplace for engineers often demands high communication skills more often than high level of mathematics, group working skills more importantly than academic individuality, and a commitment to lifelong learning and continuing professional development, in most cases, offers more to employers than a theoretical contribution to research focused projects and developments. Students have become more thoughtful and focused about their career aspirations. They demand more opportunity to enhance their educational development than has ever been in the past. The engineer of the future must exhibit a range of skills and experience which differ immensely from those of the past. Traditional engineering programmes contain significant elements of the curriculum which the graduate engineer will seldom use. Mathematical excellence seems an obsession of engineering programme, however in reality a

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much less demanding level of mathematical ability is needed. There is a need, therefore, to re-engineer the engineering curriculum. The subjects to be introduced and emphasized should be such as are relevant and purposeful in field applications. New paradigm of environmental sustainability and social concern are emerging important issues, for which, engineers need to be well-equipped. Redesigning the portfolio of syllabus in the engineering colleges has to be very consciously done, merging the student's aspiration with employer's demand. Developing group and team working abilities, project management and other generic skills in engineers should be the central focus of our engineering education for their better employability. This should be coupled with the development of a flexible learning environment where attention to pedagogic integrity is inculcated in training and development programs. Engineers need to be trained and developed to be independent learners. In doing so, emphasis has to be given to academics interwoven with peer assessment, integrated development, measurement of learning outcomes, goal setting, flexible learning and employment skills. There is a need to recognize the working culture, and introduce new teaching and learning practices. Today, introducing a culture change together with the convergence of several other factors in the same period of time poses a major challenge. There should be active interaction with the teaching institutions and the industry with a view to imparting the required skills to the engineering students.

We find that engineers are moving out to non-engineering areas like software industry, finance, marketing, human resource development and so on. Undoubtedly, there is a need to have competent professionals to work and cope up with ever rising demand in these areas. At the same time, it is not prudent to lose the bright engineering graduates to these areas. We need them for applying their knowledge and skills in the working of engineering designs, planning and implementation of engineering projects, in the manufacturing sector and so on. Obviously, employability and value of financial package attract bright engineers to work in areas away from the engineering profession. It is, therefore, necessary that the industry and employers must consider making the value of financial package for engineers in their own field more attractive and rewarding so that engineers are discouraged from moving out of engineering profession to these areas. There is a need to develop a certain sense of pride amongst engineers to remain working in the engineering profession for its growth, development and sustainability. Engineering Colleges, as a part of their teaching, need to introduce additional curricula for the development of new skills such as communication, information technology, economics, statistics, interpersonal skills , problem solving skills, critical and lateral thinking skills, presentation skills, reflective and objective reasoning skills, positive attitude to change including understanding of the arena of work, politics and society and so on and develop the urge to keep learning even after leaving the portals of the institute. Many aspects need to be reworked out to see that engineers get retained on the engineering side. The engineers must take pride in their profession. If you are not being able to bring good engineers, your design will not be the optimum design. For this, the engineers must be paid suitably. The quality cannot be optimum if you bring engineers at the cheap rates. These are the issues we which need to ponder over for correcting the scenario.

It is a known fact that “Student learns more effectively when they are actively involved both in the learning process and in the processes of the discipline. An increasing responsibility should be given to the student and young engineers for taking charge of their own studies. The curricula should be open-ended, constructive, inventive and investigative together with assignment work involving groups of

students. Some very hard decisions have to be made when deciding the philosophy, aim and objectives and thrust of new engineering programmes. Skill up gradation of the engineers coming out of the engineering colleges is required at the all stages of their career as they progress. This aspect assumes more importance as the requirements of the industry keep changing and the advancements in the industry keep on moving ahead. Any broad scheme, which is developed to meet such challenges, must be able to efficiently support a number of programmes by sharing learning material (courses) from a limited pool. The broad scheme, therefore, should address and embrace: unsatisfactory attrition rates, the national changing requirements for registration as a Chartered Engineer, a need to manage and control faculty inputs to course delivery within the confines of what is economically justifiable, a clear requirement for a significant staff development initiative so as to cope with the industry challenges, the need to move away from teacher-led activity to facilitating and supporting the learning process and encouraging developing skills within students, which allow them to become independent learners, promoting and developing generic key aspects of sustainable employability i.e. team working, communication and presentation skills, etc. and accommodating the realization that the student expectations will increase as and when they are required to contribute financially towards the cost of their higher education. Flexibility of learning is supported through the adoption of open and distance learning methods. Skill up gradation has to be a continuous phenomenon if we have to maintain our rightful place in the engineering field at the international level.

The meltdown would not affect us if we deliver the right product. In fact, we should look at the opportunity in this meltdown. We should synergies our energy to deliver the requirements which even the developed countries cannot deliver. We have a very large scope in the African continent where the engineering activities are going on at a very fast pace. We have not learnt to work in synergy. We are our own enemies pulling one another's legs. We take pride in derailing our colleagues just to climb up. This must stop. This negativity is one of the biggest diseases we have been suffering from. This mindset must be cleared. Let us re-engineer ourselves today. Let us take a pledge today that we shall have only positive and no negative attributes.

Ministry of Finance has published the guidelines for selection of consultants on cost-cum-quality basis. I would suggest that the ECI should try to have a copy of the Ministry's circular and accord high publicity amongst various stakeholders.

Address by the Guest of Honour

Dr. Ashok K. Chauhan

I am very happy to see so many veterans from the engineering profession in front of me including the young and dynamic engineers also. I have gone through the activities of the Engineering Council of India (ECI) before I came here. I have gone through the list of the 25 (Twenty-five) member associations and I saw the distinguished list of the Board of Governors. It is a real pride for all of us that the Engineering Council of India has invited Dr. Bhalchandra Mungekar, Member, Planning Commission, to inaugurate this function as the Chief Guest. I know Dr. Mungekar ji well. Ever since we

Dr. Ashok K. Chauhan is the Founder President, Ritnand Balved Education Foundation (RBEF), the Foundation of Amity Institutions and Chairman, AKC Group of Companies.

invited Dr. Mungekar in our Saket campus, I have been waiting for an opportunity to invite him again. He gave very useful ideas and my people started implementing these ideas. So, it was a great privilege to sit near him today. I know Dr. Uddesh Kohli ji for very long. Wherever he is, maybe with the Planning Commission or Chairman, SCOPE or industrial corporate world, I have found him to be very mission-oriented person. So, when he told me that I have to come in this august conference, I could not reply in the negative because he commands so much respect and affection from me. But, this gave me an opportunity to know more about the activities of the ECI. I would say that the ECI has been doing a wonderful job. I do not think any other body in the country is so much worried about the aspects with which ECI is dealing with. Our very worthy, Shri Kapila ji, brought some very useful and pragmatic points which need immediate attention from the political parties, from the statutory bodies, involved in the engineering education and also from the bureaucrats. He very rightly told that a lot of things need immediate attention. For example, he told that the syllabus, i.e., what is being taught in the engineering colleges, requires to be seriously revised. We have more than 12,000 students in engineering in about a dozen different disciplines at our four campuses (Delhi, Noida, Lucknow and Jaipur). So, I very well know what is the syllabus prescribed by other universities and what should be the syllabus. It is very important to make them employable and not just giving a degree of engineering to them. There are a few lakhs of students passing out every year but they have hardly any knowledge. After passing out when they come to the industry, they hardly become able to give to the industry what is expected out of them. They lack in managerial part, strategic approach, and behavioural sciences approach. No institution in the country teaches them foreign languages. When they go to the foreign countries, knowing the language can be a great additional mileage for them. The Bill which the ECI has put before the Govt since 2004, I was talking to our great veteran, Mahendra Raj ji, he has been working very hard for years to get this Bill in the form of an Act, I told him, "Lage rahiye, ho jaayega". He was laughing seeing my face. I, therefore, think that persuasion is required. It is really a matter of pride for all of us sitting here making a thinking about how to upgrade our profession.

I have appointed 6,000 Germans while I was in Germany. Please try to compare the four years of engineering corporate world here and the German engineers. I always came to the conclusion that our engineers are better in every respect. I tell you why this is so. No doubt the German engineers are very systematic and very precise, they have the syllabus before them, they have the books containing how to run a machine, but if something goes wrong which is not written in the syllabus, they become helpless. Our engineers always find a way which I have always been calling improvisation. If a part of a machine gets broken and it is brought out from USA, the machine will not start for even four weeks. But, in our Indian factories, one fitter or diploma-holder or the engineer comes, he sees the part of the machine, improvises it and the machine starts running. So I say we can learn procedure, we can learn accuracy, we can learn systematic approach, but how can anyone learn the improvisation.

Once President Bush invited his senior advisers and told, "India is developing very fast. Please tell me what the reason is. What strategy are they adopting? How are they developing so fast? Which technique are they using?" One of the advisers told, "Sir, there is a very special technique in India which we do not have command over and that is JUGARU technique." President Bush then said his advisers to adopt the JUGARU technique. I saw in East Germany that when the motor of a car fails, they go through the books and then they repair the car. In India, it is never like this. The Indians repair the car and the car runs thereafter for 30-40 years. What I mean to say is that our Indian engineers are, in no

way, inferior compared to the foreign engineers and they are rather superior. Kapila ji also gave very valuable ideas in his address which we really need to implement.

The 25 Member Associations of ECI are giving education, certificate courses, etc. But if the aspirants get some university degrees, diplomas that will be a very good joint venture and it will lead to a lot of advancement. Also, I have always been pleading that a dual degree in engineering and management - as rightly has been told here that when the engineers come out of the college, they should know how to manage - would be very much desirable. Nowhere, the disaster management is taught. I think whatever the ECI has been pleading for can move the mountains. I was talking to Dr. Uddesh Kohli ji in this regard and we should perhaps also include amongst our 25 Member Associations some foreign institutions so that synergy (talking with them, meeting them, inviting them, etc) for exchange of views is there. It is good that the ECI has already thought over this. I am also thinking whether the ECI has already thought of this that they should also try to bring the universities, who are teaching engineering, under their fold so that a lot of synergy is there. The students can learn a lot from you all.

The consultancy in India is not very much regarded or recognized. We are doing a lot of consultancy overseas. Because in foreign countries they know what consultancy brings but in India, this mentality / aptitude is not there.

I am very proud to be here because I am always for the nation-building. What I saw, red or heard, the ECI has been doing through their newsletter, the Indian Engineer, it would not be much if I say that they are doing tremendous work for the nation-building. I am very glad that Dr. Mungekar would be throwing a light on what the ECI should do. I am very proud to be amongst you.

Address by the Chief Guest

Dr. Bhalchandra Mungekar

At the outset, I must congratulate Dr. Kohli ji in establishing the Engineering Council of India (ECI). Having informed about the various activities and its commitment to improving the practical quality of the engineers of the country, I find that these are being reflected in the theme of today's conference also, namely Re-engineering Engineers. I put on record my sense of appreciation of organization like the Engineering Council of India which has been trying to put the quality of engineering education in the country in place in one way or the other so that we shall be able, in course of time, to establish the real boundaries of the Knowledge Economy and in the simplest meaning, as I understand, to establish India as the leader of the Knowledge Economy.

When we discuss abut Re-engineering Engineers, many of you must have obviously gone through what once Marx said, “Educators must first read to get educated”. In our country, when once degree is taken, this is not enough and subsequent change is innovation, adaptation, modification and these are rarely undertaken. In this context, I request Dr. Kohli ji to kindly present to the Planning Commission a small summary of deliberations of this conference for the advice of the Planning Commission, instrumental to the establishment of the ECI.

Dr. Bhalchandra Mungekar is the Member, Planning Commission, Government of India

As a present Member of the Planning Commission, I shall take care to forward this to the proper authority. It is beyond my capacity to comprehend the problems of the engineering education as a whole. I have been sharing my experiences not necessarily as an academician right from the stage of my vice-chancellorship of the University of Mumbai, not necessarily as a Member of the Planning Commission because these positions are momentary, they come and go. But the most important single responsibility, which continues to remain, is as a citizen of India, the responsibilities which are obligatory on the citizens.

I have been telling that if we compare our conditions with that of the pre-independence days, where we are after the brutal colonial exploitation of more than 150 years or so, the decay of indigenous industries, the rate of literacy, rate of investment, the indigenous technology, no external aid, etc., diverse society, multi-lingual, multi-religious factors. In the midst of all these internal and external constraints, whatever we have achieved cannot be underestimated. And yet, during my vice-chancellorship, when I gave my first interview about education entitled: "one people one nation", I requested the editor to entitle it "we missed the bus in 1947".

The entire education system was based upon the British system to prepare accountants, managers, etc. of lower level because higher technocrats were basically imported from Britain. In this context, we could not evolve indigenous education system consistent with the requirements of developing and growing economy and emerging democratic polity. In 1986, when new education policy came into existence, virtually our entire technical education system was not in a very good shape. Universities were not revising syllabi for years together. Let me tell very clearly that industries too did not perform their legitimate role.

The rate of return on the invested capital is the most important single consideration for the industries. Bur this rate depends upon several initiatives such as research and development expenditure. For example, the total R&D expenditure in the country, just ten years ago, was 0.5% of the total investment made in the country. Our failure to re-structure, re-model, re-innovate the education system as a whole and within that, particularly the engineering education system, could not be taken much care of. All these efforts have been made during the last 15-20 years. We had, at that time, VJTI (Victoria Jubilee Technical Institute) and other such institutes and they used to play important roles.

I agree with Dr. Chauhan that the quality of our engineers cannot be underestimated. But, having said this, our engineers basically have been segmented into different disciplines (mechanical engineering, civil engineering, electrical engineering, chemical engineering and so on). After looking at the syllabi, we find that in the first year, by and large, common subjects are there. After that, there is complete specialization, just as in the agricultural economy. When we were teaching development economics in university, people were discussing about minimum support price of jwar and bajra. Student of M.A. (Economics) in agriculture did not see jwar and bajra for their whole life. I had to purchase jwar and bajra from the market and take these to the class just to show the students that this is bajra and this is jwar. Now, there was absolute total disconnect between the reality and the students.

What is happening in engineering is a reflection of what is happening to the education system as a whole. "Mckinsey Report" suggests the startling reality that nearly 25% of the graduate engineers coming out of the engineering colleges are employable. Primarily, this is because of the quality of

engineers that are coming out of engineering colleges. This is waste of investment of human capital. As all of you are aware that the term human capital was first introduced in 1961 by an economist Theodore Schultz. This is why we need re-engineering of engineers today to make them employable.

Now-a-days, it is not fashionable to take the name of Marx or Lenin. But Marx did not utter a single word about how to make revolution. He simply thought of the inevitability of revolution. It was Lenin who laid the foundation of the science of revolution. Therefore, Marxism is incomplete without taking into account the Leninism. In the Indian context, theory and practice are totally divorced; and that is why, it is necessary that the practitioners in industry are actually involved in the teaching profession. Industry-Academia partnership does not necessarily mean only investment in finance but it means involvement and partnership at all levels of the educational process.

The IITs / IIMs have evolved over a period of time. When you talk of the top education, we find that the annual gross enrolment ratio in these institutions is not more than 10%. The annual gross enrolment ratio in China was 22%. At the end of the 11th Plan, we shall be reaching 15%; and at the end of the 12th Plan, we shall be reaching at around 22%. Reference to China will be misleading unless concrete steps are taken in our country to improve the situation.

In the context of the perspectives of the 11th Plan, quality of teaching, capacity of the teachers to teach and keep the students together are some of the important parameters. Keeping the students together in a meaningful manner is not an easy task. That is why the tremendous involvement and accountability on part of the teaching community is also required. Third important thing is about functioning of the system in a bureaucratic manner. Everything in India is intimately bureaucratized. Now, bureaucracy is not a bad term. Bureaucracy does not mean only IASs. It means the top levels implementing the procedures. Even after 1991, when we started the liberalization process, we miserably failed to renovate, restructure the procedures. There is a complete mismatch between the demands of the globalised economy and keeping our hearts close to age-old procedures. Because, in India, everybody wants to keep power close to the hearts / chest. Nobody wants to relax. Why so? Because during the last 3,000 years of Indian history, we never tested power. That is why a clerk takes pleasure in firing a peon, an officer takes pleasure in firing a clerk. This is hierarchy and becomes counter-productive. I talk of the functional relationship. Functional relationship degenerates into spiritless hierarchy. There is no difference between public office and private office and the only difference is of that of the culture of accountability. Without the functional relationship, without the functional in-built mechanism, you cannot achieve the desired objective. It is demanding something on the part of the institutions.

Inter-disciplinary approach to engineering education is extremely important. The kind of education which is given in UDCT (University Department of Chemical Technology), where my son was privileged to undertake the studies up to graduation, is such that he did the project work in IIT. The economics is a peripheral subject for the chemical engineering course. When he was purchasing a very standard book of economics, he said that he is having the lecture on accountancy the next day when I asked him why he was going for that book. India does not have only dearth of such capital. Entire Europe was destroyed to ashes in the post-world-war scenario. They developed with the tremendous sense of developmental commitments. We seem to have forgotten what our former Finance Minister and the present Prime Minister, Dr. Manmohan Singh had said particularly about accountability, work ethics, etc.

The next important point is Privatization. Because of the financial resources, relative scarcity and the quantity of demands on the central government as well as the state governments, it has become extremely difficult for the governments to undertake the responsibility of providing technical higher education. Private education, including foreign direct investment in technical higher education, has become unavoidable.

Now, let me discuss about the public sector and private sector higher technical education institutions. People, who are working in private higher technical education institutions, are accountable and they are, therefore, working with all sincerity. I asked one of the Chief Ministers in one of the meetings in Planning Commission, "If Rs. 25.00 lakhs are charged for the four - and -a - half years' medical course, can you be able to spare this amount from the legitimate sources of your income? The reply was no" Therefore, we should think about the education of the broader section of the society. A system cannot be run by the private sector alone or the public sector alone. Our commitment should be to the genuine education irrespective of the institution, whether it is public or private one. We should maintain transparency. Engineering education should not only be of multi-disciplinary nature but also you must have the sense of implementing in the society with all the sincerity whatever you study. Engineers must know what the rural village system in India is. Everything depends upon the sense of understanding, commitment and sense of involvement with the people.

Around 19.8% of the total 11th Plan budgetary allocation of 14, 18,000 crore of rupees are earmarked for education. It means that for the first time since 1951, about 20% of the resources have been earmarked for education. National Skill Development Corporation has been established under the leadership and chairmanship of the Prime Minister and the National Skill Development Board of which Deputy Chairman, Planning Commission is the Chairman. All these financial resources must be used optimally for the development of the country.

Industry must play the proper role in the area of engineering education of the Indian economy. The professors must teach what the industry wants. The industry must, therefore, take the initiative in deciding the framework of the syllabi of the engineering courses with a view to delivering the proper output. The practical conditions, in which the students will be working after passing out, must be taken into consideration. I cannot imagine any engineer getting the degree without working for at least six months in the industry. I have suggested to the HRD Minister that even the vice-chancellor of a university should have at least six months of industrial working experience. The industry must take the initiative at the much accelerated pace. The question is that this holistic perspective is applicable to the educational system as a whole. If there is complete disconnect between the industrial practical conditions and the Indian mindset, it will be very difficult to take the education ahead in the forward direction.

I am sure India is one country which is unmatched so far as the potential of development is concerned. People, women particularly, are surcharged with the ideas of development. Indian economy is refurbishing. But then growth alone would be inadequate to meet the aspirations of the people of the country. I, as a citizen of this country, consider myself responsible and accountable at every point of time not to the Deputy Chairman, Planning Commission and not even to the ministry but to the 117 crores people of the country. Every system, including the educational one, in the country should be

able to fulfill the growing aspirations of the millions of people of the country. I am sure that all of us taken together collectively will be certainly moving along this path.

In the 11th Plan, we have taken a project to restructure the All India Council for Technical Education and all other technical educational bodies.

Vote of Thanks

S. Ratnavel

In India, whenever we invest one rupee, we expect something. In manufacturing sector, we get 20-40 paisa per rupee but in construction industry we are getting 80 paisa. All the infrastructure development is going on in India in all the sectors. I am coming from Madurai, which is a small city having the potential for consultancy to the tune of Rs. 16,000 crore for developing its infrastructure. The economics of construction plays a major role in optimizing on the resources invested in construction, particularly infrastructure. Last year, some of the students from Anna University had done their project work on construction economy. Four recently constructed bridges were studied. The findings of this study were shown to some of the IIT professors, who, some times also give their consultancy, for their views. It was inter alia found that there are many identical solutions for every problem. When you are constructing a housing project, 40% of the money is buried into the soil. It may not be so near in the case of a bridge or a road project. When you invest one rupee in construction industry, you are getting eighty paisa, but then we have to spend 1.50 rupee in the name of overcoming corrosion from the next year. This is the fact. So, we must study economics of every engineering project before investment is made in such projects. But, then, do we teach engineering students economics. I think no.

While nothing is wrong with our engineering education as such, we cannot make experts in the engineering colleges is also true. Engineering students at the undergraduate level can be at the most generalist of multi engineering skills along with the skills in the other related subjects such as economics, communication and so on. We generally notice that engineering students lack in the presentation skills and also in the other skills which industry wants in them. Therefore, we need to re-engineer engineers. I would take the theme further by saying that we need to reengineer engineering education at the undergraduate level, at least if not at the post graduate level as well. This to me is also very important at this stage when India is going to join international market of services, particularly in our context engineering services, which is round the corner. It is very important to learn where to start, where to finish or when to abandon when you take up any engineering project. So here, our engineering education requires teaching methodology and teaching content in a very flexible manner. I have done a project on competing educational challenges. This was my first graduate thesis under an IIT professor and I am basically a civil engineer. In response to a survey on whether the institutes are ready to conduct the examinations in the properly desired format was no from the sixty percent of the students. Because the universities are giving the certificates by giving very good percentage of marks and if, even then, the students are not being able to get jobs because they are not ready to perform their

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duties in an industrial concern after passing out from engineering colleges, where can one go. This is very important issue that we have to settle for meeting the new challenges and seizing the opportunities that are generating fast due to the economic environment. That is why that ECI has decided to conduct a series of seminars on what type of re-engineering we can do in practice.

Now, I do not have the time and have to propose the vote of thanks. Yesterday, I discussed with my friends this matter for seeking their guidance. Today, our chief guest told that whenever you start to do anything, do it systematically and this is very important. My wife told me, "You need objectives, constraints and results while doing anything" and this essentially applies to my proposing the vote of thanks also. So, whosoever has helped to fulfill this need are to be thanked, whoever helped to fulfill the objectives are to be thanked and most important are the people who served the constraints and also we have to thank the people who have helped to overcome the constraints are to be thanked.

I thank Dr Mungekar for having accepted to be the Chief Guest despite his busy schedule and he has given us the words of wisdom and thought to guide us in this work. I thank Dr. Chauhan for accepting our request to be the Guest of Honour at a very short notice depicting his deep commitment to the technical education. Sir, we have taken note of what you have said and we will try to be guided by your words of wisdom and thought in our future endeavour. I thank all the session chairmen, keynote speakers and the panelists for accepting our invitation and we will be looking forward to hearing their words of wisdom and thought during the day. I thank all the delegates, distinguished guests and the invitees who have come from all over the country and I believe that their contribution will be valuable and meaningful. Last but not the least, I thank the principal sponsor of the conference, the ONGC and the sponsors, NDMC, the Lanco Infratech, PFC, Hindustan Petroleum, IRCON and all others including NHPC, SAIL, REC, IFFCO, etc. for their valuable support without which it could not have been possible to organize this conference. I thank all the member associations of ECI, particularly CIDC for their support in organizing this conference. I thank all the officers and staff of ECI for their dedicated efforts. I thank the India Habitat Centre for providing the venue and all the facilities for organizing the conference. I thank each and everybody who have come here on this occasion. I thank you all ladies and gentlemen.

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Technical Session - I

Re-engineering Engineers – Views from the Industry

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Mahendra Raj

It is my privilege to chair the session. The theme of the session relates to the requirements of the industry. Now, so far as the re-engineering of engineers is concerned, it means different to different people as to what exactly is implied. There are sessions in this conference on re-reengineering of graduates, re-engineering of professional engineers, re-engineering of diploma-holders, etc. But we all know as engineers that we are architecting the development of our country because, apart from resources and finances and materials and all that, what is required for the development to go through successfully is a body of engineers and if today India is developing so fast, bulk of the credit goes to the body of engineers who are servicing the projects which are taking the country ahead.

It has come from the learned speakers in the opening session that an engineer is a product of so many different sorts of elements out of which education is a very important aspect. A lot has been said about the educational part of an engineer, but post-education continuing education of an engineer is very important because engineers work basically for the society, for the safety of the society, the health of the society. An engineer has to keep himself / herself updated with the latest developments of his / her specialization. Another very important aspect is that an engineer has to be ethical and dedicated. All these aspects are very important for an engineer to render service to the society. That is why the word accountability has been mentioned and engineers have to be accountable to the society with a view to deriving the maximum benefits from the engineering services. So, this conference on re-engineering of engineers is very important one. I hope we would be able to come up with some suggestions as the Planning Commission Member has said that he would be hoping to get some recommendations which can be implemented in practice by the government. So, with these opening remarks, I would now request my speakers to be precise in their talk keeping in mind the time schedule.

Ajay Poddar

It is an honour and pleasure for me to be a part of this conference. I welcome all the dignitaries and other friends. On behalf of PHD Chamber of Commerce and Industry, it is a matter of pride for me to address the 6th National Conference organized by the Engineering Council of India. I think the theme is very topical and relevant in today's perspective. As some of our speakers have earlier said that there is a problem of employability of many engineers after passing out from the educational institutions. What about PHD? PHD is a 105 years old Chamber of Commerce which operates in ten states of the northern and central India and union territory of Chandigarh. It has about 45,000 members which consist of large, medium and small-scale industry. So, as a senior member of the managing committee, I have some companies. PHD involves interface between central and state governments about the policies and we also sensitize the businessmen about the emerging economic policy and environment. Skill-development is one such area and that is why we are here. We have been facilitating cooperation and interaction between the industry and the teaching institutions.

Why this conference is important. As you all know, India has the largest population of the young people in the world. We still produce a few babies unlike European and other people. This is a latent asset and population is not the problem. The only thing is to mobilize, guide and make them motivated. I would have been happier to see more students and faculty-members of the educational

Shri Mahendra Raj is the President of Indian Association of Structural Engineers and an Eminent Structural Engineer

institutions invited here. I think a significant part of the today's agenda is meant for the students and the faculty-members and it would have been nicer to see more of them. Anyway, I hope that the deliberations of this conference are carried to them.

During the past two decades, the world has become a different place as you all know. People's perceptions, thought-processes about the values and ethics have undergone a change. Spending and living habits have changed and so have the business and professional environment. Emergence of international markets, competition from nearby industrialized nations, you have seen the rise of countries like Korea and Thailand and some other countries in south-east Asia. Traditional decline in manufacturing industries and rapid growth in Information Technology have all changed the environment irrevocably. Most organizations are, therefore, experiencing significant changes in the way they look at the way they perform and the way they react to the situation and cutting across the culture and languages they look at these changes. The emerging global business environment is giving us a message to change for meeting the emerging challenges. It requires an appropriate response not only from the corporate sector but also from the institutions of higher education as well. More so, the world is changing so fast that we have to match this change appropriately. Business community has been reviewing certain standards of the past and restructuring itself. Many people thought that the Indian industry will not be able to be competitive. When the economy was thrown open, this concept has been belied and we have seen that all the sectors of the Indian industry are responding very well. Similarly, engineering institutions, I am also from one, need prepare graduate engineers of skills which will appropriately meet the new challenges and seize the opportunities that are coming up because of the changes that are taking place world-over. Teaching and training procedures and practices followed till now by these institutions have become out dated. The emphasis on too much theory and little practicals will not work now. It will have to change.

One of the things I have found in IITs and IIMs, where I have been going for talks on management change and things like that, is that a professor's seniority is decided by the number of years for which he is teaching a particular course. So, he doesn't want to teach something new and he doesn't want to learn something new. Even the case-studies are becoming rapidly obsolete. If we are talking about what the company did five or ten years back, it doesn't matter because it becomes a history. What we need is the current case-study. Something has been spoken about the industry and the industry's interface with the educational institutions. Everyone has talked about these things during the talk of the day. My question is : How do we do it? As an industrialist, as a person running 2-3 companies, I am very keen to do it. I wanted to develop a product. I approached my Alma Matter of IIT, Delhi and requested them to develop technology for the product. One of the things with which I have been amazed by is that the response was not only bureaucratic, but also the offer, which came three months later, was ten times more expensive compared to the foreign one. Obviously, I could buy the technology at a much cheaper rate from overseas. So, in spite of the fact that we are trying to do the things indigenously, it is not feasible. So, some sort of mechanism will have to be found out which is practically feasible in India. How are we going to bell the cat? It is the important question before us.

We in industry have accountability. Like-wise, there should be accountability in the institutions of higher technical education. We have public-private sector partnership in the educational institutions, if we want to bring about accountability, how this can be done. Even, how much accountability is there

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in the private educational institutions to day is the question. There is another question and this is regarding the accountability of students. There is no method today for evaluating a teacher's performance except for the fact that the students say that he is very good or are they complaining? There have to be specific tools and parameters for this purpose. I am sure people from very good educational institutions are looking at it. We need to look at it more closely.

There has to be interface with the industry. There was a talk wherein it was said that industry people should go and teach. I am very happy to go and teach something if somebody considers me capable of teaching. The point I am trying to make is that there has to be some mechanism for this. It should be acceptable to the bureaucracy or the hierarchy of the educational institutions. There has to be some initiative from the educational institutions on this important matter. This will happen only if people from the educational institutions come to industry. We have been inviting people individually but we find that people from the educational institutions don't think that there is any need to update them or to know what is happening in industry. While we might talk about re-engineering and what should be done, I think that what is most important is that we have to find a mechanism of how to re-engineer or who will bell the cat for it. We are ready from the industry side and if the ECI likes to interact with us, they are very welcome and we are open to how we can do it.

I remember that when I was in the college, my mother once asked me to fix a fuse. I not only simply refused but got angry too that how come she can expect an engineer from IIT, Delhi to do this work. It is not my job and I have not been taught to do such a job. A few years later I realized that engineers from Indian institutions want to take up management jobs and they don't want to do the shop-floor jobs. They want to be management consultants, they want to be in IT, they want desk-jobs. It is just the same case that one of speakers was saying that the students of agriculture did not what is jwar and bajra. This mind set must change. It can change only if students are assessed for an aptitude for a profession at the time of their enrolment. We must include some questions in the common entrance test for students aspiring for engineering profession which will find whether they have aptitude and liking for the profession.

People, who are engineering graduates, need two things. One is ethics because the engineers today join at one place and after gaining the experience of 4-5 years, they join at some other place. Their credibility is lost. The other thing they need to learn is to use their common sense. I am afraid we are destroying our common sense in the name of logic. Research is also playing a critical role. We have to have an effective and efficient interface in research between educational institution and industry.

Today's engineer needs to know the market conditions. He should know what the economical and political base of the country is. When an engineer starts working somewhere, he should know about the new technological breakthrough. They have completely forgotten whatever they have learnt in the college. Ultimately, they end up what they have done in a particular industry for 1-2 years. The habit of keeping a person updated should be inculcated while the person is in the school/college and should not happen later. Databases of what is happening in the current scenario must be known to the engineers. Such database of many engineering institutions is completely outdated whereas it should be other way round. When industry needs database, it should go to the educational institutions. But you have a situation that the industry has a more up-to-date database compared to the educational institution.

Coming to the issue of re-engineering the curricula of the engineering education for the better employability of engineers, I would like to say that the curricula should be such as would make engineers professional with knowledge and competency. You need to have an engineer with a broader understanding so that he / she knows the job whenever he / she goes to a particular industry. For this, I feel that we should have more flexibility in the curriculum, more inter-disciplinary perspective and choice of electives. The other skills an engineer is supposed to be conversant with include logical reasoning, problem-solving, process-orientation, English communication and programming fundamentals, knowledge of economics and law, etc. We need to integrate these skills in the curricula.

Further, the educational institutions have to inculcate the habit of learning. They cannot keep the same syllabus for long. It has been talked of the industry-academia interface. Some colleges have the system of industrial training in the final year; and some colleges don't have it. It is not a pre-requisite for becoming an engineer. Students must be taught how they would be facing the industry. Experienced engineers prefer to recruit engineers having such an industry-orientation. In-house technical programmes should be properly designed for the engineering students and should be implemented in practice. Industry can supplement the syllabus by incorporating the latest developments in the technologies and markets. Joint R&D with the industry on market research, knowledge economy, etc. should be pursued. Industry experts should visit the educational institutions regularly and should give some internship programmes to the engineering students. When some industrial experts from the overseas visit some industry, they should also be taken to the educational institutions with a view to talking to the students. The distance education should also be given focus by the institutions. There is a saying that it is not the strongest and not the most intelligent species which survive but only those species survive who are most adaptable to change.

Dr. Ing. N. Rajagopalan

There are two things I would like to mention. Somebody is asking you to do something and second, somebody is doing with motivation and interest. This implies that engineering education has to be considered under two basic concepts namely creating a knowledge base in the concerned area of specialization to the minimum required level and secondly the application of the same in profession with the aim of meeting the purpose of the profession. Both of these things have to be looked into when we look to re-engineering the engineering education.

I had been in IIT for quite some time. We have introduced industry-institute interaction by way of consultancy sector, by way of sponsoring research, by way of sponsoring candidates for doing education. All those things have been done. Out of this, there is no full participation by the industry or the students' side. The present education system tries to provide only the first part namely, the knowledge base and the second part is left to the candidates to learn it during professional experience itself. It is desirable to give an insight of the same even when the candidates complete their programme and enter in to the profession. I will talk about how the engineering curriculum has been modified over years leading to the lacunae in the existing system and also a possible solution to remove the lacunae. These are the two points which have to be looked into if you are going for re-engineering of engineers. When we say that something should be done, it should be done with motivation, it should be received

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with motivation. Both these things must be there and then only re-engineering is possible. The modifications in the engineering curricula leading to engineering degree in various universities with an intention of updating have not been dealt in a holistic approach. Time and course both have been modified, the former at the behest of ministry of education and AICTE. It may be mentioned that both these government organizations were concerned about budgeting and expenditure and providing facilities for more number of aspirants.

I am in this field from 1960 and so, I know that the curriculum has been changed many times. The universities and technical administrators considered the need for more knowledge on numerical mathematics, physics and other basic sciences along with the advent of space and information technology by arranging to introduce more credits for such type of education in engineering at the cost of engineering subjects or professional courses. I have been in industrial practice for about 8-9 years. Earlier I was an adviser on the research and consultancy side and no monitoring points were involved. When I am sitting in industry, I am looking at the both sides. What is the facility I am giving at what cost and at what service to the society. All these things must be done in a holistic approach. That is what is wanted in re-engineering of engineers right now. In seventies, we were told to produce more number of engineers and the time was, therefore, reduced. In the curriculum, we see only the knowledge base. The number of courses in engineering subjects was reduced very much. Many useful courses for practicing profession were grouped into electives and the students were allowed to take the desired subjects. The students always chose subjects which needed minimum application and provided for maximum marks. Hence knowledge was given a go-by. It may be mentioned that in western world, the students can choose any type of subjects and correspondingly choose a job suiting to their knowledge base and in Indian context this kind of luxury was not available and hence they had to take a generalized degree with which they could go for any job.

Academic forums give some courses and say, you have learnt something and pass out. But they have not learnt what should be provided in the services. We are producing graduates for serving the country by way of economic growth and they should know about the overall engineering picture. All these things must be brought in, not necessarily in the curriculum but in the form of training or in some other form.

When a man goes from B. Tech. to an academic field, he should know how to develop the formula but when he goes to an industry as a consultant, he should be able to use his knowledge for the economically viable, aesthetically pleasing and socially acceptable solution to the proposal for the benefit of the society. The present education system does not give knowledge for the economically viable, aesthetically pleasing and socially acceptable solutions to the practical industrial problems as the curriculum is prepared by the academicians who are not bothered about the practical industrial aspects. The academicians have not seen the industry right from the day one. In foreign countries, it is not so. We must reverse this.

Let us now consider the curriculum lacunae for infrastructure consultancy profession. Quantity surveying is a subject which leads to information on minimization of cost. Construction methodology, inventory of materials and similarly many other field-oriented subjects such as Aerial surveys, Geometric Information System called GIS, having an important role in curriculum earlier, were later pushed into elective subjects. Students give minimum importance for such useful subjects at the university levels. With the advent of computers, computer-oriented subjects got greater importance

and students choose electives which are more computer-oriented thinking that these exposures will give them greater job opportunities. Students were not inclined to take professional-oriented subjects. As a direct outcome of this, the next generation of faculty, who are chosen from the sample of these student populations (of present years), will also not have any knowledge of the above and slowly these areas are veining in the civil engineering curriculum. While there are many more lacunae, only a few of them are bought into the attention of the audience. With the opening of liberalization and international business houses coming to India, the infrastructure construction companies have taken a lead in Public Private Partnership. These companies require additional skills in engineers for successful handling of the infrastructure related projects. These skills are spread over the areas of business and commerce, human resources planning, material resources planning, environmental, health safety aspects, legal aspects, logistics for the progress, quality and documentation making applications of IT and communication technology. These need to be introduced as part of the curriculum, may be at higher levels after creating an engineering base in the students.

The subjects which are not found in the current engineering curricula at all include subjects such as Project Proposals & Feasibility Study, Preliminary surveys, Socio-Economic aspects in Project Planning, Environment Assessment and Management, Construction Methodology Planning & Equipment, Construction Management, Logistics of works and Inventory Management, Human Resources Planning and Management, Cost Analysis of projects, Project Monitoring with MIS, Finance Engineering, Statutory Regulations for Companies with Labour Involvement and Contracts, Contract Management inclusive of Legal issues. These are the subjects which should be taught in the every engineering branch.

When the doctors can go for internship in order to have the sound knowledge of their profession, why should not engineers go in for practice from day one? Why do we not allow that because there is dearth of engineers? University must be able to take care of all these by introducing the concept of Professional Engineering as outlined earlier. Internship should be introduced in engineering. It should be made compulsory before grating the degree. The period can be discussed and decided.

Engineering syllabi were earlier modified by introducing space and information technology at the cost of some deletions and dilutions. It is better to introduce special level courses for serving engineers which could be termed as a professional engineering programme leading to a diploma in P.E. (Professional Engineering). All professionals should have to have a qualification called P.E. which covers up the relevant topics. Those with only the basic engineering degree may be allowed to practice the profession but only under such professional engineers. The syllabus could be drawn, discussed and agreed to. The Curricula for engineering education should be based on a consensus of academics and industry and practising engineers

Suresh Panampilly

IT industry was chosen as a career option by many engineers from diverse disciplines over the past decade. The number of engineers recruited by TCS has been steadily increasing in tune with the

A Joint paper of Shri Lalitha K. Prasad, Head , Delivery Centre, Tata Consultancy Services, Trivandrum and Shri Suresh Panampilly, Senior Consultant and Heads the Initial Learning Programme at Tata Consultancy Services and presented by Shri Suresh Panampilly.

growth in business. The selected candidates are not 'project ready'. They are put through an intensive two-months' induction programme, the main objective of which is to give them an industry-orientation. The program is designed by the Learning & Development team of TCS in close consultation with key stakeholders such as project leaders, business development managers, and technology experts' group. This occurs as transition from the academia into the corporate world. We have done an analysis of the performance of the graduates which is used to provide feedback to academic institutions across the country, to make critical decisions in choices related to hiring process and to revise the training content. I shall be discussing some key findings from the analyses.

TCS has seen rapid growth in revenue. It was Rs. 721.00 crores in March, 1997 and Rs. 22,861.40 crores in March, 2008. The growth in revenue during the period '96-97 to '07-08 was, therefore, more than 31.00 times. This growth was achieved with an 11.33 times increase in employee strength. Increase in employee productivity has been a key driver in the growth of TCS. Fresh graduates inducted into the organization from campuses across India have contributed significantly to the growth of TCS. It means we have been able to increase the productivity of our workforce. Around 11,500 engineers joined TCS during last 2007. With the increase in number of fresh graduates joining, the organization created a unit to handle induction as a central process. The growth of TCS saw increased business with non-English speaking customers. Facility to work in a multi-cultural environment was required as a competency in the organization. Graduates were given initial training in French, German or Japanese. Until 2005-06, the technical component of the induction program covered generic competencies required across the vast majority of projects in the organization. However, the scale of training required in specific technology areas has been steadily increasing through the years. In 2005-06, TCS decided to include stream training (Training in technologies used in projects) in the induction. Performance of trainees during induction is monitored. Feedback is shared and suggestions for improvement, if any, are given. TCS has regular interactions with academic institutions. These interactions cover feedback on performance of their graduates. Possible lines of action of mutual benefit are discussed. The parameters on which the performance is measured are common training (which measures the ability to assimilate programming and software engineering concepts), oral and written communication skills (before and after induction) and stream training (which measure the ability to grasp technology concepts).

In the first month, we cover the common programme, something on application-modeling which is essentially the process side of the software industry. That is something which is lacking in the academic education. We cover a lot of space on the software process. The elements of induction training generally include software engineering, foundations of computing, organizational processes and soft skills (which included English oral and written communication). The growth of TCS saw increased business with non-English speaking customers. Facility to work in a multi-cultural environment was required as a competency in the organization. Graduates were given initial training in French, German or Japanese. We covered soft skills. It is very important that people have this skill in the industry. We covered team work and things like that. We also took up a course on TCS-orientation.

Trainees are placed in one of the 5 levels, that is, Level 0 to Level 4. These levels apply only to the communication modules and not to the overall performance of a trainee. Performance index (on a scale of 0-50) is used to measure the competency of a group. Measurement of performance of the trainees during induction has led to the following conclusions: There is no significant difference in the performance.

- Between graduates of computer science and related disciplines and those of core disciplines
- Between genders
- Between graduates from different regions
- Graduates selected in campus have performed better than those selected in off-campus drives

This can be attributed to the difference in quality of education between the colleges accredited by TCS and other institutions. We can, therefore, draw the conclusion that there is a strong need to improve the ability to communicate (Oral & written) and there are no major differences in the communication ability of graduates across different regions. The trainees, being new in the organization, first try to find their feet during the common training programme and during this period, trainees are exposed to a different learning paradigm, which emphasizes self-learning and problem solving. By the end of the common training program, the trainees are able to imbibe the new learning paradigm. Hence, they are able to do better in the stream training program. During feedback sessions, trainees place these two aspects as the best part of the training program. We have experienced that almost all fresh graduates are able to attain the competency level required to be successful in industry with training and experience. However, about 70% of the curriculum is generic and non-TCS specific. The curriculum of the engineering educational institutions, therefore, requires to be revised with a view to attaching more importance to industry-orientation. It is a well-known fact that only about 25% of the fresh technical graduates are employable. Though the subjects of programming and software engineering are part of the curricula of many universities, not enough emphasis is given to these subjects. It is recommended that the learning pedagogy needs to be modified to place more emphasis on self-learning and problem-solving. As the IT industry is maturing, the definition of an IT professional is changing. Increasingly, IT professionals are expected to possess domain skills in addition to basic IT skills.

We have observed that :

- Fresh graduates come into industry with a mindset of finding short-cuts to pass tests. This results in undesirable learning patterns. This could be corrected by changing the mindset towards education in universities
- Fresh graduates lack a strong ethical foundation. Introduction of ethics as a subject in engineering education in universities needs a serious consideration
- Fresh graduates tend to gravitate towards group thinking as opposed to individual opinions. Universities could look at interventions to promote thinking individuals
- Fresh graduates seem to lack appreciation for deep understanding of fundamental concepts. They often look at splitting hairs about whether their solution is 50% correct or 60 % correct. The industry requires a solution which is 100% right the first time and every time. This requires a mindset change and a change of the learning process.
- The majority of fresh graduates look to a teacher explaining concepts in simplified form as the only form of learning. They need to learn to become self-reliant.

Lastly, I would like to say that the number of engineering graduates joining Indian industries is on the rise, the reason being increased supply of engineering graduates due to a large number of engineering

colleges set up in recent years resulting into a compromise with their quality ultimately affecting the success of the Indian enterprises. There is, therefore, need for close interaction between Industry and academia to bridge the gap between the industry needs and the competency level of fresh graduates.

From the Floor

R. D. Gupta

I am an engineer, a product of the University of Roorkee. We will have to see that the engineering community is able to work with the values of dedication and honesty. There cannot be two opinions for change which must come in the education and training of engineers for meeting the new world economic order and this will have to come by way of re-engineering working engineers through training and development and re - engineering engineering curricula at the undergraduate level. Engineering Council of India has taken up, therefore, a subject of national importance for arriving at the consensus for the change.The second point that I will like to make is that if we have to take our country to the status of a developed country, we must involve the academia in this process as well. Engineers working in the industry should take the lead for this and industrialists should join in the movement.

Ajay Poddar

I am also a product of IIT, Delhi. We, the PHD Chamber of Commerce & Industry along with the other IITs, are doing many programmes on value of ethics, good governance and management. I think that the Engineering Council of India, the PHD Chamber of Commerce and Industry and our IIT Alumni can jointly do a lot to improve the quality of engineering profession. I am very hopeful of the positive role to be played by the PHD Chamber of Commerce & Industry in this. I consider today's conference is very useful.

A delegate

I have been in the Government jobs, I have done many projects and I am now a consultant. It can be said that only change is permanent. So, we have got to change whether it is curriculum, whether it is development or whether you have got a job or a career. The point is that for the better employability of graduate engineers, much wider education has to be imparted to him / her. The engineering curricula, therefore, needs re-engineering for making it such as would impart multi-skills in engineers and not confine them to some domains , as at present.

A delegate

The engineering students and teachers must have the liberty to visit the libraries of the reputed engineering educational institutions like the IITs, etc. to enable them to have an idea of the latest technologies.. These things must be freely available to the engineers if they have to grow in this country. Code of ethics and accountability must be implemented in practice by the engineering community.

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Technical Session - II

Theme : Re-engineering Engineers – Views from Academia

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G. Sharan

I am happy to note that the 6th National Conference has attracted many distinguished personalities and thinkers both from the industry and the academia. I can see also many eminent engineer consultants and practicing engineers present. We have had an opportunity to listen to distinguished speakers in the opening and the first session. The theme of this session is : views from the academia on the re engineering engineers . We have among the distinguished keynote speakers present here persona who have contributed significantly to the engineering education. Given the new paradigm of development in an open economy, it is not difficult to realize that fast advancements and integration in technologies, designs and the very concept of projects, particularly in the road transport and shipping sectors – in their formulation, implementation, evaluation, appraisal and operation. Engineers today need multi -skills including that of the other than engineering professional subjects for meeting the challenges and seizing the opportunities that are coming up with this paradigm shift. From this view point, I consider the 6th conference apt and timely. With these words, I invite Prof B.B.Dhar to make his presentation.

Prof. B. B. Dhar

There is nothing wrong in the system as it is today. The big companies like TCS, Larsen & Toubro, etc., give training to the fresh engineers after recruiting them for a certain period and during this training, the trainees are made to move from shop to shop where they have the preliminary idea about the industry and its working. He / she is made aware of the trends of management and then he / she becomes successful. In fact, today's India is because of such successful engineers. But what is happening today? We are talking of those junior fellows whom the contractor pays a very small amount of money.

The problem is that we have created lots and lots of engineers irrespective of the fact that we do not need them. All this has happened because you are spending some money and are getting admission in a below-average college. Nobody is asking you why you are there and why you are not there. A professional engineer automatically sets these things right in an organization. I am also a product of BHU. I have got degree from America also. The day I got the Master's Degree, I was given an identity card and I had to take an oath that shows that I would practise my profession competently and honestly. There was no examination, nothing. Since I was having a degree from America only, I did not have any problem working there. But the engineers who went from here had to come back after resigning. It has been stated here in the first session that the engineering students should have this course that course, etc. You cannot load the students with courses as he / she has to get the time to think. It is developing thinking skill which is important for developing better engineers. You all know that there was no computer hardware, software and environment course many years back. These are there now, but these are also being covered in the same number of contact hours of the course. The point is that the total number of contact hours must remain, say x or y hours and the re-engineered engineering course, which I consider in the given circumstances, has got to be framed accordingly.

Gentlemen, we are talking so much of industry academia interaction, who in industry will give you salary and vacation for taking classes in the educational institutions. In India, we can spend Rs. 100/-

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for construction of the building but cannot spend 2% of it for the maintenance of the building. I would like to say in nutshell that there are no two opinions about the fact that our engineers need re-engineering programmes to keep them updated with the developments in this profession. The technology world over is changing so fast and the practising engineers normally lack the equipments to adopt them. As such re-engineering across the board of our engineers is a need of the hour and ECI has, therefore, to take a lead in propagating it. On one hand we produce IIT products that are professionally second to none in the world, on the other hand we also have below-average engineers produced by various colleges across the country. The private sector has come of age and is gradually developing to produce dynamic, young, fully equipped, talented engineers. To name a few, Amity University in the North and Manipal Academy of Higher Education in the South. Only such two institutions in the country cannot meet the demand of expert, competent engineers.

The county has different scales, but no real scale to measure the competency of the engineers that we produce. Merely opening of an institution with the license does not fulfill the requirement of the growing demand for good, competent engineers. We need an organization like the Engineering Council of India (ECI), therefore, that can take up this challenge of the performance evaluation of the engineering graduates and provide: (a) feedback to the academic institutions across the country, (b) take critical decisions regarding the process of hiring in the professional field, (c) keep on helping and updating the various training programmes on a national base, (d) an organization like ECI should, therefore, help in the development of modern curriculum at higher and senior levels after creating an engineering base for the students so that the stakeholders can be benefited both in terms of talent and utility.

It is high time that something like Professional Engineer's License like the one prevailing in North America be introduced in India, but not on the State to State basis, only on all India basis across the country. This will help to produce a uniform code of dedicated capability and professionalism in our engineering graduates and the profession. Separate course or additional course is not the answer to re-engineering. The answer is that the present curriculum should be updated on regular basis and inputs provided like study of project proposals and feasibility study, socio-economic aspects of project planning, environmental assessment and management, construction management, cost analysis, finance engineering together with rules and regulations of the country to ensure safe design for safety.

The current system of our engineering education lacks many things and with the result the inputs are not aligned with the outcome. The infrastructure and the facilities both academic and others provided should, facilitate the development of such activities that can bring into the system integrity together with a sound academic environment.

The future engineers of this country after suitably introducing re-engineering of engineers will produce the engineers for future generations, who will be competent, capable and at par with any international institutions. Under the system of WTO/GATS such a requirement is a must if our engineers have to be global partners nationally and internationally.

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Prof. Priyavrat Thareja

Engineers know now how the business is created. In fact, we engineers have since contributed to 'make it happen' by being an engine to growth, development and Change. In the shoes of society, we have realized requirements and we have products (to be) made like that which are innovation-oriented. Thus we owe a very large role to play in the society. The engineering is the art of practising organized forces of technological change. We must have enough competence. Unfortunately, our process of engineering education is not is not quality-oriented. It is number oriented and when we say with a pride that we are producing large number of engineers in the country; maybe we feel hollowness somewhere? I feel that there is something wrong in the system.

We have a very complex phase to cater to after we have graduated. It may be reiterated that the consortium of competencies required by today's engineer has only widened and also the realization that more accent is laid on cultural strengths and attitudes; concurrently calls upon to increase the intellectual sharpness of product. Both aspects of lateral and vertical grooming of students in engineering and emotional intelligence (elevation) should be catered to in the new state of educational process. There is thus a need to reengineer our engineering educational schemes such that the system is robust and potent. The current requirement of educational product is in diversity @ core competence. The know-all requirement spells the unique learnability concurrently with handling of diverse set of tools failing which the industry or society is ready to count losses incurred due to lack of competency. Most of the infrastructure for development of such activities should be provided in the academic environment, at the behest of student for 24 X 7 X 365 access. We have to look at the competence of the engineers today or tomorrow and to look at the growth and culture of our people. If we do not develop the good attitudes and other good habits, we are going to render a big loss to the society.

I think that lot of resources be made available while we have good access to the Internet and various journals. The stipulation that all the incompetence in a duly professionally deployed graduate engineer rest in the educational process" is indeed not to be taken without a bout of chilies by the academicians. It is despite the fact that there is a considerable awareness, deliberate customer pressures for quality of graduates, thanks to a large disparity of compensation structure and pressure from the managements where the education has gone commercial. Yet, no one would be willing to take on responsibility for risks associated because of the misdoings of a bad product. The onus of responsibility for the bad product has however been debated extensively in the quality discussions world over. Further-on, while there may be debates launched over the academe's systemic deficiencies or current lack of authority of the educators over their raw material, i.e. students, and because of the stance over the statutory demands that the students cannot be resorted to physical punishments or psycho-emotional assaults by their teachers it cannot be ruled out that a tendency in students to take their teachers for a ride proliferates. This is unlike the manufacturing sector where the raw material / or product does not retaliate. In a scenario, when the responsibility to maintain the quality of the product rests with the operators, the teachers may be seen to be looking sideways to avert the question when it is directed over them. Their simple excuse is that the students are obliged to share the responsibility of being an operator of educational process. They are merely facilitators and resource-providers. Given that the design process is always complex and so is the educational process, their interactions are likely to further complexity more strongly.

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Thus, it will be extremely challenging to comply with the requirements of catering to a robust product given the scenario analysis mapping of what is happening in the engineering colleges. The teacher comes and speaks for one hour in the class. The students are sleeping. The teacher also may be incompetent. The students are unsatisfied. Therefore, we have incompetent designs at the root itself. We have a lack of motivation as a result of all this. The teachers must develop all-round competence. The question is what is the (SMART) Target in education? Is it the competency staked by the student or desired by the employer? If these are at variance then what draws the precedence? That is, what target should be considered by the academe: the syllabi, mandated by the student as per contractual agreement between the student and institute duly agreed upon by both of them at the time of admission or the concurrent demand of industry (employer) or the student? This all is complex and Fuzzy, and needs to be resolved for a successful consummation of the process.

The four emerging key research areas (KRA's) that need to be considered are: 1) the inputs would have to be designed such that there is no gap in the education delivered and the education desired. The design process of the inputs should be mature enough to include stipulated changes in the technical and social environment expected over the duration of course and / or the productive deployment of the engineer. It is very vital to decide who takes charge of the design of such inputs from the industry or academia? 2) The second possible option is in giving the teacher a free hand. In this case, the question of accountability arises if this freedom is given and how many of the present-day teachers will be takers of this challenge? 3) The third option is in giving the student a prerogative to select his product. The industry is though a consumer and the ultimate beneficiary but industry allows the student to be appropriately compensated for his displayed quality both in cash and kind. 4) The fourth option is the domain in the current structure, when a student is left to his / her own decision-making. However, the society is not yet ripe for this interface unless the students have been culturally oriented to take charge of their own development. Out of these four cases, it has to be explored which option must yield maximum benefit to the society, keeping in mind that the world is continually transforming into a global village and new integrations like bio-technology or miniaturizations like nano-technology are making outreaches into common engineering and are steadily strengthening their applicability in technological infrastructure.

Attempting the implementation of a solution to the problems in this complex field leads to the following situations:

- A Holistic, Disciplined Decisive Development (DDD) must undertake itself in a disciplined, ethical, and quality environment. The question arises as to what will be the response of the students if they are handed over the reigns of their own academic process and whether the society can be able to provide an environment conducive to such a development. Such a decision-making competency calls for a big technical maturity conforming to the logical requirements of SHEQPC (Safety, Health, Environment, Quality, Productivity and Cost).
- The pre-requisites of such a development are conclusive competency and proficiency in settling the issues to the most socio-beneficiary option and a sea-change in the current education system.
- Certain specifically designed value-added indicators should be used to monitor the performance of the students to avoid the unintended consequences.

As educators and stakeholders we must take the trouble to look for respective roles in design of curricula, design of delivery and design of experimentation. Our sense of education has to be people-oriented so that the society does not suffer any loss. While People from reputed companies like Philips, Larson & Toubro, TCS and many others have all been talking of industry–academia interaction, the will surely exists; while the mechanisms need to be standardised. For educators, it is alright to share competent processes of the industry, but I think that the onus of responsibility for the quality of a product lies mainly upon the producers (academe; and as our products are being packaged up to / for industries the latter have a right to be satisfied of our process capability. Thus re-engineering of curriculum at every stage of student development is a must condition. As an input, feedback on the initial industrial experience of the students should become handy for the teachers to implement gradual change. It is vital because we have to meet the needs of the industry. We have to see that there is no gap between what they aspire to achieve and what they are achieving by way of improving the quality of our products, i.e., the students. This is why we are supposed to re-engineer. The demands of the customer can thus be satisfied. We must have a systematic approach to bring in qualitative improvement in the system to achieve the desired results. In order to be able to correctly visualize what is needed by the industry, the teachers must be more than competent. If he/ she has practical experience of the industry, it is only then that he / she can prepare his / her students according to their systemic needs.

Though the teachers have to inculcate all-round competency in the core sector during engineering student's planned education, their role is further challenging because they have to make engineering student's holistic professionals. They have to teach them both hard, soft (ware) and super soft skills keeping all these factors in view.

I have been interacting with my students who are now in good positions in the reputed companies towards nursing their soft and super soft skills. In fact I used to interact more with my students outside the class with a view to coach through one-to-one contact with them. I used to motivate my students in such meetings. It must be remembered that the educational process is managed not merely in the classroom but through a total life style activity. The environment in the educational Institution determines the brand the students carry forward, and is built at the behest of a positive relationship. Such interactions lower entropy while facilitates positive energies. Additionally, contribution to consultancy and 'earn while you learn' schemes tend to induce motivation and coherent teacher-student bi-development.

The system of engineering education must be responsive to the phenomenon of requisite development traversed in the journey from childhood to that of being a creator of material goods, infrastructure and / or functional products, etc. It must holistically stand-to for incorporating within the educational sub process a competence or an attitude "to make a reality of the potential value of science by translating scientific knowledge into tools, resources, energy and labour to bring them into the service of man or woman. To make contributions of this kind, the engineer requires the imagination to visualize the needs of society and to appreciate what is possible as well as the technological and broad social understanding to bring his vision to reality. 'Reengineering' conceptually empowers new creativity in problem solving using radical rethinking to meet stated objectives optimizing current technologies. While the engineering graduates accurately foresee compelling requirements of near future and determine requisites to realize them, reengineering presents itself as the preamble to conform the students to forecasted requirements.

Recounting the sins in educational system, it evidences that the largest and the most dominant in competency in engineering education is that the inputs are not aligned with the outcomes and there is, therefore, an urgent need to re-engineer it with a view to producing holistic engineers, who are masters of all trades, by programming the optimal utilization of the educational institutions' resources. If the product from education sector is required to emerge as robust, the academic process must be strengthened for its design-abilities.

Prof. Javed Husain

The history of technology has seen a number of episodes of re-engineering. One such transformation took place in the late 19th century when, because of the great strides in electrical applications, engineering became much more than mere mechanical and civil engineering and added electrical engineering to its corpus of knowledge. Similarly, the emergence of electronics in the 20th century was another great example of re-engineering. This was followed by computers and information technology revolutions. Are we going to see more waves of re-engineering? At least one such wave has already started to hit the engineering shores and promises to have consequences for all branches of engineering. This is nanotechnology.

Nanotechnology is based on being able to manipulate matter at the level of particle sizes of less than 100 nm and consisting of a few dozen atoms or small molecules. At this scale the surface properties begin to play a much more important role than with bigger size samples. Nanotechnology may be expected to provide the future building blocks of all technology. Traditional manufacturing has been based on a top-down approach. This works by starting from bulk raw material and generates the finished products through various processes such as cutting, milling and shaping. Such an approach leads to wastage of both the raw materials as well as energy. It also gives rise to atomic level defects in the finished product.

The advent of nanotechnology can lead to a major re-engineering paradigm shift. The new technology involves a bottom-up approach which is ubiquitously present in nature, including plants and animals. It involves manipulation at the molecular or nanoparticle level. The finished product based on this approach is of far superior quality and there is minimum wastage of the raw materials as well as energy. The incorporation of nanomaterials has given rise to hundreds of new products (see, for example, http:// www.nanoshop.com). These range from paints to textiles to packaging materials to cosmetics to foods. New products are being introduced on a weekly basis.

The time of nanotechnology has also arrived in India. The governments and the institutions of higher learning have been quick at adapting themselves to nanotechnology. However, the response of the business community in India has been less than desired. Perhaps the glamour of the information technology revolution has over-ridden the mental frame-work of our private sector. The general business bodies in India are trying to play their role but a separate nanotechnology business organisation does not exist. An early attempt in this direction is the Delhi Nanotechnology Business Group (http:// nanotech.meetup.com / 62)

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The demand for re-training and short courses in nanotechnology for our engineers can be expected to take off only when nano-industry begins to get well established in India. As long as the critical mass for nanotechnology short courses takes time to develop, it would be wise for different organizations to introduce "emergent technologies" courses which would consist almost fifty percent of nanotechnology but would also cover some other areas as well.

If you go back in the past to find out as to when the word re-engineering was coined, I think it was in the middle of 1990s. People realized that the information technology was such a big revolution that those not in this sector would be left behind. I think that the concept of re-engineering is old in the sense that technology has always emerged in waves and at a brisk pace, making the current ones obsolete. If you go back to the late 19th century, you will find that there were only mechanical and civil engineering. Electrical engineering and other branches of engineering came later on. The emergence of electronics in the 20th century was another great example of re-engineering followed by computers and information technology revolutions. The question now is what would be the future. I think that the future will be dominated by the Nanotechnology and Biotechnology.

Nanotechnology may be expected to provide the future building blocks of all technologies. Traditional manufacturing works by starting from bulk raw material and generates the finished products through various processes such as cutting, milling and shaping. Such an approach leads to wastage of both the raw materials as well as energy. It also gives rise to atomic level defects in the finished product. Nanotechnology is based on being able to manipulate matter at the level of particle sizes of less than 100 nm and consisting of a few dozen atoms or small molecules. At this scale, the surface properties begin to play a much more important role than with bigger size samples.

The advent of nanotechnology can lead to a major re-engineering paradigm shift. It involves manipulation at the molecular or nano-particles. The finished product based on this approach is of far superior quality and there is minimum wastage of the raw materials as well as energy. To understand this technology, one has to invoke the quantum physics. The basic quality of the product is very different compared to the conventional products and this is very significant as far as the nanotechnology is concerned. Once you get down to the nano-region, straight things start to happen. When you have nano-size objects, everything is on the surface as the nano-size is so small and there is no interior.

Nanotechnology business has now taken off in some of the developed countries. World-wide, the amount of money spent by the private sector on nanotechnology R&D has begun to exceed to that put in by governments and is likely to increase further by several notches within the next few years. This is not the case, however, in our country, coincidentally, though our government has funded a number of research projects in this area; and also the government and the institutions of higher learning in India have been quick at adapting themselves to the nanotechnology. As far as teaching nanotechnology is concerned, perhaps, it has been introduced at the M. Tech. level at more than fifty places. I would like to congratulate Dr. Ashok Chauhan for his initiative in this direction.

The supply of nanotechnology-related instrumentation and the supply of all kinds of nano-materials have become stable business areas abroad. However, the response of the business community in India has been less than desired and this is unfortunate. The reason for this is probably lack of awareness. Perhaps, the glamour of the information technology revolution has over-ridden the mental frame-

work of our private sector. The general business bodies in India are trying to play their role, but a separate nanotechnology business organization does not exist. Nano-instrumentation is very important nanotechnology businesses, taking off in India, as the colleges and universities, having nanotechnology courses, require suppliers of instruments. I think that the business community in India should take the nanotechnology business in a big way. We have made a very small attempt to start a nanotechnology business group. I would request Shri Ajay Poddar of PHD Chamber of Commerce and Industry to take some business proposition related to nanotechnology.

The area of re-engineering through nanotechnology short courses and training is related to nanotechnology-consultancy wherein the consultants would be producing business reports and training people relating to the establishment of different types of nanotechnology businesses in various parts of India. It would be wise for different Indian organizations to introduce "emergent technologies" courses consisting of almost fifty percent of nanotechnology while also covering some other areas as well. Our engineering colleges and polytechnics need to take the initiative in developing these needed courses. The Indian Society for Training and Development can also provide leadership in this area. Nanotechnology is suited for the small business players because its products do not require after-sales service as the nanotechnology products are passive in nature.

Nanomaterials also exist in nature. Research is needed to study its effects on health as this aspect is not fully understood. There are certain catalogues of nanotechnology products on the internet, *http://www.nanotechproject.org/44*, and it deals with Nanotechnology Consumer Products Inventory. This site contains many nanotechnology companies. 580 products and 305 companies of 20 countries, excluding India, have participated.

From the Floor

A delegate

I am from Calcutta University and have remained in the teaching profession for so many long years. I am involved in the consultancy work for the last ten years where again I am virtually in the teaching profession. I have come across the young graduate and postgraduate engineers whom I have found material-wise very good and they only need a little help for further improvement. I am also found them willing to improve. In the early days and in my time particularly, I have found that though the teachers were not very bright, they were so dedicated and so sincere that a student could approach them any time. Now-a-days, it has become a business. My concern is that the engineering educational institutions must develop, must compete in producing quality engineers. A fresh graduate engineer considers that doing postgraduate is simply wasting the time. He/she rather prefers to join the industry in order to get a good pay. It is not that doing postgraduate does not fetch more money. I know one of my students who, after joining an industry, was initially getting Rs. 9,000/- as salary but, after he did the post-graduation, he started getting a salary of Rs. 40,000/- Let us not make education a business. I fully agree with Prof. Thareja that education cannot be done by everybody.

A delegate

We have landed on the moon. It is perfectly o.k. Electricity to the big industrial houses is being supplied by an uneducated person. Where are the engineers and the diploma-holders? The second point I

would like to make is that the teachers' dedication is an essential pre-requisite, as expressed by my learned friend just now, for improving the quality of engineering education. Students, after passing class XII, start looking for good coaching centres and those, who can afford the huge fee, do join. We must remember that the red fort can exist for so many years without steel. What matters is the foundation, the base. The student, in fact, has got a different objective. He has to go to a different coaching centre for getting chance in IIT and to a different coaching centre for getting chance in other engineering colleges.

The All India Council for Technical Education Council (AICTE) should conduct only one entrance examination for admission in engineering colleges throughout the whole country. It may, however, consider giving the franchise to the engineering Council of India. Different states are conducting these examinations separately. Sometimes, the students are put into severe difficulty when the dates of examinations of two states happen to coincide. This august body should consider these points seriously and should make a recommendation in this regard.

Dr. P. K. Sarkar

It is very difficult to summarise what different learned keynote speakers had said in such a short time. Prof. Dhar was very enthusiastic in saying that there is no problem in the system but there is need for one certificate such as diploma or degree available in the country and there is not going to be any difference in the system. So, it is a good endeavour to adopt the system of re-engineering, but it is very difficult to do that. The next speaker while stating that there is no problem in the present system as such, there are some shortcomings and there is a need for more transparency in the present system. These need to be addressed with the process of re-engineering. Prof. Thareja said that an engineer's job is very difficult as he / she needs to compromise with the science and society by contributing in a most honest and dedicated manner. We should be guided by the process of re-engineering in order to give maximum benefit to the society. We have also to look into the aspect of quality of teachers. The teachers should basically have all-round competence. It was also expressed that the teachers should be made available for twenty-four hours. Being from academic side, I also feel that if the teachers are not motivated, the students cannot be expected to be motivated.

Prof. Javed Hussain, said that the engineering fraternity should concentrate on the information technology, nanotechnology and biotechnology as this is the need of the hour. It is very difficult for me to explain the relevance of this aspect in the context of today's conference.

Being an academician, I feel that many points made in the session need to be addressed. However, I will address some important points out of these. Many speakers have said that about 4.5 lakhs of engineers are coming out of the educational institutions per year. There is the problem of quality as we find that only 25% of them are employable and 75% are not employable. So, how to manage? There is a great demand of engineering graduates in the country and also there is ample opportunity abroad. Our engineers have got a good reputation in foreign countries also. So, how to go about when so many colleges have come up? Somebody was mentioning about the different coaching institutes depending upon the college the students wish to be admitted. The point is that do we have inadequate faculty in our engineering colleges? Many colleges are running on fifty percent faculty and this point has been

Dr. P. K. Sarkar is the Hony. Secretary , Institute of Urban Transport.

put up to the government of India. The other point is that when we look at the various engineering colleges, many students get entry into the colleges just by paying high amount of money. The quality of such engineers can naturally be imagined. The question is that are we going to look at this issue? Some keynote speakers have identified some problems and defects in the basic system (of the engineering education today).I will no agree more with them. Yes, there are a number of problems and defects in the basic engineering education system today. We cannot expect that we have the quality engineers. We are not in a position to rectify the institutional mechanism. We can have a number of workshops but under these conditions, nothing is going to come out.

I belong to the School of Planning and Architecture. The teachers of the institute develop a number of assignments of the live projects for students and the students are required to work on these projects involving also collecting the data from the field. When after doing such type of exercises during the course, the students feel very comfortable when they go to the field after passing out and are immediately absorbed. Many industries feel like to have people from our institute. Our institute has a mechanism that we do not confine our teaching to the classrooms only. In short what I am saying is that the engineering students should be required to work on the practical projects involving also collecting the data from the field. When after doing such type of exercises during the course, the engineering students will feel very comfortable when they go to the industry after passing out, which will find them employable. The teaching should not remain confined to the classrooms only, as is the case generally at present. It must change.

I always tell my students to come to my house also for academic discussions. So, unless we address the shortcomings of the institutional mechanism, nothing is going to come out no matter how many conferences or conventions are organised on this subject, which, I consider, is of national importance. We try to motivate the students to the extent possible. We, therefore, find that our students may not be of very high quality and rather of mediocre quality but we teachers take that type of initiative to see that when they pass out, they are not only well placed in our country, but also get placed abroad like Australia, Canada, United Kingdom, etc. Therefore, I feel that if you are interested in re-engineering the engineering fraternity, there are many ways. The only thing is that we are to motivate ourselves and to make ourselves committed. I will like to tell this august gathering that if a committee, consisting of members from the industry and the academia, is setup after the deliberations to address the shortcomings of the mechanism and to suggest that how best we can improve the quality of engineers by making some suitable recommendations, we can put up the same to the government of India for kind consideration.

Technical Session-III

Re-engineering Engineers – Views from Professional Associations

Blank

Lt. Gen. A. K. Puri

We have had excellent sessions and a lot of ground has been covered on the subject of this national conference. We have in the technical wings of the Army, particularly in the Boarder Road Organization with which I have been associated with as its Director General, graduate engineers, postgraduate engineers and PhDs as main functionaries, as executives and think tanks. On the supervisory side, we have diploma engineers and engineer technicians. All these professionals are continuously re-engineered through short courses, seminars, workshops so that they are able to perform their assigned tasks with high degree of professionalism. In the Army, given the nature of jobs those are required to be undertaken both during peace and war, technical arms like corps of engineers, EME, signals & the Boarder Roads, adopt seamless engineering innovative techniques. We lay emphasis on building multi - skills in our engineering workforce for undertaking jobs which often need a multi-skilled workforce. These skills are continuously re-engineered and upgraded to face actual combat conditions with the enemy. We, therefore, re-engineer engineers for meeting the technological and other challenges, which keep on emerging at a fast pace, with their continuing professional development. A similar parallel can be drawn with the industry. Given the kind of challenges and the opportunities that are coming up with the new competitive and international economic order, industry cannot afford to remain in the old antiquated mode. It has to change for meeting the new demands of the open economy. It will have to re-engineer its technical work force. In the distant horizon of meeting our long-term needs, we should also think of changing the engineering education as well for making it more specific to the current and future needs of our economy in general and the industry in particular. From this view point, I think that the theme of this conference is apt and timely.

L. Pugazhenthy

Coming from the Indian Institute of Metals, we compliment the Engineering Council of India for bringing the various professional bodies and societies, dealing with the engineering profession, under one umbrella and trying to create a vehicle for the engineering community like many other professions such as lawyers, doctors, chartered accountants and identifying themselves with the profession.

The engineering community is highly fragmented as well as getting more and more specialized. Everyone looks to his / her own contribution. To that extent, ECI should be complimented creating an awakening. I know a number of national conventions have been organized by the Engineering council of India on the seamless engineering, re-engineering, etc. We have been discussing the various issues like lack of passion amongst students and teachers, industry-academia linkage missing, etc. All these issues and concerns which, we are discussing today are not new. These were all known earlier also. It is re-engineering or re-inventing the engineering values. We had economic reform and reforms in other sectors, why the reform in the educational sector is very far and few? It is going at a slow pace. The question is why we have not done so all these long years. It is high time, therefore, to act and re-engineer the professional / engineering education in India.

If you look at the definition of engineering, you will find that it relates to using the laws of nature to create products and services for the benefit of mankind. That is one definition. The other one is the

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application of scientific principles by which the properties of nature are made useful . According to the third one, engineering is the art of directing the great sources of power in nature for the use and the convenience of humans. If we look at all these three definitions, one thing which is common is nature and the second common thing is humans. Therefore, the question is how mankind gets the benefits from the nature. If you remember the Stone Age, the ancient man created fire (energy) by rubbing stones through friction. Today, the same man generates power and energy from the running stream of water. So, that is the story of nature and how mankind has been benefiting from the nature. Now, coming to engineering, how is it different from science? Science is the foundation and engineering is the super structure. Engineering is totally application-oriented, applying the scientific theories for useful and economical ends / applications. Therefore, engineering requires the creative imagination to innovate useful applications of natural phenomena. In its modern form, engineering involves application of men, money, materials, machines and energy for getting benefits. Most importantly, engineering is highly innovation-led and creativity-driven. Creativity or innovation is the hallmark of engineering. That is why we see a young, creative child, when fully grown up, desiring to become a jet pilot, an engine driver, an astronaut etc., all linked with gadgets developed and produced by engineers. Engineering is dissatisfied with the present methods and equipment; it always seeks newer, cheaper, better means of using natural sources of energy and materials to improve the standards of living. But, today the children are different. They want to play with computers and mobile phones. The common toy of today's children is the mobile phone.

It is amazing how our forefathers would have handled the construction materials and built the well known monuments like Pyramids, Pisa Tower, Taj Mahal, Iron Pillar etc. which are strong and stable even today. These have been built so strong that they have passed through hundreds and hundreds of years. In the forenoon session, Prof. Thareja had mentioned about tissue engineering, which I think is something new. You have today bio-medical engineering, highway engineering, marine engineering, aeronautical engineering, leaving apart all the conventional branches of engineering.

Today, engineering has become, multi-disciplined, multi-skilled and multi-directional. Engineers should feel proud of whatever they have done. This multi-disciplined, multi-skilled and multi-directional growth of engineering has certainly been able to meet our requirements along with the passage of time. It has been able to meet the needs of infrastructure, construction, research, training and other fields adequately. What has happened in the process is that engineers have remained totally bogged down to the machines and he / she is, therefore, very particular about the function or predictability of the behaviour of machines'. On the other hand, the engineer is not able to predict the behaviour of his / her own management team, group dynamics, the psychology, behaviourial science, handling money, handling a product, teaching the customer / user, etc. These are also very important areas for an engineer to know and work with. This is a very important point for an engineer today to consider. Unfortunately, engineers, as professionals, continue to remain focused in their chosen areas of specialization and complacent meeting the production or quality targets only, keeping their eyes completely closed to the other areas. Many engineers lack the basic knowledge in finances and a large number among them could not even read and interpret the balance sheets. Thus, engineers remain, by and large, insulated from the modern and emerging subjects and techniques in HR development, financial management, business management, marketing and sales management. The root cause of

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this situation in which engineers find themselves today is the educational and merit evaluation systems that we have inherited, which we had not revalidated with the ever changing needs of the society.

India is fast emerging as a knowledge economy. Many blue-chip companies have set up manufacturing bases, research and development centres, design centres in India because of the vast engineering and software skills available in the country. India is expected to become an export hub for many companies around the world. Our engineers should have the power and vision to understand as well as comprehend the existing system and the power to make exciting new beginnings for discovering the unknown, to leverage innovation, research, optimization, breakthrough technologies and developments to sustain the whirlwind pace at which the world is surging ahead in the knowledge sector. Besides the nuclear advantage, India's spacecraft reaching the moon through "Chandrayan", has already put the country in the super league. All these mean that the Indian engineers will have to be multi-faceted, global engineers with a high passion for innovation. It is the innovative spirit of our engineers as well as the scientists that is going to take India several miles ahead of other countries in the race for global leadership. That is where our homework also begins to critically look at the current educational and training systems so as to bring about radical changes in the shortest time. It is also here that the process of re-engineering of our engineering education and profession should begin.

We should also look at the deficiencies that are there in our higher educational system, particularly higher technical education. Perhaps, these deficiencies have crept in partly from the current regulatory mechanism represented by the government bodies like the UGC, AICTE and multi-level state government bodies. Perhaps, time today demands that the education sector should not remain in the hands of the government. If Amity and other educational institutions are doing well today, it is because they are free enterprises. A minimal intervention in the process of education, however, is desirable. We need to spell this out clearly and implement it.

Turning to the metals sector, to which I belong, I am very happy to say that Indians are everywhere running steel plants, acquiring resources and mining companies. They are literally driving the whole world. Meltdown is a natural phenomenon. We should not worry about the current phase of recession. It is a passing phase. It is the part of a cycle. Every dark cloud has a silver lining. It is India and China who are partly going to mitigate the problems of global recession. These countries can accelerate the infrastructural growth. If they can sustain themselves on the export front, I think most of the commodity markets and products would see better days. The IT revolution led India to where it was centuries ago. Today, India is looked upon as a knowledge economy and a super economic powerhouse. India has become a hub for the global computer and automobile companies.

Having said all this, what is needed from this country is "engineers with a very high innovative spirit". For that, we need global engineers with a global vision and passion for engineering. Today's children may know about Bill Gates but they may not know about our own engineer the great Viswesarayya. They would know about all the brands of telephones such as Nokia, Samsung, Motorola, etc. but they will not know who invented the telephone. Children are fancied by the modern exposure. So, we have to create a passion in the students community and re-engineering is, therefore, a must at the school-level. This is the duty of this august gathering with persons of vast experience. We have to tell the students directly where our country is going to be in future.

In the schools, we have two streams, arts stream and science stream. I recall in my young days there used to be a third stream known as engineering stream. People used to do carpentry, fitting, etc. in schools also. We should enable students in doing something with their own hands in their schools. This will give them a practical or an industry-touch. Today, when you write to an industry to take a few students for summer vacation training, industry is very reluctant to take them. Industry also has to come in a big way. Today, much needed industry-academia linkage is missing. The industry does not go the academic world as they think that the academics are all bookish. Persons from the academic institutions also do not go to the industry at regular intervals. I think that both should work together pro-actively in an exchange program.

Today, engineering colleges, particularly after privatization, have mushroomed in many cities and towns of the country. Many of these colleges do not have the required infrastructural facilities like machines, computers and even roof, etc. Many operate without requisite strength and quality of faculty. I leave it to you all to guess what kind of engineers these institutions will eventually turn out in the coming years.

In conclusion, the apex body ECI can play an active role in bringing the various engineering professional bodies, academia, researchers, students etc., as frequently as possible at various places and create a new wave and generation of young engineers with a global vision and innovative spirit.

S. Ghosh

Engineering is to contrive, make and happen something tangible which is useful to the humanity. The community who does so and have to have special skills to do so are known as engineers. Re-engineering of engineers would be remaking these engineers with skills and thinking ability to act in an appropriate manner rather than carry on mindless repetitive action they have been following. An engineer acquires his basic knowledge of fundamental principles of nature and the forces those controls, causes things to happen ("physics") in schools, colleges, universities. They also learn materials, methods and tools as to how to make things happen. The skills of engineers need to be sharpened and developed while they pursue their working life - may be when they are engaged in practices such as teaching, research or working in industries or in the governmental or regulatory bodies. The objective of the re-engineering is, as I understand it, to upscale the skills to respond to emerging economic and commercial scenario in the world and to address changing needs of the society as we go along the time horizon. The process to be effective has to happen during the initial years as they enter the working life (1 hint at the Initial Professional Development – IPD) and periodically as they go along their professional life (I mean they need to pursue Continuous Professional Development (CPD) programmes).

Let us look into the aspect of what are the changing needs of the society and why we talk about re-engineering. The question here is: are we not concerned with the fact that while the population is growing, limited natural resources (land, water, conventional energy sources, etc) are depleting fast. If the population grows and the availability of natural resources remains constant, the per capita availability of these resources will fall resulting in reduction in the quality of life. This would not be

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acceptable. The demand for a better quality of life will always remain rising. Is it not a paradox? So the onus is on the "innovativeness and re-engineering" of things to do, way to do these and the mindset of people who do it. The society wants the engineering community to act in a manner that results in enhancement of quality of life through optimum use of limited resources inter alia also with recycling of the resources, achieving energy efficiency, judicious use of financial resources, etc. The society also wants engineers facilitating well fare of the entire cross-section of the society by way of poverty alleviation, empowerment, protection of the environment and the biosphere.

It is being said widely that we, the engineers, are not in sympathy with nature, do not strictly adhere to the sense of morality and ethics because we are under pressure of being influenced by technology and other compelling reasons. It is affecting our society at large and also our planet earth. So, engineers have to re-engineer and to do it, the process that he / she follows will have to be such as would lead to the desired end. Expectations from an engineer are that they should give holistic solutions to problems that they may encounter. The most important goal for them is the protection of environment for which engineers need to act sustainably and in responsible manner and that's the right thing to do. Sustainability is an issue of very central concern in our built environment.

Today, we are in a different kind of world economic order, which is wide open and of competition from overseas suppliers. We need multi-skilled engineers for tackling the emerging challenges and seizing the opportunities that are coming up at a fast pace in the new open world economic order. Engineers that we have today are still in the old mould. We have to recast them in the new mould. Merely, the basic knowledge of physics, material science, theory of structures, machines, multiplicity of analytical models and the like will not do. For meeting the current and emerging challenges, we need to change the very engineering education at the undergraduate level by integrating engineering disciplines and adding to the curricula subjects from the other disciplines like economics, law and management for producing multi-skilled engineers.

Engineers of today must be able to understand, appreciate and have full knowledge of the usage of the end products (functional requirements of what he / she is to produce), financial constraints - budgets and other commercial requirements, project execution time, legal and statutory provisions guiding his / her work, his obligations to the society and accountability, risks and rewards of his / her work, codal provisions - IS / BS / NB Code / ISO, et. al., ISO – quality assurance needs and safety and health requirements, knowledge of formulating projects, conducting feasibility studies, detailed project reports, managing construction of multi dimensional projects ,etc.

An engineer today should also have and acquire full knowledge on sustainable use of materials, relevant environmental concerns, construction techniques, skills for programming and control of project implementation and the routes and forms of construction contracts and, most importantly, he / she must have effective communication skills and inter-personnel skills which are a must to be able to express his her viewpoints and make others understand and appreciate the same.

Further, an engineer should understand the project environment and the project-sponsor's needs. When talking from structural engineer's point of view, a structural engineer should know structural stability, durability, aesthetics, analysis and design of structures – software applications and follow the global shift from deterministic models to probabilistic models and reliability-based design criteria.

I fully understand that the quality of the engineering education and the curriculum is to be improved in order to re-orient the engineers in the above-mentioned direction. While the various authorities involved in it like the UGC and the AICTE are very much concerned with the issue, the professional bodies have the most important role to play. They have to shape the professional engineers through the pro-active CPD programmes in the initial years and as they go along with their career path. I know that most of the associations are trying to do so by designing various modules, models, holding conferences / seminars. But the question is that do they get enough support from the profession as well as the society and the regulatory authorities?

K. K. Agrawal

My presentation relates to providing solutions to the extreme shortage of adequately qualified and trained workforce of civil engineering graduates on the designing, planning and construction of civil engineering projects in the country. I am confining myself to the Industrial structures and to the housing, commercial and technical buildings. You all know that the civil engineering construction activity in India has grown in explosive proportions during the last few years in the areas of buildings–residential / commercial / industrial and civil engineering infrastructure – roads, highways, flyovers and bridges / energy & power generation / tourism & hospitality, etc. Projects have come up in plenty, barring, of course, in the last about 5-6 months which is only a temporary phase to continue for another couple of months. The availability of civil engineers' has become extremely acute. The demand for civil engineers has gone already multi-fold and will grow even further in the years to come. Today, therefore, there is an acute shortage of qualified and adequately trained civil engineers in the country. The shortage may explode in the years to come, if it is not properly and timely tackled today on a war footing basis. The fresh civil engineering graduates of reasonable standards are not available. The quality of the available working civil engineers too is also far from meeting even the minimum requirements. Consequently, the pace of development in the real estate and construction industry at large is being greatly affected. This is also greatly affecting the product quality, causing an unwarranted increase in project costs in design, procurement process and construction.

The situation is going to worsen with time to come as the construction activity will continue to grow for at least a quarter of a century more. The number of civil engineering graduates passing out annually is so low that it covers up only a small fraction of the market requirement. The quality of these engineers is far below desirable standards. The issue, according to me, has not been properly addressed. Project economics and sustainability and quality and competitiveness are the biggest casualty. The capacity building will eventually suffer, resulting in a great concern especially when globalization has entered India fully. The existing workforce needs to be trained for the optimum utilization of the new technologies. The diploma holders in civil engineering, though are in short supply in present times, are still not in reckoning as a force to come to the rescue of the situation. Their engineering potential can be tapped by their re-engineering with short term need based skill up - gradation programs in various areas of building planning, designing and construction. I am suggesting, therefore, both the short-term as well as long-term measures which can be taken immediately for implementation as a matter of concerted action plan.

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The short-term measures – 3 fold suggestions are made:

i) Qualification and skill up-gradation of diploma holders (and poorly qualified graduates) in civil engineering through specially designed and structured training capsules separately in the areas of a) structural designing and b) construction management and supervision providing for application variability in different fields. This will partly fill the gap caused by shortage of graduate civil engineers.

ii) A program should be taken up for qualification and skill up-gradation of advanced level for the available graduate engineers in a) advanced structural designing and b) advanced project planning and construction management. This will enable developing designers and construction managers; it will also fill the gap caused by virtual non-availability of post-graduates in civil engineering.

iii) The engineers and managers working in the industry as consultants, contractors and user organizations should be periodically trained in-service skill up gradation through short courses and workshops as a matter of regular measure for their professional updating. This aspect of human resource management has to be brought home to the user organizations: construction companies, real estate developers, design consultants, construction management consultants, etc.

The issues to be addressed for all the above mentioned measures are:

1) Quality and contents of the up-gradation programs to be of the state-of-the art quality, and be Industry-Specific and Application-oriented,

2) Extensive training of the trainers / teachers of these programs,

3) Vocationalisation of the training and teaching with high assimilation and absorption levels,

4) Organizing special training for the academia to meet the standards and requirements of teaching which should be of optimum use for direct applications into the industry,

5) Using the trainers from the industry for interaction with the academia, and

6) Exchange between academia and industry professionals.

The Long-term measures :

The long-term measures that need to be taken primarily relate to introducing reforms, as a course correction, with an objective to improving the civil engineering education. Specifically speaking, there is a serious necessity for bringing about reforms in the civil engineering education in the country at the undergraduate, postgraduate and research levels for making it state-of-the art, useful, objective, Industry-specific and market-need-specific, suitable as application-oriented ..The contents and syllabi need immediate modification as part of an urgent course-correction.

The civil engineering education especially at the undergraduate level is still in the very old and traditional frame. It is proving to be insufficient for catering to the needs of the modern day technology required by civil engineering projects in terms of materials, design, construction methods and construction management and maintenance. The suggested reforms are in direct response to and guided by the industry requirements of the day. It is also relevant for the distant future in order to make

the teaching and contents of knowledge transfer of the civil engineering as objective, responsive, directly application-oriented and helpful in improving on quality and cost effectiveness of the civil engineering projects. The reform needs to be brought on a fast track action programme as the implementation to reforming the civil engineering education at the undergraduate level will take time; and after the implementation of the programme , the results will take as much as four to five years before fructifying and start showing up on the ground.

The suggested brief on the proposed reforms, its genesis and necessity, is detailed here-in-after.

1. The size of civil engineering projects, their complexity, need for cost effectiveness in structural designing, the updated materials technology and modern and mechanized fast track construction techniques, make the available level of course contents in existing degree programs appear as too general and grossly insufficient. These are not able to cater to the requirements of present day level of technology.

2. More contents and specific discipline-wise industry specific specializations need to be included in the degree course syllabi and duration of degree program needs to be increased. Splitting up of the degree courses suiting the discipline-wise course contents is called for.

3. The existing Civil Engineering under-graduate degree courses are of general subjects covered in 8 semesters in 4 years duration.

4. The present degree programs of 8 semesters need to be changed to separate Honours Degree programs of 9 / 10 semesters in various different specialized and application courses covering updated and modified courses conforming to newer technology in various application areas. If course duration of 4 years is not favoured to increase, two summer breaks / vacations each of about 8-10 weeks, after 6^{th} and 8^{th} semesters, can be converted to teaching to carve out the time span of so suggested 9^{th} and / or 10^{th} semester.

5. The present syllabus of core subjects should be pruned and covered in the first 5 to 6 semesters and the last 4 to 3 semesters devoted to the respective specialization in different application areas of Civil Engineering practice.

6. The duration should include the practical training and compulsory exposition to at least two projects related to the relevant specialization, one each in last 2 semesters of the honours degree course.

7. There will have to be sufficient choice in the list of elective courses available to choose various sub-specializations in different programs.

8. The standard of the courses, in theory content, will be higher than that of the present under-graduate teaching programs and slightly lower than but touching the boundary of the post-graduation.

9. However, the orientation, besides coverage of adequate and comprehensive theory, will be practical, vocational, with sufficient direct application practice and market need / industry specific, that is, of direct professional application rather than being general and theoretical alone.

10. The areas of honours courses could be in the streams identified as :

- Structural Engineering (Bachelor of Structural Engineering) : Specialization in Building Structures and Specialization in Bridges & Grade Separators;
- Geo-technical Engineering & Foundations (Bachelor of Soil Mechanics & Foundation Engineering);
- Transportation Planning & Engineering (Bachelor of Transport Engineering) : Specialization in Roads & Highways, Specialization in Railways & local Rail Transit Systems, Specialization in Ports, Harbours & Off-shore Structures, Specialization in Airports & Civil Aviation Infrastructure;
- Construction Management & Maintenance (Bachelor of Construction Management) : Specialization in general Buildings, Specialization in Roads & Highways and Specialization in Industrial Projects;
- Public Health Engineering & Waste Management (Bachelor of Public Health & Environmental Engineering);
- Irrigation Engineering & Hydrology (Bachelor of Irrigation Engineering) and
- Rural Infrastructure Engineering (Bachelor of Rural Engineering).

11. The number of seats in each of these courses has to be optimally high, at least for a few years may, be a decade, depending on the availability of infrastructure and faculty of the Institutions.

12. All this will warrant huge augmentation of the infrastructure/resources in each academic institution. The financial support has to come from the Industry out of the savings expected to be generated in the process.

- Structural Engineering (Bachelor of Structural Engineering) : Specialization in Building Structures and Specialization in Bridges & Grade Separators;
- Geo-technical Engineering & Foundations (Bachelor of Soil Mechanics & Foundation Engineering);
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- Construction Management & Maintenance (Bachelor of Construction Management) : Specialization in general Buildings, Specialization in Roads & Highways and Specialization in Industrial Projects;
- Public Health Engineering & Waste Management (Bachelor of Public Health & Environmental Engineering);
- Irrigation Engineering & Hydrology (Bachelor of Irrigation Engineering) and
- Rural Infrastructure Engineering (Bachelor of Rural Engineering).

13. The protocols and procedures have to be set up by activating the Administrative organizations like AICTE and Min. of HRD at the center and similar action in respect of the State controlled organizations.

Augmentation of Part-time Degree Programs.

1. The part time degree programs are offered by some institutions to diploma holders. These programs should be made more popular with certain incentives to the students as well as to the Institutions. Such courses should also be made attractive for industry that can provide support to such a part-time degree courses by sponsoring people working with them.

2. The course contents and syllabi should be upgraded to include more relevant subjects and the degree courses need to be vocational and specialized.

Reforms for the Postgraduate (PG) Degree & Research Programmes

1. The Postgraduate programme contents can follow the degree courses mainly for higher specializations and advanced applications as well as preparatory to suit the research applications; but 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 and / or research-oriented.

2. The level and quality of research, especially in the civil engineering field, need to be upgraded to higher standards, to be objective and to be of linkages and application to industry. The research should be on current and emerging issues related, particularly, to the civil engineering applications such as on materials, designs, innovations, etc, and for realizing cost effectiveness.

3. The faculty for the purpose will also need to be given special training and orientation of not only traditional theoretical treatise of various subjects but also of practical subjects to suit the industry requirement through putting them to some essential courses / workshops conducted by knowledge oriented teams from Academia / Industry professionals.

4. The engineering institutions should also invite industry professionals to their faculty for the courses which relate mostly to the practical working. This can be better done by introducing industry-academia interaction and faculty / professionals exchange programs between industry and engineering educational Institutions.

5. The faculty should also include practicing professionals who are highly qualified and experienced from the government, public and private sector and individual reputed engineering consultants

6. These types of interactions will partly solve the problem of shortage of trained faculty as well as give a platform for understanding the Industry requirements to reinforce the courses and its contents.

7. Such interactions will also help understanding, synthesizing and compiling of the Industry and market requirements, from time to time, to enable the course contents to be dynamically upgraded as a continuing exercise. A mechanism will need to be developed for this type of course correction in the syllabi of the honours degree courses.

Suggested Mechanism of Application:

The short-term measures indicated above, can be undertaken by professional organizations like the Engineering Council of India, Institution of Engineers (I), Consultancy Development Centre, Consulting Engineers Association of India,etc, in addition to the prime academic institutions like IITs and NITs with close co-operational and interaction with professional organizations. The participation of industry has to be pro-active to see that the above mentioned proposals are given due consideration by all concerned. The above mentioned professional bodies must get seized of the matter and come forward for playing their role, shedding out the hesitations and inhibitions. Industry's cooperation, in the matter, with the academia has to be ensured and organised in terms of financial assistance and funding in the huge efforts for augmenting their infrastructure for implementing the reforms as well as increasing the seats in various engineering courses, particularly of civil engineering stream. Industry should also come forward for academia and industry cooperation in the field of teaching, revision of syllabi, exchange of faculty, technology transfer etc.The efforts of ECI in conducting the present conference is the 1st step in the direction which needs to be extended on war-footing by all concerned, as suggested.

Re-engineering of Diploma Engineers:

It is well-known that the diploma engineers are initially deputed mostly and generally to jobs requiring technical skills of engineering-specific functions. They need exposure to specifically developed programmes to orient them to adopt those skills which are required for the job for which they have been hired. This can be part of induction level programme to be conducted by the hiring organisations, if they have the mechanism in place to do it, or, if they do not have this mechanism in position, it can be done by those education and training institutions that have been specially promoted for it. As these diploma holders grow up in the service ladder, a stage comes for them when they find opportunity to be in either senior technical positions, or, in managerial positions. When this stage comes, they need to upgrade their skills. In the senior technical positions, they need relevant higher technical skills along with managerial skills, personal management skills, policy identification skill of organisations for which they are working. This calls for re-engineering exposure to a very well designed training programme.

For the managerial positions, they need exposure to : a) business processes, methods and management, b) project planning, monitoring & management, c) procurement management, d) quality assurance management & monitoring, e) safety management, f) environmental planning & management, g) business and mercantile law covering labour laws, contract laws, arbitration and disputes laws etc., h) personal management including behavioural psychology & personality development, motivation and leadership, j) financial management & accounting and k) decision making & organisational aims and policies.

The Engineering Technicians

They are basically technically-qualified skilled technician's whose practical skills are to be developed for achieving quality out put. The induction level training for them can be on - the job programmes comprising achieving proficiency and quality of their work. Over the period of time, their avenues of upping on ladder are positions of supervisors, assistant foreman and foreman. They need skills

covering quality assurance and management through inspection and testing, personal management, motivation for achieving targets and at the foreman level a limited exposure to the policies of organisation for which they are working.

India should have many training schools to cater to the small and medium size companies who cannot afford to have their own training divisions. The organisations like Engineering Council of India, the Institution of Engineers (India), CEAI, CDC, national and state industries corporations, academic institutions like IIT's, NIT's and various other private and public sector institutions should come forward for this purpose. What is required to ensure is the quality and efficient delivery of the programmes. There has to be monitoring and regulatory body to oversee the quality and delivery of the programmes.

Alok K. Ghosal

I have been working with the Tata Steel for the last thirty years. I am deeply connected to American Value Engineers. You should be happy to note that India is a fastest growing economy today. We are next to China and Japan. We should be proud of it. The GDP growth rate of India is very fine and robust. A strong competitive workforce is a pre-condition for sustainable national progress. The increased share of the educated people, particularly of the engineering graduates, is an essential pre-requisite for this. If you want rapid industrialization and increased competitiveness, we have to shift from low-cost labour to high-skilled intensive products i.e what China did. We have to have engineering education development for this. The subject of today's conference is Re-engineering of engineering education.

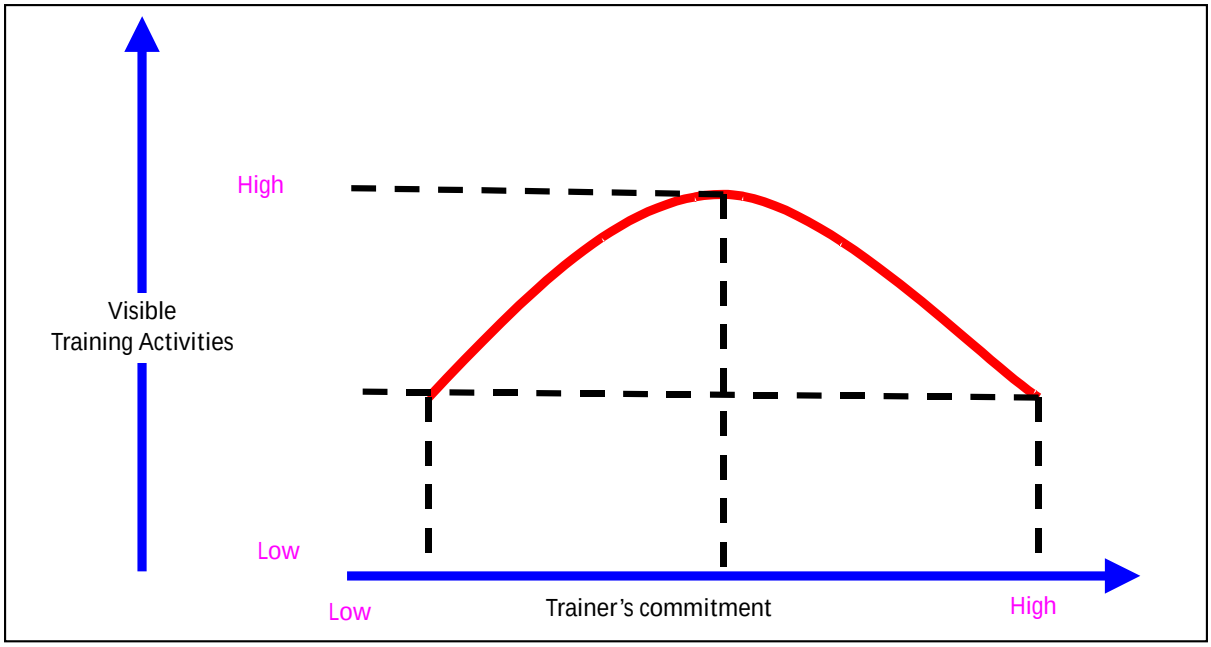
India is the 4th largest economy in the world on purchasing power parity basis. GDP growth rate of India is around 9.4%, second only to China. Economy is growing robustly (6%). Our population is more than 110 crores and that of China is a little more than 125 crores. In another 10 years, we are going to catch up China with respect to this ratio. Let us look at the ratio of population to the number of engineers. It is given in the following table. We can see that the Europe and the USA are producing / per capita more engineers than India and China; while as today India is marginally higher than China in this ratio.

China	India	USA	Europe
2197	2306	4285	8096

India currently has 113 universities and around 2088 engineering colleges. Engineering colleges in the country have been growing at 20% a year. India produces about four lakh of engineering graduates every year. While there are a handful of engineering colleges which are worth mentioning, most of them are not up to the mark. This should be a serious cause of worry. The Employees Federation of India (EFI) foresees a severe shortage of skilled workforce (read engineers) a few years ahead which would seriously retard growth if left unaddressed. The only way to forestall this possibility is a complete overhaul of the present engineering education system to synchronize it with the growth of global technological developments.

Shri Alok K. Ghosal is the Projects (VE), Engineering & Projects Division, Tata Steel

The students pass out from engineering colleges and get absorbed in organizations. Today a fresh engineering graduate does not know what is exactly economy and what is exactly meant by society and he / she suddenly gets absorbed in an industry which has to deal with the shareholders, suppliers and customers, etc. Students are thus lost. For improving the education effectiveness, we must have an evaluation system. We don't have an evaluation system. I passed out thirty years back. I find that there is no system for measuring the effectiveness in engineering profession. There is no system for evaluating whatever I am doing professionally. The main purpose of evaluating engineering education system is justification of investment, scope of improvement, performance of teachers and performance of students. Evaluating engineering education system should be seen from the angle of visible training activities versus trainer's commitment.



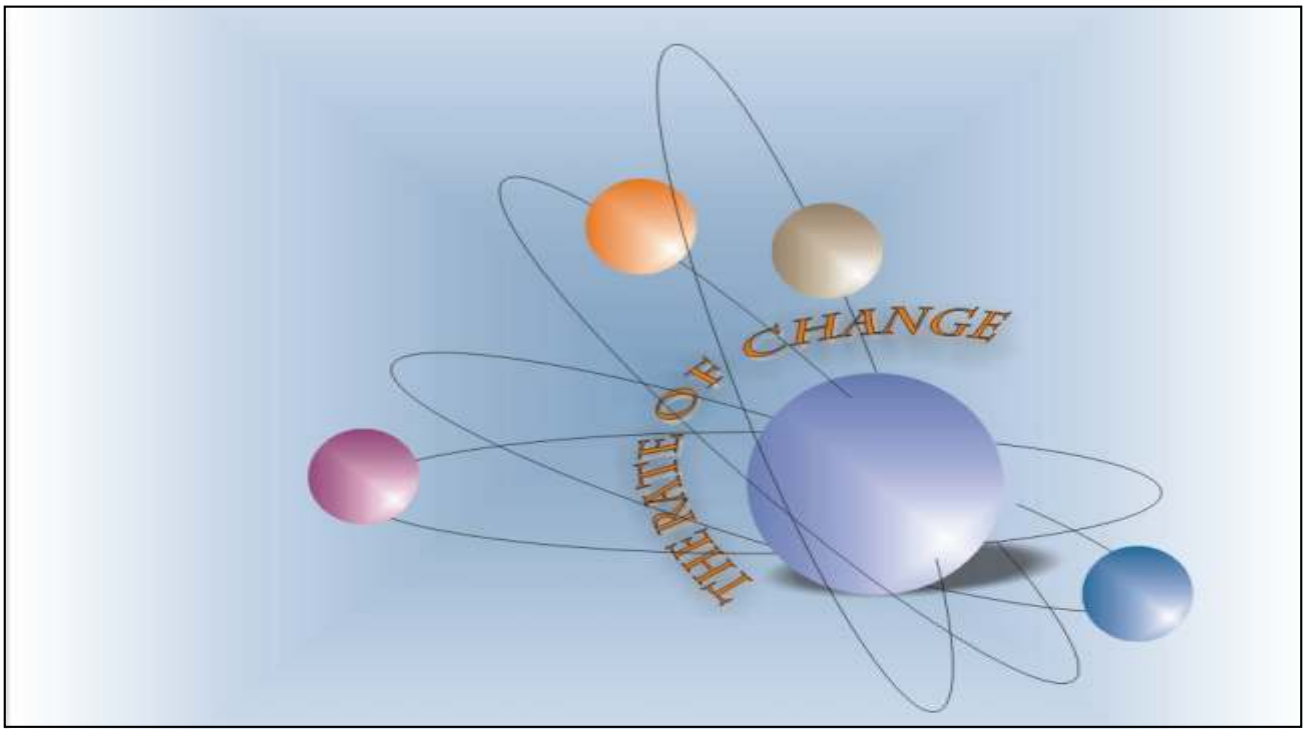
Engineering education evaluation should start long before education and continue long after education. There should be Pre-Education Evaluation, Evaluation during Education and Post-Education Evaluation.

Students get absorbed to socio – economic patterns of the organisations

For teaching effectiveness, Kirkpatrick's four levels of evaluation should be adopted.

Level 1 : Evaluation – Reactions : It focuses on how participants in an education programme react to it. It attempts to answer questions regarding the participants' perceptions about the teaching methodology, i.e., whether they like it.

Level 2 : Evaluation – Learning : Assessing at this level moves the evaluation beyond learner satisfaction and attempts to assess the extent students have advanced in skills, knowledge, or attitude. Measurement at this level is more difficult and laborious than level one. Methods range from formal to informal testing to team assessment and self-assessment. If possible, participants take the test or assessment before the training (pre-test) and after training (post-test) to determine the amount of learning that has occurred.



Level 3 : Evaluation – Transfer : This level measures the transfer that has occurred in learners' behavior due to the teaching program. Evaluating at this level attempts to answer the question - Are the newly acquired skills, knowledge, or attitude being used in the everyday environment of the learner?

Level 4 : Evaluation – Result : This level measures the success of the program in terms that managers and executives can understand - increased production, improved quality, decreased costs, reduced frequency of accidents, increased sales, and even higher profits or return on investment. From a business and organizational perspective, this is the overall reason for a training program, yet level four results are not typically addressed. Determining results in financial terms is difficult to measure, and is hard to link directly with training.

The results will show whether the engineering education system in India has been effective or not. Let us select some good students, say very brilliant students from electronics engineering discipline, as samples from some good engineering college, say, IIT, Chennai. After graduating, the selected sample student, say, does MBA in finance discipline from IIM, Ahmedabad. Naturally, the government has spent a lot in producing such a brilliant engineer student. When the finally selected sample student joins a very good organization, his / her output / worth to the society should be evaluated for at least 15-20 years. It is then only we should try to make recommendations what types of reformations should be incorporated in the engineering education system so that we are able to evolve a system which remains in force for at least 500 years.

It is said that if you want one year's prosperity, grow grains, if you want ten year's prosperity, grow trees and if you want hundred year's prosperity, grow people. A strong competitive workforce is a precondition for sustainable national progress and that an increased share of higher education graduates, particularly engineering graduates in the labour force. If we want rapid industrialization

and increased competitiveness, we have to shift from low-cost labour to higher skill - intensive products and services. We have to have funds for the engineering education & development project, which will aim to assist in improving the quality, relevance, and capacity of engineering education, while enhancing the access of economically disadvantaged but qualified students.

From the Floor

K. K. Agrawal

Well, industry support has to come. I could not complete it in my presentation due to paucity of time. When I am talking of industry-academia interaction, I am also talking of support from the industry because we cannot depend upon the government support and also upon the self-support of the institutions. The support from industry must come and it is something that we have to keep asking for. We should not get worried if we don't get it. We may ask 100 times and get one surprise and if at all it comes, that is our success rate. While I totally agree with what has been said, blaming 1600 engineering colleges is not right. We have to find the solution to the problem. That is important and that requires quite a bit of self-introspection. When I talk of the industry, I do not talk of the industry alone, what I mean it is the contractors, the engineer-contractors and the factories, the government (state and central governments), all taken together.

A Delegate

The industrialists say that there are mushrooming engineering colleges and the employability of the engineers (produced by these colleges) is very low. What are the people in industry doing to mitigate this problem? If you see the internet, 95% of the funding in R&D is going to the industry and a very little amount is going to the institutes like, IIMs, IITs, etc. where from you do not get even 2% of the engineers and 90% of the engineers are coming from these 1600 engineering colleges. What is industry doing for improving this situation?

Dr. Deepak Bhatnagar

We are talking of the quality of engineers. What about the quality of roads? Does the blame rest with the civil engineers? I am giving an example of the Gurgaon roads. Why does the ECI and eminent civil engineers come forward with a basic code stating that the quality of the roads has to be like this and so on. Let us form a delegation of ECI, go to the Chief Secretary of Haryana and put up the problem. I am a civil engineer from IIT, Roorkee. In Gurgaon, there is not a single drain. The ECI should take a lead in this direction.

K. K. Agrawal

Don't blame engineers. Just don't blame individuals. Engineers are equally to blame as anybody else to blame. Nevertheless, let us all share the responsibility. If the roads of Gurgaon or any place for that matter are not working, what the hell people living around are doing? They should come forward and create a problem for the local self-government. Why do we not raise our voice against this? That is the basic point. Blame-game has to stop positively. Blame-game either in terms of non-performance or bad productivity or blaming the engineering colleges not churning out good engineers, etc. etc. will

certainly not serve the problem. We have to come out with the solutions for getting results; even if it does not bring about results, we should feel satisfied that we have taken up the cause and try again and again till we get the desired result.

Group Captain H. C. Bhatia

Summary : We had a very thought-provoking presentations and discussions. We had a lot of very interesting questions. One important consensus point that emerged is that there is an urgent need for having an effective and efficient working industry-academia interaction mechanism in place in the country with a view to enhancing the standards of the engineering education. The engineering students will have to be creative and innovative. The Intervention by the government agencies in the matter of engineering education should be the minimum possible. The sustainable economic and industrial development through addressing adequately concerns about the protection of environment needs to be an important component of the engineering education system. The professional competence and efficiency is the need of the hour.Prof. Agrawal talked about the long-term as well as short-term measures for express / concerted action plan for re-engineering engineering education in the country. I fully support his views and suggest that an action plan may be drawn at the earliest for taking these measures for re-engineering our engineering education system. Further, I would suggest the Engineering Council of India may coordinate this work of national importance. Mr Ghosal referred to the economic growth data of the country and raised very important questions about the engineering education system.

Group Captain H.C. Bhatia is the Secretary, (Admin.) , the Aeronautical Society of India.

Panel Session

Blank

Panel Session

L. Pugazhenthy

Looking back, I must say that we had very thought-provoking sessions today: views from the industry, the academia, and the professional societies. We also had quite a bit of inputs from the various sectors with regard to re-engineering their engineers for better employability. Now, it is time to assimilate and finalize some of the good points, short-term as well as long-term measures and take them forward. All these are more or less well-known issues and concerns. Therefore it is the right time to act now. Let us also talk more about the practical implementation of the various suggestions made. Before I articulate my views, we have a panel of eminent experts here to crystal- gaze at the various issues. There was a question about industry-academia interaction. This is an important point which needs to be considered in depth. Professional bodies have a great role to play in supplementing the efforts of the technical institutions in this regard. There was also a query as to what the industry is doing with the various educational institutions. As you saw this morning, Tata Consultancy, L&T, SAIL, and a number of large companies in the public and private sectors have been sponsoring short-term courses for training students, providing scholarships etc., with a view to making these engineers more skilled and professionally-oriented.

Prof. Ambuj Sagar

I shall not be talking about the concrete steps to be taken in order to improve the standards of the engineering education. Let me talk something about the general engineering education. People generally ask as to what is the education at the IIT and other places. Let me start by saying that to use the general terms of engineers is not enough. People talked about the practising engineers and I think that they talked about the civil engineers. There is a need for the engineers, working on the ground, to bring about innovativeness and competitiveness in them. The engineers have got a vital role to play in the development of the nation. I will like to classify the engineering needs as along the three dimensions, not to say that they are mutually exclusive but I think, in terms of broad categorization, each one of these areas probably needs slightly different kind of engineering expertise. So, one seeking about training engineers or engineering education, one has to be capable in those terms. Since I am in the education area, I will approach it from that side. What can be done to improve the education of engineers to overcome the today's needs? I think the engineers have to play the different roles in the society for its benefits. I think they have to be able to contribute in the society in the different ways. I think there is a gap in the engineering education system with respect to the skills we are giving and that as needed. My talk will be different compared to those who talked before me with reference to what should be the engineering education about. I think the current engineering education system is too much focused on teaching people about the specifics. I have had different teaching experience prevailing in and around the world. I have had the honour of experiencing the different engineering approaches in the world. I have felt that what we have to do in the field of engineering education is to think about more exciting the people intellectually, as in abroad, and make them curious so that they can contribute in a mature way in the field. There should not be any difference amongst different types of engineers from different institutions. I think the people have to make their own choices and, in

Prof. Ambuj Sagar is from the IIT, Delhi.

democracy, people have this right. My question is: how to excite and encourage them to enable them to contribute more to the society.

I think the engineering contents should be divided into basic sciences and basic engineering. I am more interested in the outcome. I simply want the engineers to contribute; maybe the electronics engineers can be able to contribute in a much better way in the finance sector. I know one electronics engineer who took finance afterwards and became the head of finance in the IMF. I don't mind it. I would ask the engineers to understand what is exactly the practical relationship between an engineer and the society. I think that, at least in the IIT education, it is missing. I think it important for the people to understand this relation and how they can contribute. I think that engineers are not industrial products. One has to look casually that they are the thinking people and they have to make their own choices. One should clearly understand the supply-pool and the demand-pool. Suppose you go to R&D, create the product and the product is launched in the market. I think one has to think about the engineering profession in the same way. You have to consider both the supply aspects and the demand aspects equally importantly. I think that people have to understand that people in the engineering world have options. They can go to the fields of finance, software or any field they want. The engineers are rational people like anybody else. They have to make decisions out of the choices available to them. It is up to the industry to provide them the choices. The industry wants intelligent, intellectually curious and smart people. It is incumbent on the other side. The people, who are fulfilling the demand of engineers, are to provide the training whether it is the case of innovation, industry, R&D or anything else. In India, about 80-85% of the R&D jobs are financed by the government. In foreign countries it is the 70% of the R&D jobs that are financed by the governments. So, they are fulfilling the demand of engineers by doing research and development. They excite the engineers to join the R&D. That is not the case in India. In the case of practising engineers, there is, of course, a demand but we have to think why the engineers are going to a different field like finance and software? I don't think that I am answering the question. It is an open question to the people who are in employment.

S. S. Chakraborty

We, the engineers, are the most marginalized and neither the politicians, nor the bureaucrats nor the administrators except us. I have boldly said to the UNIDO that we, the engineers, are the marginalized lot. We really need tremendous amount of re-engineering, how to communicate with the society, how to address the societal needs which includes sustainable development in the truest sense. There has to be active industry-academia interaction. The fact still remains that lakhs of engineering students, who come out of the engineering colleges, are not exposed to the industrial requirements. Present IITs are facing shortage of teachers, if more are set up, as has been proposed by the government, where are the teachers for these up coming new IITS . Therefore, there is a tremendous demand-supply gap in experienced teachers of engineering. I am regularly delivering lectures about the industry-academy programmes. But I feel that I am contributing very little. We, engineers will have to find the right place in the country. We are doing so much work for the country. Let us not think in terms of one particular branch of engineering. Let us consider all the engineers as a whole. We are spending the money but the politicians are dictating the terms. We, engineers, have to remain on our toes. Because we are gradually

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getting sacked. I am still very happy, extremely glad that we engineers are given some recognition. On the other hand, we should also be very responsible to the societal needs which we are not.

Let us take the example of Nehru Place in Delhi. Once upon a time, it was a very large commercial establishment. But, some organizations are thinking to move put from there because of poor service roads. Such infrastructural needs are dictated by the civil authorities, the administrators, the policy-makers and not by the engineers. So, we must go into the roots of the problem. I very well remember that the Engineering Council of India was formed to promote the cause of engineering and let us do that and start re-engineering of engineers at the earliest.

Dr. Deepak Bhatnagar

It is expected that there would be a paradigm shift in the skills required from engineers in the 21st Century. In addition to the broad engineering skills and know-how, they would need to be knowledgeable on 'multi-disciplinary' areas and quickly adapt to learn from different disciplines. The engineers of tomorrow would need to be flexible, mobile and be able to work internationally. Some of the attributes for the engineers of tomorrow are as follows:

(a) Global competence – knowledge of the fundamentals and dynamics of globalization as well as opportunities to become immersed in study, work or research abroad are the key elements that should be integrity in different engineering programmes.

(b) Transnational mobility for engineering students, researchers and professionals need to become a priority.

(c) Linking engineering education to professional practices in Industry and Society would be an imperative.

(d) A new element on management and technology including technology intermediation to build linkages in the entire technical innovation chain would be necessary. The engineers would need to carry out the idea or a successful laboratory experiment in different innovations to new products or services. The engineer has to 'manage' the technology interface required to convert an idea into a product.

TIFAC has launched a mission reach programme which is focused on creating relevance and excellence in emerging areas useful to industry and society. So far, 32 centres of relevance and excellence have been set up in as many areas across the country, which have created a significant impact on the human resource needs for the Indian industry. For more details about this program, please visit our website (*www.missionreach.org.in, missionreach@gmail.com*).

Vijay K. Saluja

To my mind, the subject of discussion could have been rejuvenating engineers or evaluating our engineering profession. Let us see who the stakeholders are. The stakeholders are, first of all, students, the parents, the academics which starts from the schools, the colleges, technical institutions and

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continuing education organizers, the government, the policy-makers, the industry, professional institutions / associations, research institutions and all the councils who have, on their agenda, improvement and achievements of the engineering profession. Last of all, I think these stakeholders will also be alumni. I say alumni because I happen to be from IIT, Delhi and the ex-President of the IIT Delhi Alumni Association. I went subsequently to the University of Birmingham, U.K. and am also the founder Vice-President of the association of the British colleges and Convener of the India Chapter of the University of Birmingham Alumni Association.

Why this conference, this question comes to my mind and you must also be thinking about this and why all these efforts have been made by the Engineering Council of India to bring all of us together. To my mind, perhaps, comes the matter to re-visit the engineering community and why the education has fallen short of. What was the broad objective of training the professional engineers? Are we really meeting the needs of the system, needs of the government and needs of the society? I think we had a very good of intervention from Deepak when he said and gave the case of Gurgaon regarding the poor infrastructure there. To my mind, this story equally applies to Delhi and to almost all the cities of India, rural or urban. Who are to be blamed for this? Perhaps, all of us including engineers, because the engineers are definitely the major contributors in giving goods to the society using the funds in an optimum manner. The funds in a developing country like India are always going to be short and the challenges are so may to meet. We have a very vast growing population with problems like illiteracy and so on. Therefore, in our earlier session, we have been discussing about re-visiting the engineering curricula, growing needs, expectations, evaluation of education system in detail. I will not spend time on that. Rather, I would like to observe in about next few minutes the role of values and ethics in our governance, in our management because, to my mind, this is the devaluation of the values and ethics in our educational system, in our bureaucracy, in our political system, in our engineering profession, in our judiciary, in our media. These are the main ills which are affecting our society, our system, etc. This, according to me, is one of the reasons which have given rise to corruption and I must say openly that the corruption is the HIV or AIDS of our administrative system. It is better that we start discussing about it earlier and find a solution for it. The educational system is also certainly afflicted by it and so we must talk about it.

While talking of the values and ethics, we must know what are the values and ethics. Well, values are the most important things in the society like don't tell lies, respect your parents, etc. etc. Now, what is the ethics? Ethics is the professional value. A doctor must treat a patient properly. An engineer must utilize his knowledge, use the funds properly, give the maximum benefits to the society by giving good roads, good buildings, good bridges so that it does not fall. An engineer should take all safety precautions so that there are no accidents. As a good engineer, the municipal engineers must see that there are no unauthorized constructions and proper infrastructural facilities come up. The engineer must be conscious of all these things. Well, I had been in the NDMC for a long time. So many times I was told that this person is to be posted here or there. If you do not put the right person at the right place and if we have to place the assistant / junior engineers under pressure, which is generally the norm in our local bodies, the result is all of us to see. Therefore, we are going to discuss these things in our various

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IIT fora in the coming days. The IITians do not have only to make money, to go abroad and to earn PhDs. But they have a societal role to play as well. We should do this by infusing the essence of value and ethics. Therefore, you must do what you are supposed to do for the betterment of the society.

I will ask you a question. Are we really following whatever we studied in the IITs or in other engineering colleges in our actual profession? Do we stand up professionally when our seniors say to do something? I personally feel that 90% of us will say, "no". More so, when we are taking instructions from the non-technical persons, the bureaucrats. Most of us simply go on saying, "yes sir. yes sir". I think it is the time our professional societies like the Engineering Council of India, the Institution of Engineers (India), the Indian Buildings Congress, the Indian Roads Congress of which I am also a life member, etc. must stand up and say, "sir, we are not supposed to do because we are taking the people to make the roads and buildings in the proper professional manner. If curing is to be done for seven days to achieve the strength, we should not say that we can finish the building in one day. The result is for all of us to see. Finally, I shall say that engineers should preserve our values and ethics and be a role-model for the students. That is what we are trying to do from this year from the IIT, Delhi forum.

Dr. K. G. Bhatia

I am just trying to share my experiences regarding re-engineering of engineers for five minutes. I did my graduation from the BHU, master's degree from Roorkee, Ph D from the IIT, Delhi. I have experience of academics as well as industry. I was in BHEL for a considerably long period and, finally, I retired from BHEL. In the early sixties, there was hardly any interface between the industry and the academia. It started in seventies. Initially, the problems of the industry used to be referred to the academia for the solutions. The academic institutions helped only those industries who used to approach them. Now, we are looking for re-engineering of engineers. Every company like L&T or the BHEL, have their own training programmes. With these they try to meet their own needs. But, this is certainly not going to solve the global problems today. What we need today is that engineers from the teaching institutions should be useable directly in the industry. This possibility can prevail in practice only if there is an exchange between the industry and the academic institutions. Exchanging of faculty is very important in this regard. Even after retirement, people remain very active. The retired engineers from the industry can go to the academic institutions even after retirement and take the classes. I think that it should be mandatory. The academic people should also, after retirement, join the industry and contribute from out of their teachi8ng and research experience. Presently, academics are only doing R&D and publishing papers and are not being able to solve real-life engineering problems except producing engineers.

What we rightly say today that people, right from the B.E. level, should be usable. In medical profession, it is said that people should be M.D.; same is true for the engineering profession also. The need today is that even the graduate engineer should be gainfully employable. The industry needs the trained engineers and they should come from the academic institutions only. If a doctor makes a mistake, he kills one but if an engineer makes a mistake, he kills many. We should start training the engineers right from the academic level itself. If the exchange of industry and academics people is started, this may give the desired result. Engineers must be very flexible in their professional attitude. I

Dr. K. G. Bhatia is the CEO, Delhi CAD Technology

am a civil engineer but had been heading the mechanical engineering department in BHU for twenty-five years. So many subjects are common in the civil and mechanical engineering disciplines. This also boosts the flexibility in the professionals. There should be a change in the technical books. All technical books contain theoretical problems. There is hardly any book which really talks of real-life technical problems. Books should be there on real life case studies from the industry. Engineering curricula should also have subjects on real life problem solving through case studies. Engineers from the industry can better teach this subject. The faculty for this should, therefore, be of practicing engineers from industry and eminent individual engineering consultants. The courses from the other specializations like law, economics, project management, finance management, communication, accountancy, etc need to be included at the level of undergraduate engineering education which will enable the students acquire desired additional skills at the college level itself. With this done, engineers will straightway become suitable for their jobs in the industry.

From the Floor

R. D. Gupta

I superannuated as Additional Director General, CPWD. I believe that we are neither tired nor retired ever. The focus here is: re-engineering an engineer which is an extremely important issue in the present-day context because the engineering community has made enormous contribution for bringing India to the present status. While there is no doubt about this, the pace of development is slow. I feel that the national values in the past twenty years have degenerated. The re-engineering of engineers, according to me, is to reverse this process. If we are able to reverse the process of degeneration, I think we will achieve our objective.How to do it and what role is to be played by the Engineering Council of India in this are the points in my focus at the movement. While there are many core issues which need consideration, the first and the foremost core issue is as to what is causing the degeneration. Our engineers are serving the country in two parts, one in the public sector and the other in the private sector. The engineering community can be broadly divided into three categories. Those who have played the aggressive innings, those who have fought the war in their active service period and most of us belong to that group. The second group, which is very important and is the critical mass in the group, is really fighting the war today. The third group is of engineering students who will come on the stage in future. The critical mass is of those, therefore, who are fighting the war today.

Our 60% of the population is living in villages. While Deepak talked about the quality of roads in Gurgaon, the condition of roads, water-supply and electricity in the villages is so poor. India lives in villages and I also belong to a small village. The question arises that why the engineers are not being able to solve this problem. The problem has arisen because the engineering community, serving the public sector, has been overpowered by the quality of this country in the past twenty years. Today, in states (PWD, local self-government or any body) or in public bodies like MCD and the like, the politicians decide almost everything. Engineers are only to take the blame, that's all.

Today, due to , the engineering community stands divided into three parts. Those who don't follow the dictates are neglected. Those who have resisted have been subdued. The majority are onlookers. My request is that this forum, the ECI, should try to solve the problems being faced by the critical masses of engineers, who are fighting the war, to avoid their political hijacking / hostage. The Engineering

Council of India should come up actively by not merely talking but by continuing to give directions either through exposure in media or through exposure in press or by way of delegation to different organizations.

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L. Pugazhenthy

Thank you panelists very much for the views expressed by you. The important point that all the speakers made is that the engineering community is being the victim of the political set-up. The issue here is that how do we take the subject of re-engineering forward. I would like the Engineering Council of India to think of forming a small task force comprising six persons from academia, two persons from the industry and two from the government (whatever it is as they still have the role there); let this task force identify the issues, examine these issues and put forward their suggestions and recommendations on squarely tackling these. Let us pick and choose some of the issues which can be taken forward in a limited time-frame, discuss, talk to the ministry / government, talk to the industry also, talk with the R&D establishments like the Department of Science and Technology, etc, and come up with a workable action plan and implement this plan.

Concluding Remarks

P. R. Swarup

I am fortunate enough to be here today. There are situations that I could basically understand that issues that were pointed out and the concerns that were articulated and they expressed that the engineers were not having nationalist feelings. It was talked about financial engineering. There were many models suggested basically and what are the requirements to come up in future and what we are to confront. In due course of time when exactly the proceedings are drawn, projects would be instituted. But there are two issues which I would definitely like to dwell upon. The first one is the issue of compatibility, the relationship between the industry and the academia. This has been discussed time and again and we have listened to that for many years. One small humble initiative that could be launched and possibly it is not really possible in practice to inspect members of the academia, to got the industry and start working and vice versa and that is not practical and there is no point discussing about it. What can happen is that the students are to be recruited by the industry and they can be definitely trained by them. Maybe in the last lap of their training programme, the trainers can definitely be invited to interact with the industry. The academic institutions of engineers also need to look into the dynamics by which the industry is governed. I think that then only some kind of

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compatible situation can arise. This is one of the tasks that the Engineering Council of India (ECI) might like to undertake.

The second issue is that of compartments that we have today in engineering. Some speaker said that so much money students spent for graduating in engineering from the IIT and then go to IIM and become mangers subsequently draw huge salary. That is fine. I think as much as I know of IIT education, that used to be almost five years ago, it wasn't much about engineering really. It was much about having a holistic education and the peace that you have. I would quite agree with Prof. Ambuj Sagar when he said that there is a sea-change between what used to happen even in the IITs and what is happening today. What we need to know is that it is not whatever we are going to pump in the form of knowledge for the four or five years that is going to be very relevant to the industry. Engineering is something which comes by practice. One has to go to the industry and really work. We have today branches in engineering within the branches and the various types of specializations in the branches. I think the present-day curricula in engineering and syllabi need some kind of modification. That is where the ECI could be possibly the interface agency between the academia and the industry.

Delegate List

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63. Hemmy
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Indian Earthmoving & Construction
Industry Association Limited.

114. Dr. Mohanty G. N.
Secty.
IIM Delhi Chapter

115. Mool Chand
Assistant Manager (Trg.)
BSNL Corporate Office

116. Prof. Mukherjee. T. K.
Independent Professional & Consultant

117. Mr. Muneshwar. S. K
Senior Scientific Officer
Mission Reach
Technology Information,
Fore-casting of Assessment Council

118. Dr. Mungekar Bhalchandra
Member
Planning Commission

119. Dr. Muralidharan M. K.
Prof. & Head
Department of Mechanical Engineer
M. S. Ramaya Institute of Technical

120. Dr. Murli
Director
SSPS

121. Mr. Murthy G. K.
G. M. (Water Porjects)
LANCO Infratech Limited

122. Dr. N. S. Venkataraman
Director (Academics & Projects)
Hindustan Group of Institutions

123. Nanda Kumar T. G.

124. Narasimhan A.
Vice President – Corporate Affairs
LANCO Infratech Limited

125. Brig. Nasa M. N.

126. Ojha C. B.
Executive Engineer (Works & ESH)
Engineering Department

127. Ms. Pal Geeta
CIDC

128. Pal Suranjan
Director
Public Interface

129. Pal Suranjan
Director,
Public Interface

130. Panampilly Suresh
Tata R&D Design Centre
(A Division of India Consultancy
Services Ltd.)

131. Pande K. K.

132. Pangasa Nitin
Technical Director
SEMAC Private Limited

133. Dr. Panwar. V. S.
Member IETE

134. Parida .A.
Director, Mission Reach
Technology Information, Fore-casting of
Assessment Council

135. Parthasarathy Ravi
Chairman
Infrastructure Leasing & Financial
Services Limited

136. Piplani Tilak Raj
Secretary General
Phoebus Foundation

137. Poddar Ajay
Sr. Member, PHD Chamber &
MD, JCL

138. Praful Arvind Shinganapurkar

139. Prasad Lalitha
Head Corporate Learning Center
Tata Consultancy Services

140. Prasad Lalitha K.
Delivery Centre Head
Tata Consultancy Services

141. Prasad. K. A. N.
Addl. Director General
National Academy of Construction

142. Pugazhenthy L.
President
Indian Institute of Metals

143. Puranamalka. O. P.
Group Executive President
Grasim Industries Limited
(Cement Business Marketing)

144. Lt. Gen. (Retd.) Puri A. K. PVSM, AVSM
Ex D.G., Boarder Roads &
Chairman, IIBE, DSC

145. Rai K. B.
Member
ICC

146. Raina Shiban
CIDC

147. Raj Mahendra
President
Indian Association Structural Engineers &
Vice Chairman, ECI

148. Dr. Ing. Rajagopalan N.
Head Technology Development &
Chief Technical Advisor-Bridges
L&T – Ramboll Consulting Engineers Ltd.

149. Prof. Rajendran. S
Prof & Head, Information Technology
SRM University

150. Rajesh Verma
H.O.D. & Asst. Prof.
Guru Nanak Khalsa Institute of technology
Yamuna Nagar

151. Rajgopal Ganesh
GM-Corporate Affairs

152 Raju M. P.
CIDC

153. Ramamoorthy D.
Dy. General Manager-E&P
Hindustan Petroleum Corporation Limited.

154. Ranjit Basu

155. Rao S. S.
Sr. Manager (PR)
Power Finance Corporation Ltd.

156. Mr. Rao. P. V.
Retd. Engineer

157. Ravi Shankar
Project Engineer
CIVTA

158. Ray. T
TMC Consultants

159. Ms. Sachdeva Seema
CDC

160. Prof. Sagar Ambuj
IIT
Delhi

161. Dr. Saini Anil
Chairman
CSI-DC

162. Sakthivel. R.
Sr. Executive- Human Resources
L&T Ramboll Consulting Engineers Ltd.

163. Saluja K Vijay
Former Chief Eng. (Civil),
NDMC

164. Sangal Madan Mohan
Member ICC

165. Sanjay Kumar
Media / Web Coordinator
Public Interface

166. Sanjeev Kumar
Scientist 'E'
STQC IT Services, Delhi Centre

167. Sanjeev Reddy
Coordinator
CIVTA

168. Dr. Sarkar. P. K.
Hony. Secy., IUT
Institute of Urban Transport

169. Prof. Sarukesi .K.
Vice-Chancellor
Hindustan Institute of Technology & Science

170. Sarvkesi. K.
Vice Chancellor
Hindustan Unversity

171. Dr. Sataya Murty. M.
Jt. Advisor (Col)
Planning Commission

172 Mr. Satija C. Ramesh
Member CSI &
Systems Analyst
Indian Statistical Institute

173. Satija Ramesh
Member
CSI

174. Col. Sen Ranjan Kumar (Retd)
Jt. GM. (Admn.)
Ircon International Ltd.

175. Shali P. N.
Director
Engineering Council of India

176. Sharan G.
Chairman, ING-IABSE &
DC (RD), Min. of Shipping Road
Transport & Highways

177. Sharma Sneh Kumar
Member
CSI

178. Sharma Subodh
CIDC

179. Sharma Sushil Kumar
Sr. Lecturer
Guru Nanak Khalsa Institute of technology
Yamuna Nagar

180. Shev Raj
DGM (M)-Technical Services
Oil and Natural Gas Corporation Ltd.

181. Col. Shivraj Kumar
Member
CSI

182. Shukla Mohit
CIDC

183. Shyam Kishore
Retd. Chef Engineering
CPWD.

184. Brig. Sian. R. P.
Hony. Secy.
The Institution of Surveyors

185. Singh Dalip
Chief Consultant
The Power-Quality Engineers

186. Singh Gurpreet
MT (Mech)
Western Colfiels Limited

187. Singh Manish
SE(M), Technical Services
Oil and Natural Gas Corporation Ltd.

188. Singh Natrapal
Project Engineer
CIPTDA

189. Singh Satyavir
Senior Manager
Engineers India Limited

190. Singh Sumiran
CIDC

191. Singh Yograj
Engineering Council of India

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

193. Singhal J. P.
Executive Director
Indian Buildings Congress

194. Prof. Somendra Kumar
Advisor, ICT Pvt. Ltd.
Sr. Hydrologist, SWI Pvt. Ltd.
Inter Continental Consultants &
Technocrats Pvt. Ltd.

195. Sonkusare Ashok
Dy. Advisor
Planning Commission

196. Srinivas
CIVTA

197. Mr. Subhash Chander
Member 'UP Electricity Regulatory
Commission'

198. Prof. Subramanian .K
Ex-DD(NIC), Ministry of C & IT &
IT Advisor to GAG of India

199. Sudhir Srivastava
Managing Director
Metso Minerals New Delhi Pvt. Ltd.

200. Suri S. C
Vice Chairman
IIM Delhi Chapter

201. Surout Satbir
CIDC

202. Ms. Swaminathan
Manager-HR
BHEL

203. Swarup P. R.
Director General,
Construction Industry Development Council

204. Prof. Thareja Priyavrat

205. Prof. Thareja Priyavrat
Punjab Engineering College
Chandigarh (Deemed University)

206. Mr. Tripathi Shailendra
Director
Indian Railways Institute of
Electrical Engineering, Nasik

207. Tyagi V. K.
M. N. Dastur & Company (P) Ltd.

208. Tyagi. S. Ramesh

209. Tyagi. V. K
Member
CDC

210. Ukalkar Sanjay
Member
Institution of Mechanical Engineers (India)

211. Vaddadi S. N. Murthy
Dy. Director (Finance & Administration)
CIDC

212. Vashistha A. K.
DGM (MM)
Bharat Electronics Ltd.

213. Venkatesh Babu
MD, LANCO Infratech Limited

214. Verghese Ashok
Director
Hindustan Group of Institutions

215. Verghese Ashok
Director
Hindustan Unversity

216. Mrs. Verma Archana
CIVTA

217. Verma Chander
Treasurer, ECI
Chairman, CIDC &
President, ICC, IndSTT

218. Verma Shailendra
CIDC

219. Verma. A. K.
Advisor
Planning Commission

220. Vidyasagar
Addl. Director
Public Interface

221. Vidyasagar
Addl. Director
Public Interface

222. Prof. Vishwakarma. A. K.
Coordinator Tech.
Amrapali Institute

223. Vyas R. K.
Regional Student Cordinator (Region-I)
CSI

224. Wadhwani L. Gurmukhdas
Member, CSI

225. Ziyauddhin M.
Chief Engineer & Joint Secty.
Public Works Departments

226. Zutshi. S. C.
Member
CDC

About
Engineering Council of India

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Engineering Council of India (ECI)

Objectives

The main objectives of ECI are to work for the advancement of engineering profession in various disciplines and for enhancing the image of engineers in society. To this end, ECI will be focusing on quality and accountability of engineers.

In the emerging WTO / GATS environment, mobility is becoming an important issue. Mobility of Indian engineers for delivering engineering services in other countries will be hindered unless expertise of Indian engineers is recognized and accepted at the international level. Conforming to internationally laid down norms is essential also for protecting employment of engineers in internationally funded projects, multinational corporations and large companies in India.

According to its Memorandum of Association, the objectives of ECI are as follows :

1. To promote the science and practice of engineering for national development, collectively along with constituent members.
2. To encourage engineers to serve the needs of the society.
3. To promote advancement of education of engineering in the country.
4. To promote the practice of continuing education and training to upgrade the quality of engineering professionals.
5. To identify and undertake activities of common interest to the engineering profession.
6. To encourage inventions, investigations and research; and promote their applications for development of the national economy.
7. To identify and undertake activities directed to enhance prestige of engineers in the country, and to secure their rightful place at various levels of planning, administration etc.
8. To promote steps to attract bright persons of the younger generation to the engineering profession.
9. To assist Associations / Professional Societies in normalizing criteria for membership so as to make these nationally equitable and internationally acceptable.
10. To establish a common "Code of Ethics" for professional and consulting engineers adoption by Association / Professional Societies and to evolve the strategy for its enforcement.
11. To interact with the government at State and Central levels and help adoption of policies for betterment of the engineering profession.
12. To represent engineers and engineering professionals of all disciplines, at National and International levels.
13. To maintain a Natioanl Register of "Professional Engineers" and a National Register of "Consulting Engineers" who are engineering organisations employing professional engineers where principal occupation is the independent practice of engineering.

14. To acts as a Nodal Body, representing India, for bilateral / Multi-lateral recognition of "Professional Engineers" and "Consulting Engineers" on mutual and reciprocal basis.

15. To identify and encourage the implementation of best practices for the development and assessment of engineers intending to practices for the development and assessment of engineers intending to practice as professionals in domestic as well as foreign markets.

16. To standardize criteria to be adopted for according status of "Professional Engineer" and "Consulting Engineer" and to accord licence / accreditation to practice engineering in India.

17. To identify major engineering disciplines in which substantial cross-border mobility is expected and to cater to those disciplines in which substantial cross-border mobility is expected and to cater to those disciplines in ECI's policies, practices and their registers / sub-registers.

18. To identify barriers to professional engineers' mobility and to develop and promote strategies, to advice and, if required, assist Central and State Government Departments, in managing those barriers in an effective and non-discriminatory manner.

19. To develop mutually acceptable standards and criteria for facilitating cross-border mobility of experienced Professional Engineers and Consulting Engineers among WTO signatories.

20. To establish such committees, as may be necessary, for reciprocal joint activities with similar professional bodies in other countries who are signatories of WTO and other related agreements.

21. To network and cooperate with other such international bodies who are engaged in similar activities.

22. To perform any or all other acts, deeds and things, which may become necessary to be performed at any stage to achieve the main objectives of improving the image of the engineering profession and of the professional engineer and to serve the needs of the society.

Tasks

In order to meet its objectives, ECI task include the following :

- Certify the competence of engineers for undertaking professional activities.
- Certify the competence of organisation offering engineering consultancy services.
- Integrate continuous development programme with the certification process to upgrade expertise continuously.
- Lay down norms of professional conduct and take appropriate action promoting and ensuring compliance.
- Join international networks such as Engineers Mobility Forum for protecting the interests of Indian engineers in the emerging international scenario.

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 Professional Engineers and Consulting Engineering organisations 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 atleast four years.
- the accounts being audited annually.

Board of Governors

Chairman	
Dr. Uddesh Kohli	Chairman Emeritus Construction Industry Development Council (CIDC)
Vice -Chairman	
Mahendra Raj	President Indian Association of Structural Engineers
Treasurer	
Chander Verma	President International Council of Consultants
Members	
S. Ratnavel	Member Association of Consulting Civil Engineers (India)
P. S. Sundaram	President Broadcast Engineering Society (India)
Dr. Naresh Kumar	Advisor, Head - RDPD Council of Scientific and Industrial Research
P. R. Swarup	Director General Construction Industry Development Council
K. K. Kapila	President Consulting Engineers Association of India
Rajeev Kher	Joint Secretary Dept. of Commerce, Ministry of Commerce and Industry
Prof. C. V. Ramakrishnan	Member Indian National Academy of Engineers
K. K. Kapila	President Indian Buildings Congress
D. P. Misra	Past President Indian Institute of Chemical Engineers
Lt. Gen. (Retd.) A. K. Puri *PVSM, AVSM*	Chairman Indian Institution of Bridge Engineers (DSC)

Dr. K. K. Padmanabhan	Chairman Indian Institution of Industrial Engineering
J. S. Saluja	Member Indian Institution of Plant Engineers
Dilip Takbhate	President Indian Society for Non Destructive Testing
Niranjan Swarup	Executive Director Indian Society for Trenchless Technology
B. N. Puri	Principal Advisor (Transport) Planning Commission
A. K. Bhatnagar	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
Ashok K. Sehgal	Member The Institute of Marine Engineers (India)

Executive Committee

Dr. Uddesh Kohli *Chairman, ECI*	Chairman Emeritus Construction Industry Development Council
Mr. Mahendra Raj *Vice Chairman, ECI*	President Indian Association of Structural Engineers
Mr. Chander Verma *Treasurer, ECI*	President, International Council of Consultants Chairman, Construction Industry Development Council Chairman, Indian Society for Trenchless Technology

Members

Mr. K. K. Kapila	President Consulting Engineers Association of India & Indian Buildings Congress
Mr. P. R. Swarup	Director General Construction Industry Development Council
Lt. Gen. A.K. Puri, PVSM, AVSM (Retd.)	Chairman Indian Institution of Bridge Engineers (DSC)
Mr. P. N. Shali	Director Engineering Council of India