Indian National Academy of Engineering

25

Annual Report - 2012 - 13

Key Pages :

Foreword

I embraced humility and inspiration on the eve of my selection to serve Indian National Academy of Engineering in the capacity of the President. Almost 30 months back, I expressed confidence in my maturity, experience and commitment to charter a path of continuing and improving good traditions. I promised committed efforts towards realizing paradigm changes for enhanced connectivity of INAE with policy makers, society, education, research and industries. Improving publications in a qualitative and quantitative way was another key endeavour. It was also widely recognized that INAE needs and deserves more and better office space to make effective contributions matching with the objectives and challenges of growing India.

The academy had a distinctive land mark; silver jubilee year, to record the presence, enhance its brand, take new relevant initiatives and prepare a foresight with vision for the coming 25 years.

I do not wish to dwell, on the above-mentioned processes and products. These details are available on the website and Annual Reports of the last two years. I have chosen to mention a few significant achievements. INAE has more space and better eco-system for functioning; vision is experiencing final touches; Annual Engineering Convention to deliberate, address and take actions on specific relevant technology and social engineering is ready to be launched, and action plan to make a paradigm improvement in publications is being implemented. Specific engagements (for a period of 5 years) with select foreign academies on topics of mutual interest, to realize tangible results are bearing results. We have established clear interfaces and built new mechanisms to meet the challenges in emergency management, innovation realization and giving implementable inputs of relevance to the planning commission.

Dedicated groups to deliberate and prioritize challenges in the domains of education, energy, water, infrastructure, heritage, sustainable growth, cyber security, micro electronics etc. are active in meeting their essential objectives. We have brand new initiatives and mechanisms for enriching the quality of teachers in private engineering colleges for their Ph.Ds with best mentors and facilities in laboratories of CSIR, atomic energy, defence and space, and for providing opportunities to engineering students to present their research work in international conferences abroad.

I have realized that once we have right thoughts and decisions on collective thinking of such eminent persons as in our Academy, the next step is to interface with stake holders and responsible persons in key organizations. The process requires commitments in building robust mechanisms to enable quality delivery in time and cost. Driving force is intrinsic characteristic in all of us, for being useful to the country. Many a times we have ended achieving more than our anticipation, and many a the times we have not succeeded in our endeavours. I can say that successes have been due to competence and commitment of our Fellows and a vibrant efficient secretariat of the INAE. Convictions and paths suggested by the Fellows of the Academy can never forgotten; these are more often than not pursued with alternative strategies to get success.

I had learnt as a child that dreams are telescopic, and dreams expand their horizon and impact of effectiveness as we experience successes, and social value of these successes in improving quality of life for our citizens on this beautiful planet, with breathtaking biodiversity, marvels and landscapes.

I wish to share, my unfinished agenda with you, with a desire to get your valuable advice and support.

Engineering Academies are different in their objectives and assets, all over the world. We have to be partners in creating wealth for the country and enhance competitiveness of our industries with emphasis on sustainability. We intend to create Industry Forum affiliated in functioning to INAE. This new structure should not create any conflict with already well constituted and practiced objectives of the Academy. Furthermore, our focus in the Academy on industries should not leave MSMEs, as these are vital for creating major share of wealth, employment and realizing breakthrough innovations. We have successful examples, elsewhere in the world, which are being studied for an appropriate organizational structure, to be proposed for implementation.

We take satisfaction (rightly so) in our successes of existing schemes and new initiatives. The need for India, is to enhance successful initiatives such as mentoring of students and teachers, enriching those of educational institutes, who have capacity and commitment to do so and provide unbiased meaningful and sometimes out of box advice to the policy makers and domain ministries, towards meeting the specific challenges.

Replicating success is not trivial; it is a challenge and pursuit that are worth the efforts and focus. We need to achieve the growth multifold, to make a qualitative difference to the growth of the country.

India needs rich experiences and eminence of the Academy now, and expeditiously.
We, the fellows, need to commit with courage and convictions.

Dr. Baldev Raj
President

About the Academy

The Indian National Academy of Engineering (INAE), founded in 1987, comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. INAE functions as an apex body and promotes the practice of engineering & technology and the related sciences for their application to solving problems of national importance. The Academy provides a forum for futuristic planning for country's development requiring engineering and technological inputs and brings together specialists from such fields as may be necessary for comprehensive solutions to the needs of the country.

It is the only engineering Academy in India. INAE is a Member of the International Council of Academies of Engineering and Technological Sciences (CAETS). The salient aims and objects of the Academy are given below.

1. To promote and advance the practice of engineering and technology and the related sciences and disciplines and their application to problems of national importance.
2. To disseminate information on all matters pertaining to 'Engineering' by publishing proceedings, journals, memoirs and by holding meeting, lectures, seminars, symposia etc.
3. To interact with professional bodies, engineering and scientific academies etc. already established or as may be established in future in India and abroad.
4. To represent at all academic forums, research and development activities on 'Engineering' in India and abroad.
5. To promote the National Policy on Education of the Government of India.
6. To offer the Government of India, the Local Governments and others, facilities for conferring with and ascertaining the views of 'Engineers' pertaining to 'Engineering' and to confer with the said Governments and others in cooperation with fraternal professional bodies
7. To encourage inventions, investigations and research and promote their applications for development of both organised and unorganised sectors of the national economy.
8. To institute and establish Professorship, Fellowship, Studentship, Scholarship, Awards and other benefactions and to grant Certificates of Competency and Charter whether under any Act of Government of India or otherwise howsoever.

INAE Silver Jubilee Inaugural Function

INAE Silver Jubilee Inaugural Function was organized on April 20, 2012, at Indian National Science Academy (INSA) Auditorium, Bahadur Shah Zafar Marg, New Delhi. Dr. R Chidambaram, Principal Scientific Adviser to the Government of India was the Chief Guest. The function commenced with the address by Dr Baldev Raj, President, INAE. He mentioned that the Academy has recently brought out comprehensive and exhaustive reports in selected areas of national interest & challenges, viz., healthcare technologies, civil infrastructure and water resources management. The Academy has also set-up four Forums, viz, INAE Forum on Engineering Education, INAE Forum on Microelectronics; INAE Forum on Energy and Forum on Technology, Foresight and Management. One of the focus areas of the Academy is to find innovative mechanisms to increase synergy among the fellows and nurture young leaders capable of meeting the challenges in future and advise policy makers to realize paradigm changes to solve the challenges in an inclusive fashion.

Lighting of Lamp by Chief Guest

Dr. Baldev Raj, President, INAE welcoming the guests

Dr. T Ramasami, Secy DST

This was followed by the address by Dr. T Ramasami, Secretary, Department of Science & Technology, Government of India. He mentioned that there is a need to enhance the quality of engineering education in the country. He brought out that though the number of engineering graduates has increased substantially in the past twenty five years, there is a need to improve the quality of engineering education. The Academy should play an important role in this area.

Prof. René Dändliker, President, International Council of Academies of Engineering and Technological Sciences, Inc. (CAETS) and Past–President, Swiss Academy of Engineering Sciences (SATW), during his address mentioned that the primary objective of CAETS is to provide an independent nonpolitical and non-governmental international organization of engineering and technological sciences academies to advise governments and international organizations on technologies and policy issues related to its areas of expertise and contribute to the strengthening of engineering and technological activities in order to promote sustainable economic growth and social welfare throughout the world. He further brought out that during CAETS Annual Meeting and Symposium being held on Aug 29-31, 2012 at Zurich, the topics of discussion will be Nuclear Power: National Plans and Attitudes; Promoting Engineering-based Innovation; and Developing Regional Strategies for Adaption to the Effects of Climate Change. He also mentioned that in 2015, India shall be the host of CAETS Annual Assembly.

Prof. René Dändliker, President, CAETS

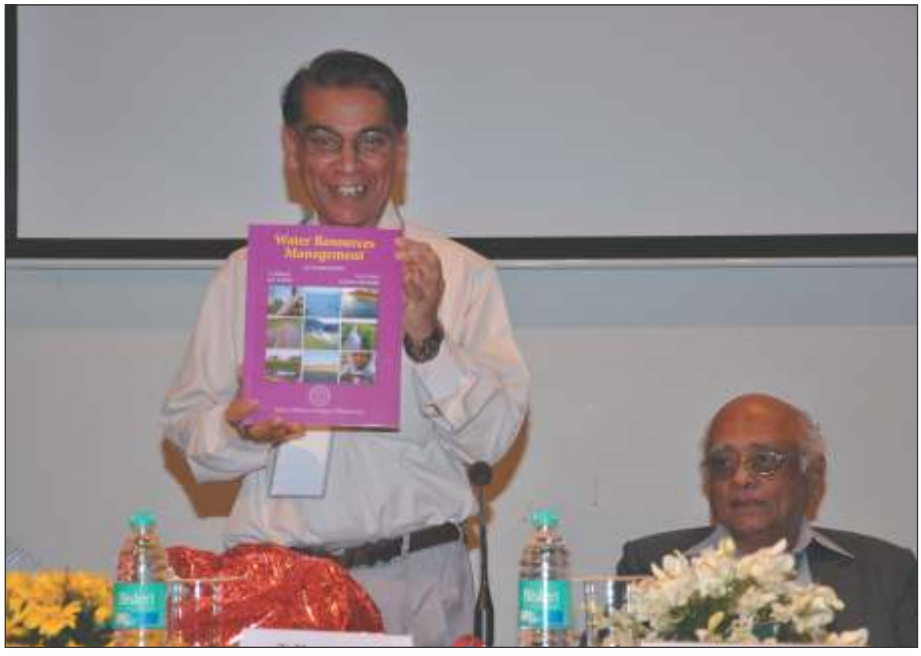
This was followed by the release of the INAE Coffee Table Book on "Glimpses of Indian Engineering Achievements" by Dr R Chidambaram. The INAE Coffee Table book is a landmark document on the retrospect and prospect of Indian engineering. The book highlights notable engineering achievements of the country with the objective of creating awareness and inspiring a new generation of engineers. Brief descriptions and photographs have been included in the book in a manner that makes it interesting for the reader.

Release of Coffee Table Book

The research study reports on Technologies for Healthcare Sector in India, Assessment of Civil Engineering Inputs for Infrastructural Development and Water Resources Management were released by Dr T Ramasami. The research study on "Technologies for Healthcare Sector in India" addresses state of healthcare in India; role of engineering in healthcare sector; identification of priority areas; technologies for healthcare sector; cost-effective technologies for the Indian market; equipment available in India; challenges that lie ahead and how the healthcare sector can be improved with core recommendations. The objective of the Research Study on "Assessment of Civil Engineering Inputs for Infrastructural Development" is to create a position paper on Civil Engineering manpower available in the country at present and envision the needs for the ensuing immediate future. The research study on "Water Resources Management" assesses the demand for water from the various sectors of the economy, their trends and the potential shift from one sector to another in the light of the changes in the composition of the economy, the food security requirements, implications of changes in the lifestyle and other factors.

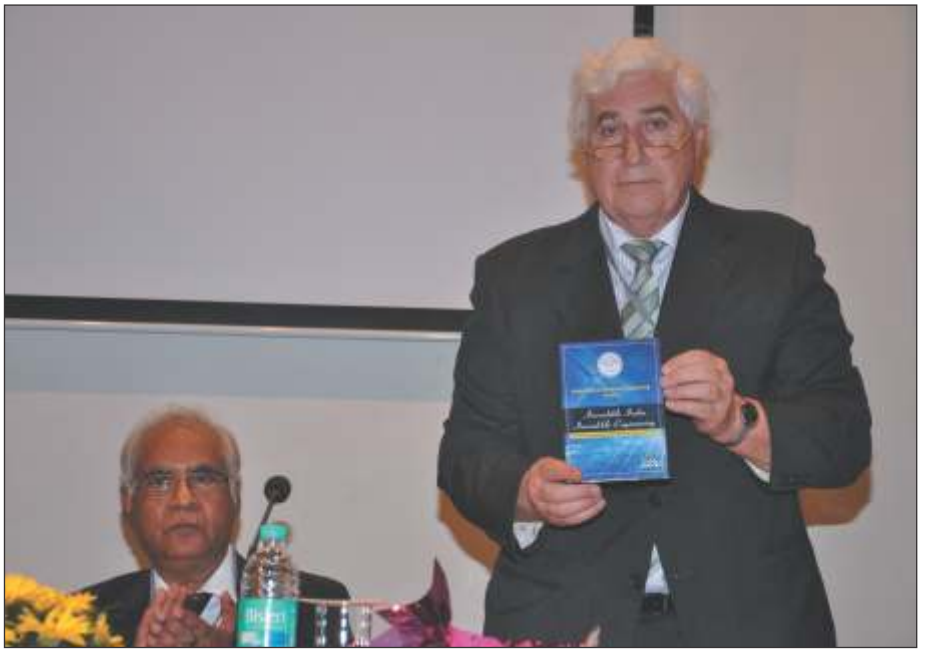
Release of Healthcare Study Report

Release of Cilvil Infrastructure Study Report



Release of Water Resource Study Report

A video film to commemorate the INAE Silver Jubilee Celebrations was released by Prof. René Dändliker. This film showcases the engineering excellence of the country. The film covers a period from past and highlights contemporary achievements in various domains of engineering. The film highlights objectives, functioning, activities and contributions of INAE to the growth and excellence of the engineering profession in the country; since its inception in 1987. A Special Cover to commemorate the Silver Jubilee Year of INAE was released by Sh. L. N. Sharma, Postmaster General, Department of Posts.



Release of INAE Film

Release of Special Cover

The INAE Silver Jubilee Young Engineers Awards were presented by Dr R Chidambaram to four young engineers below 45 years of age. The objective of the award is to recognize the outstanding engineering achievements/contributions made by them after receiving the awards from the academy when they were below 35 years of age. The awardees were Dr Sukumar Mishra, Professor, Department of Electrical Engineering, IIT Delhi for his outstanding research contributions in the areas of Power System Engineering, Intelligent Techniques for Control of Power Systems and Renewable Energy; Dr Avinash Kumar Agarwal, Associate Professor, Department of Mechanical Engineering, IIT Kanpur for his noteworthy research contributions in the areas of Combustion phenomenon in IC Engines, reduction of Automobile Emissions, and Non-Conventional Sources of Energy; Prof Sanghamitra Bandhopadhyay of Machine Intelligence Unit, Indian Statistical Institute, Kolkata for her pioneering contributions in the areas of Evolutionary Computation, Pattern Recognition, Bioinformatics, Data Mining and Multiobjective Optimization; Prof Sirshendu De of Department of Chemical Engineering, IIT Kharagpur for his significant research contributions in membrane separation processes and Heat Transfer Modeling in Micro-reactors.

Silver Jubilee Young Engineer Award

Dr. R Chidambaram, in his inaugural address mentioned that scientists create ideas which are converted into products by the engineers and innovators create wealth. He emphasized that the wealth of the nation depends on innovative technologies. He mentioned that India, through its Universities, Research Institutions, S&T Departments, including Mission-oriented Agencies (Atomic Energy, Space, Defence Research) has laid a strong foundation for basic research as well as applied research and technology development. For industrial development, we need in-house R&D centres in industry and enhanced academia-industry interactions, and for rural development, we need improved mechanisms for identifying relevant technologies and their rural technology delivery. He mentioned that the National Knowledge Network aims to connect all knowledge institutions in India through a high-speed all-optical fibre low-latency network. Regional and international research collaboration can be enhanced by connecting such Knowledge Networks. He further highlighted that the most important issue today, not only in India but everywhere, is attracting talented young people to careers in science and technology, particularly in those areas which a country considers important. INSPIRE programme of DST is a significant initial step in this context, starting from age group 10-15 (middle and high schools) to faculty awards in the age group 27-32 (post-doctoral) .He mentioned that more than 6,40,000 awards have been released since the inception of programme in 2008. He urged the Academy to do more in chosen domains of engineering education and other national challenges.

Dr. R Chidambaram delivering his address

The first INAE Silver Jubilee Distinguished Lecture was delivered Prof. P Rama Rao, Chairman, Governing Council, ARCI Hyderabad and former Secretary, Dept of Science & Technology, Govt. of India. He explained in a lucid and comprehensive manner that the wealth and prosperity of a nation depend on the effective utilization of its human and material resources through industrialization (investment capital). The use of

manpower resources for industrialization requires education in science and training in technical skills. He mentioned that India being a vast country, diversity of governance systems is truly mind-boggling and unlike in any other country in the world. Government support to private institutions should be seriously considered. He correlated economic growth with relevant post-graduate and doctoral specialization.

Prof. P Rama Rao delivering Silver Jubilee Distinguished Lecture

The second INAE Silver Jubilee Distinguished Lecture delivered by Dr. Anil Kakodkar, DAE Homi Bhabha Chair, former Chairman, AEC and Secretary, DAE, Govt. of India was on the subject of securing the future of energy in India. He mentioned that securing India's future in energy is indeed a major challenge as India alone would need around 40% of present global electricity generation to be added to reach an average 5000 kWh per capita electricity generation. While solar energy represents a large enough energy source provided we can arrange adequate collection area, it would take a while to become commercially viable; nuclear energy is the only other large enough clean and sustainable energy source. It is commercially viable and has been providing around a sixth of global electricity for decades. Also it does not emit carbon-di-oxide. However, our uranium resources are very modest. He highlighted the importance of recycling in fast spectrum reactors and Thorium utilization. With reprocessing and recycle, energy potential is enhanced several ten folds and even our modest uranium resources represent an energy source larger than coal. Reprocessing and recycle with fast reactors also enables use of thorium which is abundant in India. Thorium also offers many advantages such as; high burn up, capacity, reduced minor actinides production, higher safety margins, higher proliferation resistance etc. India has a unique opportunity as eventually Thorium would assume importance worldwide. He iterated that while we must make full use of all available energy resources, only three stage programme of DAE and Solar energy are sustainable in the long run as far as India is concerned.

Dr. Anil Kakodkar delivering Silver Jubilee Distinguished Lecture

The third INAE Silver Jubilee Distinguished Lecture was delivered by Dr. Baba N Kalyani, CMD, Bharat Forge Ltd., Pune. He mentioned that while China would be second largest economy in the world, India will be third largest economy. There is a dire need for Indian Industry to invest in R&D rather than importing technologies from abroad. For this, the need for indigenous manufacturing technology is vital. He mentioned that advanced economies and emerging economies are on diverging trajectories. Emerging countries generally have favourable demographics (except China on a relatively longer horizon) with prospects of modest to high GDP growth. The world's economic centre of gravity will shift towards emerging countries like India in the years to come. He highlighted the importance of high level human expertise, proper policies and need based products.

One of the highlights of the function was participation by Presidents/representatives of the member-academies of CAETS. The first presentation was by Prof Robin Batterham, President, Australian Academy of Technological Sciences and Engineering (ATSE) who mentioned that a CAETS Working

Dr. Baba Kalyani delivering Silver Jubilee Distinguished Lecture

Group on Low Carbon Technologies was constituted which comprised of member academies from Australia, Canada, Germany, India, Japan, Korea, South Africa and UK. The CAETS Energy report had come up with clear recommendations on improved efficiency of energy end use and means of promoting efficient usage globally; research, development and commercialisation of carbon capture and storage technologies and new technologies for electricity distribution networks. He highlighted the importance of close working of Chinese and Indian Academies on areas of mutual interest and enhancing the collaborations. This was followed by a presentation by Prof Gan Yong, Vice President, Chinese Academy of Engineering. The next presentation was by Dr Ainomaija Haarla President, Technology Academy Finland who mentioned that the mission of their Academy is to promote innovations that improve the quality of people's lives; to enhance networking of Finnish technology companies, governmental bodies and the academic community and other national engineering academies and to inspire young people to choose a career in technology and the natural sciences is close to the priorities of INAE. This was followed by a presentation by Dr. Arthur Ruf, Vice President & Head of foreign relations, Swiss Academy of Engineering Sciences (SATW). The last presentation was by Ir. Bertrand van Ee, President, Netherlands Academy of Technology and Innovation who highlighted that the objective of their Academy is to be the meeting and network place for high level decision makers and experts; to positively influence society's attitude to technology and innovation and to advance favourable climate for innovation in the Netherlands through innovation conferences.All the Academies expressed keen interest in activities of INAE and enhancing collaborations.

The function was a success and was appreciated by participants. Live webcast of the whole day's events was very well received and appreciated by a number of INAE Fellows within India and overseas who were not able to attend the function. The event was followed by a dinner at India International Centre. The video recording of the event and the presentations under the INAE Distinguished Lecture series have been posted on INAE website.

INAE Silver Jubilee Distinguished Lectures

Besides the three Silver Jubilee Distinguished Lectures delivered during the Silver Jubilee Inaugural Function, the following five Distinguished Lectures were organized.

Silver Jubilee Distinguished Lecture by Prof. Paulo B. Lourenco

INAE Silver Jubilee Distinguished Lecture on 'Preserving Our Past Built Heritage: Challenges for Modern Engineers' was delivered by Prof. Paulo B. Lourenco, Department of Civil Engineering, University of Minho, Guimarães, Portugal and Head of the Institute in Sustainability and Innovation in Structural Engineering, Portugal, on Aug 23, 2012 at Indian Institute of Technology Madras. The lecture highlighted that a hazard map cannot be related to a disaster map, and disasters are the consequence of inappropriate risk management. The aspects related to disasters, risk and earthquakes, guidelines for conservation projects, providing safer, economical and more adequate remedial measures were discussed during the lecture.

The lecture was coordinated by Prof. CVR Murty, FNAE, Department of Civil Engineering, IIT Madras and was attended by a large number of dignitaries including INAE fellows, faculty and students of IIT Madras.

Silver Jubilee Lecture by Prof. Paulo B. Lourenco

Silver Jubilee Distinguished Lecture by Prof. MM Sharma

INAE Silver Jubilee Distinguished Lecture on *"Exiting and Rewarding World of Chemical Engineering"* delivered by Padmavibhushan Prof M M Sharma, FRS, Emeritus Professor of Eminence and Former Director of ICT, Mumbai on Nov 1, 2012 at Indian Institute of Technology, Bombay, Mumbai. This was attended by several young researchers, faculty of IIT Bombay and other eminent dignitaries. The speaker highlighted the challenges in Chemical Engineering for a young engineer. In this regard, he shared his personal experience of his long illustrious career, with the young engineers present in the audience.

The event was coordinated by Dr. KV Raghavan, Vice-President, INAE who introduced the speaker and enumerated his achievements.

Silver Jubilee Distinguished Lecture by Prof. C. Ravi Ravindran

INAE Silver Jubilee Distinguished Lecture on 'Inculcating and Celebrating Excellence in Young Engineers of the 21st century' was delivered by Prof. C. Ravi Ravindran, Professor of Advanced Materials, Ryerson University, Canada and Past President of the Canadian Academy of Engineering

(CAE) on Nov 15, 2012 at Indian Institute of Technology, Bhubaneswar. This lecture was directed towards the engineering students and young faculty with a view to excite the inherent excellence in them. The speaker emphasized that the educators have a key role to imbibe enthusiasm, technological excellence, communication skills and entrepreneurship in the students. Apart from INAE fellows, other young engineers and staff from IIT Bhubaneswar also attended the lecture.

Silver Jubilee Distinguished Lecture by Prof. John Banhart

INAE Silver Jubilee Distinguished Lecture on 'Synchrotron X-ray and Neutron Imaging in Materials Science and Engineering' was delivered by Prof. John Banhart, Technical University and Helmotz Zentrum, Berlin, Germany on Nov 15, 2012 at Indian Institute of Science, Bangalore. The lecture highlighted the application of tomography in materials science which is evolving fast: Radiation sources such as synchrotrons, the installation of dedicated imaging stations at reactors, the availability of a new generation of detectors for efficient data collection and readout, and finally, the increase in computing power and development of mathematical algorithms are the drivers of this development.

Prof. U Ramamurty, Department of Materials Engineering, IISc, Bangalore coordinated this event which was well attended by many dignitaries and INAE fellows.

Silver Jubilee Distinguished Lecture by Prof. John Banhart

Silver Jubilee Distinguished Lecture

INAE Silver Jubilee Distinguished Lecture on *"Exciting Challenges in Space"* was delivered by Prof UR Rao, Chairman, PRL Council, ISRO-DOS on Nov 29, 2012 in the Faculty Hall, Indian Institute of Science, Bangalore. The speaker shared his experiences in the development of space technology and recounted the challenges faced. He also emphasized the need for in house development of space technology and the suggested course of action. In addition, he spelt out the future challenges which needs to be addressed to put the country among the top leaders in space technology.

The event was coordinated by Prof. BN Raghunandan, Chairman, Division of Earth and Environment Sciences, Department of Aerospace Engineering, IISc, Bangalore and was well attended by large number of researchers and other dignitaries including INAE fellows, faculty and students of IISc, Bangalore.

Silver Jubilee Distinguished Lecture by Prof. UR Rao

Seminars/Conferences

Lighting a lamp by dignitaries

International Conference on "Towards a Better Innovation Ecosystem"

One of the important events planned during the INAE Silver Jubilee year was the International conference on "Towards a Better Innovation Ecosystem" which was held on Sep 20-21, 2012 at India International Centre, New Delhi. The conference was organized in collaboration with National Innovation Council (NIC), India; International Council of Academies of Engineering and Technological Sciences (CAETS) and Confederation of Indian Industry (CII). Dr. MJ Zarabi, Vice-President, INAE was the Conference Chair.

Dr Baldev Raj, President, INAE. Special Keynote address on 'On Building an Inclusive Innovation Ecosystem' was delivered by Dr. RA Mashelkar, National Research Professor & President, Global Research Alliance National Chemical Laboratory. The Inaugural Address was delivered by Mr. Sam Pitroda, Chairman, National Innovation Council & Adviser to the Prime Minister on Public Information Infrastructure & Innovations. In addition, two Special Keynote addresses were delivered on 'Improving the Research & Innovation Ecosystem' by Dr. R Chidambaram, Principal Scientific Adviser to the Govt. of India & DAE Homi Bhabha Chair Professor and on 'Innovation and Measurement' by Mr. Arun Maira, Member, Planning Commission, Govt. of India. Among the other Keynote addresses, Dr. T Ramasami, Secretary, Department of Science & Technology, delivered the address on 'Nurturing an Ecosystem for Innovations:

Dr. Sam Pitroda delivering Inaugural Address

The conference was held in seven Technical Sessions followed by a Discussion in each session. The themes of the sessions were Innovation Ecosystem: An Assessment; Creating and Nurturing Innovation Mindsets; Fostering International; Collaboration for Innovation; Restructuring R&D; Inclusive Innovation; Funding Innovation & Building Innovative India. Some Lessons'; Prof. R Natarajan, Formerly Chairman, AICTE, New Delhi delivered his address on 'An Assessment of The Significant Ingredients of Innovation Ecosystem'; Prof. Anil K Gupta, Founder, Honey Bee Network delivered his address on 'Missing links in the inclusive Innovation Ecosystem'; Dr. HK Mittal, Adviser, Member Secretary, National Science & Technology Entrepreneurship Development Board (NSTEDB) & Secretary, Technology Development Board (TDB) delivered the address on 'Funding Innovation: A Government Perspective' and many more other distinguished speakers.

The conference had a wide participation to include INAE fellows, delegates from Industry, R& D establishments, Academia, foreign delegates and students from various IIT's and other Academic institutions.

The function was a big success and was appreciated by all participants. A Live webcast of the two-day conference was also organized and was very well received by a number of INAE Fellows and others within India and overseas. In addition, a Networking Dinner was organized which was attended by large number of guests and participants.

INAE-NU International Workshop on Mobile Wireless & Pervasive Systems

The INAE - NU Workshop on 'Mobile, Wireless and Pervasive Systems' was held on Jan 4, 2013 at the NIIT University (NU) campus in Neemrana, Rajasthan. The workshop was inaugurated by Dr. Rajeev Shorey, General Co-Chair and the Founding President, NIIT University.

Shri Rajendra S Pawar, founder of NIIT University and MD & Chairman of NIIT Ltd addressed the delegates. He spoke about the four core principles of NIIT University and the importance of the theme of the workshop in both Industry and Academia. Prof. Parimal Mandke, Vice-President and Registrar of NIIT University welcomed the delegates and briefed about NU.

Several eminent researchers from India and USA participated in the one day workshop. The invited speakers in the workshop were Dr. K. K. Ramakrishnan, Fellow, AT&T Research, USA, Dr. Giridhar Mandyam, Vice-President, Qualcomm, USA, Dr. Venkat Padmanabhan, Senior Researcher, Microsoft Research, Bangalore, Prof. Rajat Moona, Director-General CDAC, India, Dr. M.J. Zarabi, FNAE, Prof. Vijay Kumar, UMKC, USA, Prof. Ranjan Gangopadhyay, LNMIIT, Jaipur, Dr. Surendra Pal, FNAE & President IETE and Prof. M. B. Srinivas, BITS Pilani, Hyderabad. The workshop concluded with Dr. Sushanta Das and Dr. Debopam Acharya presenting an overview of the research activities at NIIT University.

The workshop covered a wide range of topics to include wireless broadband, indoor localization, pervasive healthcare, satellite communications, emerging mobile applications for the Indian market and VLSI. In addition to the invited speakers, the workshop had 20 delegates who had registered for the day long event. A large number of students and faculty of NIIT University participated in the workshop. The workshop concluded with a Networking Dinner at the Cambay Sapphire Hotel in Neemrana. The delegates, faculty and students of NIIT University interacted with the experts during the networking dinner.

Seventh National Frontiers of Engineering NatFOE(7)

The 7th National Frontiers of Engineering Symposium (NatFoE), the annual flagship event of INAE was hosted by the Indian Institute of Technology Guwahati, during Oct 12-14, 2012. Several young engineers took part in the workshop. This year being the silver jubilee year of the Academy, the four themes were chosen relating to the country's progress in science and technology: Engineering in Daily Life; Engineering in National Development; Research in Engineering and Innovations in Engineering. The format of this year's symposium was designed to have equal representation from Industry and Academia. The event facilitated young engineers from different demographic locations in India, belonging to premier educational Institutes as well as corporates, to share leading research and development in respective areas and was intended to promote transfer of new ideas and collaborations, and encourage them to build a network across disparate engineering fields.

NatFOE7 Symposium

Prof. CVR Murty, IIT Madras, FNAE was a coordinator of the event. Dr Hemant B Kaushik, Co-Chair of the Symposium welcomed all the participants. Prof Sukumar Nandi, Acting Director, IIT Guwahati inaugurated the Symposium by releasing the abstract booklet. Ms Dheepa Srinivasan, Symposium Co-Chair described the rationale behind the selection of the themes of the event. Dr Srikumar Banerjee, Guest of Honour shared some thought provoking facts about the number of engineers in India and whether suitable environment is provided for innovation in the country and urged the engineers to adopt a continuous learning process.

The first theme of the Symposium on "Engineering in Daily Life" started with a presentation on "Sustainability Challenges in Renewables" by Dr Monto Mani from India Institute of Science, Bangalore. Mr R Sreedep, Tata Advanced Materials Ltd, Bangalore shared some interesting ways of containing composite waste, while Dr Monica Katiyar, IIT Kanpur spoke about commodity electronic gadgets such as television or mobile phones having cheaper and superior materials in the form of light emitting diodes. Dr Utpal Garain, India Statistical Institute, Kolkata brought out the role played by language engineering and its importance in enabling easy communication in a diverse country like India having a large number of regional languages.

The second theme on "Engineering in National Development" addressed a variety of issues of national importance such as healthcare, defence, power and education. Ms Anasuya Mohan Rao, General Electric, Bangalore highlighted some of the challenges in health care in the country. Dr Sukumar Mishra, IIT Delhi addressed the issue of grid integration, especially to suit many future power requirements which would require integrating renewable to the power grid. Mr N.L. Ravikumar spoke about personal and vehicle armour development done at Tata Advanced Materials Ltd, Bangalore while Dr Parag Bhargave, IIT Bombay shared an interesting study on what motivates school students to take up engineering.

The third these of the symposium on "Research in Engineering" had four speakers sharing their efforts in research. Prof Sanjay Mittal, IIT Kanpur showed how Computational Fluid Dybnamics could be used to predict complex fluid flows in aero engineers as well as in sports. Dr Neeta Trivedi, DRDO, Bangalore touched upon multi target fusion for use in tracking targets during war. Dr PR Venkateswaran, Welding Research Institute Tiruchirapalli proposed a model for translating innovative ideas from the laboratory to the shop floor while Dr S Karthikeyan, Indian Institute of Science, Bangalore addressed the issue of accelerated materials via modeling for more efficient gas turbine applications.

During the last session on "Innovations in Engineering", Dr Suchismita Sanyal, presented an overview of how innovation is enabled in General Electric Company. Dr Avinash Kumar Agarwal, IIT Kanpur stressed on the importance of reducing emissions in the automotive sector by using vegetable oil as fuel as well as igniting sparks for combustion using lasers. Dr Namrata Gundiah, Indian Institute of Science, Bangalore looked into biomechanics of insects for possible applications in detection and cure of cancer.

A Pre-Dinner talk was delivered by Dr. Srikumar Banerjee, former Chairman, Atomic Energy Commission (AEC), currently DAE-Homi Bhabha Chair Professor at BARC, Mumbai on “In the Life of an Engineer”. Dr. Banerjee commenced his talk with the human development index and related this to the energy sustenance of India. He also shared some experiences from his own engineering career. The documentary film by INAE, brought out during the silver jubilee celebrations, on “Glimpses of Indian Engineering Achievements”, was screened during the evening's function, showing some vignettes of the marvels of India in Science, Engineering and Technology.

In addition to the presentations, there were posters presented on a variety of topics. The posters were displayed throughout the meeting enabling participants to interact, share and discuss their work. One of the key highlights of the symposium was the panel discussion on the challenges involved in motivating young engineers and whether the current engineering education in the country is conducive to a practicing engineer. The panel discussion was on the topic "How to help young engineers succeed in their endeavours". The outcome of the symposium resulted in some key areas of collaboration between some of the participant young engineers and their organizations.

Academia-Industry Interaction

AICTE-INAE Distinguished Visiting Professorship Scheme

Academia and industry, which for long have been operating in separate domains, are rapidly moving closer to each other to create synergies. Academic institutes now place great importance to closer interaction with industry and R&D organizations. Traditionally, engineering colleges are looking for placements and internships for their students and the industry for fresh recruits who are well trained and equipped with the right knowledge, skills and attitude to be able to contribute to industry's growth. Further, during the course of teaching engineering at under graduate and postgraduate levels it is desirable to correlate theoretical knowledge with 'real life' practical problems encountered in industry. This would make the teaching relevant to the industrial realm and add to the realism of the courses taught in engineering institutions.

The Indian National Academy of Engineering (INAE) launched a Distinguished Visiting Professorship (DVP) scheme jointly with AICTE in 1999. The Scheme envisages promotion of industry-institute interaction by facilitating the dissemination of knowledge through the expertise of experienced and knowledgeable persons from industry to integrate their rich industrial experience with technical education. As per the objectives of the scheme; the Distinguished Visiting Professor is required to deliver lectures on the state-of-art of Industry, industrial ambience and R&D needs of the industry to the students and faculty of technical institutions; guide student projects/ theses of interest to industry; help curriculum development, keeping in view, the changing industrial needs; develop cooperative undergraduate and postgraduate programmes with industry having potential benefits to faculty, students and Industry and take up any other activities for the mutual benefit of engineering institutions and industry.

The scheme has no doubt been a great success and has been running effectively during the last twelve years. Thirteen Industry Experts were selected during the year 2000; eighteen each in 2001 and 2002; fourteen in 2003; ten in 2004; thirteen in 2005; fifteen during the year 2006, fifteen during 2007; eleven during 2008; eighteen during the year 2009; nine during the year 2010; seven during the year 2011 by a high level Steering Committee of INAE Fellows and representatives from AICTE and CII. The Industry experts selected under the subject Scheme include experts from Industry as well as DRDO/DAE/DOS Labs. During their visits, the visiting professors besides delivering lectures on the state-of-art industrial practices and sharing their industrial experience with the faculty/ students of the affiliated engineering institutions are also assisting in updating the curriculum. There is no doubt that both the industry and engineering institutions are the beneficiaries of academia-industry interaction. The outcomes of this interaction are industry support to basic research; industry participation in technology development involving exploratory work and academic intervention in solving specific industry problems.

The Steering Committee during its meeting on May 21, 2012 discussed 25 nominations received for the year 2012 and selected the following 12 industry experts. In all these cases the industry experts have already identified the matching engineering college/institution.

1 Dr Surendra Pal, FNAE, Senior Advisor-Navigation, ISRO, Prof Satish Dhawan Professor, ISRO, Bangalore
2 Dr SK Kaushik, FNAE, Consulting Structural Engineer, Beas (Punjab)

3 Mr Paritosh C Tyagi, FNAE, Consultant in Environmental Management, NOIDA4Dr Kamalesh Dasgupta, Outstanding Scientist, Head Tunable Laser Section, BARC, Mumbai

5 Dr A Subhananda Rao, DS & Chief Controller R&D (Aero) & Director, Gas Turbine Research Establishment (GTRE), Bangalore

6 Dr Madhu Ganesh, Director, Technical, Reneo Energy Systems, Coimbatore

7 Dr MR Kalgal, Senior Vice-President, UltraTech Cement Ltd., Bangalore

8 Mr KN Suryanarayana Rao, Formerly Engineer-H, Project Director, IRNSS, ISRO Satellite Centre, Bangalore

9 Mr RP Ritolia, Advisor (Coal) to MD, Tata Steel and Formerly CMD, Central Coalfields Ltd

10 Dr N Rama Murthy, Scientist 'G', Additional Director, Centre for Artificial Intelligence and Robotics (CAIR), Bangalore

11 Dr Bishwajit Chakraborty, Scientist 'G'/Chief Scientist, National Institute of Oceanography, Goa

12 Dr Arya Kumar Bhattacharya, Head, Intelligent Systems and Mathematical Modeling, Tata Steel, Jamshedpur

Some of the representative feedbacks received recently from engineering colleges/institutions associated with this scheme are given below.

(a) *The visit of the industry expert was of immense importance for the students for getting acquainted with the problems of industry and gaining knowledge of the application of technological theory in industry".* Head, Department of Metallurgical and Materials Engineering, Indian Institute of Technology Kharagpur

(b) *"The lectures delivered by the industry expert were extremely beneficial for the students. The students are definitely benefitted by the industrial inputs which will help in making them competent in real life situations".* Head, Department of Mechanical Engineering, National Institute of Technology, Agartala

(c) *"The interaction was very fruitful for technical collaboration and start of new activities is envisaged."* -Head, Department of Electrical Engineering, Indian Institute of Technology, Madras, Chennai

INAE-AICTE Distinguished Industry Professor Scheme

"INAE-AICTE Distinguished Industry Professor" Scheme was instituted in the year 2007, in which Faculty from engineering institutions spend some time in industry to contribute to the Industry, as well as, gain exposure to the industrial environment/requirements. This can initiate the development of longer-term relationships between the institution and the industry, by way of joint projects, joint student practical training programmes, research and consultancy contracts, and placement of students. The faculty can enhance and update the basic theoretical knowledge of the engineers in industry by interacting with them and solving industrial problems. For engineering faculty, this would provide the opportunity to learn about the State-of-the-Art technologies and get exposure to current industrial and commercial practice. This would also help in making the teaching more relevant to the industrial realm and add to the realism of the courses taught in engineering institutions.

Prof Sukumar Mishra, FNAE, Department of Electrical Engineering, IIT Delhi was selected under this scheme during the year 2012. He was associated with Ecosense Sustainable Solution Pvt Ltd, New Delhi. Prof Sukumar Mishra undertook a project on tracking of maximum power point of a Photovoltaic Panel. This is a pertinent issue today as in most of the cases mechanical tracking is not possible and is essentially required for optimum harnessing of solar energy. He also delivered lectures on "Maximum Power Point Tracking of Photovoltaic (PV) Panel" to the engineers in the industry and developed a new Maximum Power Point Tracking (MPPT) scheme which has the potential to be implemented in real commercial system.

International Affairs

CAETS Symposium and Annual Meeting

CAETS had constituted a Working Group for a study on "Opportunities for Low Carbon Energy Technologies for Power Generation to 2050". A draft report prepared by this Working Group was discussed during a meeting held on August 29, 2012 at Zurich, Switzerland in which representatives from Australia, Canada, Germany, India, Korea, UK and South Africa participated. Dr. KV Raghavan and Brig SC Marwaha from INAE attended this meeting. Each of these representatives had been assigned the task of preparing an assessment of the technology under different heads, viz,, Hydroelectric Power Generation, Geothermal Energy, Marine and Tidal Energy, Wind and Biomass, Coal, Solar, Nuclear Energy, Risks to Deploy Low Carbon Energy Technologies, Challenges facing Industry and Governments to introduce LCE Technologies and Recommendations.

CAETS meeting in progress

INAE delegation

Dr. KV Raghavan briefed about the report on Solar Energy covering the current state of the solar photovoltaic and solar thermal technologies; the most promising solar power systems and most promising initiatives that might accelerate investment and deployment of solar power technologies. The integration and combination with other technologies that can accelerate investment and deployment of solar technologies were also included along with investments required at scale for solar technologies incorporating the most promising initiatives. Regarding R&D – industry – Government roles, it was highlighted that for achieving the goal of commercial deployment of solar energy based power technologies, the R&D institutions, industry and government have to play proactive and complementary roles with the sole objective of substituting solar energy in place of fossil fuels at the shortest possible time with minimum cost.

The working group (WG) also discussed the changes to be brought into both the structure and content of the working group report. The report of the working Group is under finalization and shall be published by ATSE during June 2013. A meeting of the Working Group is being held on the sidelines of the CAETS symposium at Budapest during June 26-28, 2013 which will be attended by Dr Baldev Raj, President, INAE. The objective of the meeting is to discuss the dissemination of the report and the next activities for the Working Group.

The CAETS Council on Aug 31, 2012 decided that the CAETS Working Group on Low Carbon Energy (LCE) to be converted into a CAETS Standing Committee on Energy to provide more focus and monitoring system for development and deployment of LCE technologies in member countries.

CAETS Symposium on "Urban Development and Public Transportation – Improved Understanding of the Interdependencies" was held on Aug 30, 2012. The Symposium focused on the impediments and potential solutions to controlled sustainable urban development . This requires efficient intermodal public transportation and effective use of motorized individual transport (specifically cars and motorcycles), integrated into one optimized transportation system. Future cities have to fulfill the following basic criteria : sustainability, good quality of life (low noise, plentiful daylight and space); and an efficient, integrated transportation system. Transportation makes its greatest contribution if it is integrated so that switches between different modes are seamless for the users, enabling them to choose the optimal solution for each leg. Prof. PK Sikdar from INAE gave a presentation on "Planning and Implementation of BRT (Bus Rapid Transit) in India". He mentioned that the BRT system varies from being a set of applications that employ widely used and proven techniques to upgrade traditional fixed-route bus service. BRT in India was an initiative taken under the JnNURM scheme where it was planned to create high quality Public Transport System, oriented to the user that offers fast, comfortable and low cost urban mobility. Under the scheme, development of BRT was taken up in 4 cities namely, Ahmedabad, Indore, Jaipur and Pune. However, these were road widening projects transformed into BRT projects or projects developed with a focus on road infrastructure. A large network of BRT has been planned in Delhi. In the last eight years bus ridership has decreased by 17% while the person trips/day have increased by 22% in the same time. Delhi has relatively low rise development with multiple business districts and it keeps expanding in a radial mode. There has been an urgent need to augment mass transport facilities to reverse the trend of increasing use of personal vehicles. Accordingly, the first corridor of BRT in Delhi is planned from Dr. Ambedkar Nagar to Delhi Gate and is 14.5 km long, which is implemented in phases. A good BRT system works well when it is integrated with other transport systems and an efficient "Park and Ride" facility which can compensate the feeder service, enabling people to use their private vehicles till the corridor. For a successful BRT system to be planned and implemented, a thorough understanding of the concept, detailed engineering specifications for the roads and other components like the bus stops, proper planning of service facilities, public outreach, brand identity and marketing are essential. Prof. Sikdar brought out that the BRT systems planned and implemented in India are of different levels of complexity and they have mixed level of success. Both in India and worldwide existing BRT systems have proved beyond any doubt that BRT like any other rapid transit system would require integrated system of operation for efficiency and profitability.

The programme for the Symposium was balanced with presentations, Panel Discussions, and Q&A Sessions.

CAETS Council meeting was held on Aug 31, 2012. Besides, the administrative actions and issues, brief presentations were made by CAETS Committees on International Organizations (CIO) and CAETS Noise Control Technology Committee (NCTC).

One of the important topics for discussion was regarding "Recent Efforts and Experiences Promoting Engineering-based Innovation". Dr. KV Raghavan brought out that keeping in view the importance of innovation for national and global growth, employment, competitiveness and sharing of opportunities in the 21st century, the Government of India has declared 2010-2020 as the 'Decade of Innovation'. The challenge before India is to develop an inclusive model of innovation that will move the country to become not merely a knowledge-producing economy but a knowledge-sharing society that will have relevance to many parts of the world. An important initiative like Aadhar or the Unique Identification Programme, e-governance, e-procurement and e-tendering has been taken in this regard. Aadhaar is a 12-digit unique identification (UID) number which the Unique Identification Authority of India (UIDAI) is issuing for all Indian residents. By providing a clear proof of identity, Aadhaar will empower India's poorer citizens in accessing services such as the formal banking system and give them the opportunity to easily avail various other services provided by the Government and the private sector. Certain other initiatives in the recent past like setting-up of National Innovation Council, National Innovation Foundation etc.

Dr. Raghavan also mentioned that INAE International Conference on "Towards a Better Innovation Ecosystem" was being held on September 20-21, 2012 at New Delhi which was to be co-hosted by CAETS, National Innovation Council and Confederation of Indian Industry (CII). Four speakers from Member-Academies of CAETS had confirmed to deliver their key-note speeches during this Conference. This Conference was aimed to provide a platform for collaboration and engagement with other countries to understand their views, ideas and strategies for strengthening the innovation ecosystem.

"Promoting Discussion with the Public on Engineering, Sciences & Technology" was another interesting topic that was discussed. In this regard, Brig SC Marwaha mentioned that Department of Science & Technology, Govt. of India has set up a a joint Academies Advisory Panel comprising experts from Science Academies and Indian National Academy of Engineering (INAE) for implementation of three new schemes for attraction of talented students to study and pursue careers in science, viz, (i) S*cheme for early Attraction of Talents for Science* for a total of one million young learners of the age group 10-17 years once in their school career. (ii) Ten thousand *Scholarships for Higher Education for* the age group 17-22 years, per year. . (iii) *Offering Assured Opportunity in Research for* the age group 17-22 years, for 5 years' doctoral research, backed by an assured research career opportunity for another period of five years after their PhD in sciences. All these schemes include attractive scholarships for motivating the students. The programme is steered jointly by the entire science Academies and engineering academy (INAE) of the country in an autonomous fashion. Government of India has earmarked 600 million dollars budget for these schemes.

The next CAETS Annual Meeting and Symposium on "Current Innovative approaches to Engineering Education" will be held in Budapest, Hungary during June 26-28, 2013.

Collaboration with Foreign Academies

INAE–ATSE Workshop on Solar Thermal and Solar Photovoltaic Technologies

The second INAE –ATSE workshop conducted in the field of energy; was on the topic of "*Solar Thermal and Solar Photovoltaic Technologies"*; which was held during Oct 15-19, 2012 in Canberra, Newcastle and Sydney, Australia. Dr Mike Sargent, AM FTSE, was the Convenor from Australian Academy of Technological Sciences and Engineering (ATSE) and Dr RR Sonde, FNAE, Executive Vice President, Thermax, Pune was the Convenor from INAE. During this workshop, leading experts from India and Australia joined together and conducted detailed deliberations on the complete spectrum of Solar Energy with the aim of building a roadmap for faster deployment of these technologies in India and

Australia. These meetings were aimed at facilitating exchange of information about solar energy initiatives in each country, and identifying opportunities for collaboration between Australia and India in the research, development and deployment of solar energy.

The members of INAE delegation led by Dr RR Sonde were Dr Shyam Chetty, Director, National Aerospace Laboratories, Bangalore; Dr Dilip Saha, Raja Ramanna Fellow, Bhabha Atomic Research Centre, Mumbai; Dr. Satish Ogale, Chief Scientist and Coordinator, Centre for Excellence in Solar Energy, National Chemical Lab; Dr Suresh Kumar, Executive Vice President and R&D Director, KG Design Services; Dr Ajay Dhar, Head Metals &Alloys Group, Materials Physics and Engineering, National Physical Laboratory, Delhi and Prof Vivek Agarwal, Department of Electrical Engineering, IIT Bombay. Eminent experts representing Academia, Research, Policy and Industry segment from Australia also participated in this event. The Workshop was enhanced by technical visits to Liddell Power Station, ARC Photovoltaics Centre of Excellence and Commonwealth Scientific and Industrial Research Organization (CSIRO) National Solar Energy Centre. A half day Workshop was held at CSIRO, New Castle and a technical visit to University of New South Wales was also organized.

The round-table meetings between the Indian delegation and Australian representatives of governments, research institutions and businesses in the renewable energy sector concluded that collaboration in technology development between India and Australia, focused on the areas of improved solar photo-voltaic technologies; Organic solar photovoltaic/building integrated PV; Concentrating solar thermal technologies for electricity production and process heat; Solar heating and cooling; Solar fuels and Energy storage will provide benefits to both countries in the more rapid deployment of solar energy.

During the visit, CSIRO and Thermax signed a Memorandum of Understanding to progress opportunities in the area of development of concentrated solar thermal technology. A joint Report by ATSE and INAE on "Australia-India Solar Thermal and PV – Workshops, Round Table Meetings and Technical Visits" has been brought out. A clearly defined action plan for pursuing follow-up actions has been worked out and is being progressed.

INAE-CAE Conference on Clean Coal Technologies

On signing of MOUs between INAE and Canadian Academy of Engineering; the topic of "Clean Coal Technologies" was identified as an area of mutual interest to both academies. In this regard the first INAE-CAE Conference on Clean Coal Technologies was held on Dec 4, 2012 at India International Centre, New Delhi. Dr K V Raghavan, Vice-President, INAE was the Convenor from INAE and Prof C Ravi Ravindran, Former President, Canadian Academy of Engineering was the Convenor from CAE. The Conference was attended by eminent scientists, experts on energy and industry leaders from both countries. The topics for joint interactions in the workshop were Clean Coal Technology Overview; Coal Beneficiation; Clean Coal Combustion Options; Pre and Post Combustion CO_2 capture; CO_2 transportation and sequestration in deep saline aquifiers, disused oil/gas fields and mines; Coal bed and mine methane recovery and processing and Coal gasification and IGCC.

Conference on Clean Coal Technologies

The function was inaugurated by Dr. B Prasada Rao, Chairman & Managing Director, BHEL. Dr. Baldev Raj, President, INAE delivered the Presidential Address during the Inaugural Session. The special invitees included Ms. Ivy Lerner-Frank, First Secretary and Trade Commissioner, Canadian High Commission, India. Eminent Speakers and Panelists contributed in the event which included Dr R K Chopra, CMPDI, Ranchi; Dr. D Yogeswara Rao, Adviser (PSA), GOI; Dr T C Rao, Former Director of AMPRI, Bhopal; Dr Amalendu Sinha, CMFRI, Dhanbad; Dr G Thyagarajan, IICT & CLRI; Dr R R Sonde, Thermax Ltd., Pune; Dr P S Sai Prasad, IICT, Hyderabad; Prof Sushanta Mitra, Univesity of Alberta; Dr Rajender Gupta, University of Alberta; Dr Subhir Bhattacharjee, University of Alberta and Dr Rajender Gupta, University of Alberta, Canada.

The scientific presentations made by the INAE and CAE delegation members have brought out the important role to be played by the engineering academies in flagging the vital issues confronting the commercial deployment of clean coal technologies and the need for evolving joint initiatives in frontier research areas which can make a significant difference in currently practiced technologies. The interactions between experts and policy makers during the panel discussion session chaired by Mr Shyam Saran, Former Adviser on climate change to the Prime Minister of India had yielded several new ideas on Indo-Canadian joint initiatives. The joint establishment of a centre of excellence on clean coal technologies with focus on application centred coal characterization, water footprints of clean coal options, bioconversion technologies for ecofriendly coal processing and modern tools for scientific evaluation of various clean coal technologies has received major attention. The need for providing a major push in India to IGCC technology demonstration, coal liquefaction progrmames and human capacity building in clean coal research also received attention.

Consequent to INAE-CAE Joint Conference on Clean Coal Technologies" held on Dec 4, 2012 at India International Centre, New Delhi, the following areas have been identified for the proposed joint initiatives on Clean Coal Technologies.

(i) Industry Foresight Development (medium and long term)
(ii) Human Resource Capability development in Clean Coal R&D
(iii) Advanced Techniques for Coal characterization with Application orientation
(iv) Evaluation Methodologies for water footprints of clean coal technology options
(v) Bioprocess options for Clean Coal Processing
(vi) Engineering Evaluation for relative performance assessment of various clean coal technological options

Indo-German Workshop on "Big data for Engineering Applications"

The Indo-German Workshop on "Big data for Engineering Applications" was held on March 14-15, 2013 at Berlin, Germany. The objective of the workshop was to find the ways in which it is possible to generate useful information from the constantly increasing data volume, in order to use this information beneficially in production and business processes. This and various related questions were discussed by German and Indian experts, from Indian National Academy of Engineering (INAE), National Academy of Science and Engineering (acatech), Germany, Indian National Science Academy (INSA) and the National Academy of Science Leopoldina, Germany. Dr. Baldev Raj, President, INAE and Prof. Otthein Herzog, acatech - Executive Board - International Relations were the coordinators of the event.

The term "big data" in general refers to data that has grown too large to be managed by conventional methods and tools. Search engines and data generated from sensor networks have led to exponential growth and availability of huge data pools. Such large distributed data stores present new challenges for finding information, identifying data patterns and hidden relations within the data (machine learning),

evaluating risks, and forecasting trends. Big data include all types of data, such as alphanumerical data, images, and videos.

The joint workshop/research addressed several aspects of big data management for engineering applications, including secure data storage options (databases, clusters, etc.), indexing methods for distributed data, easy access, automated analysis, and the visual presentation and analysis. The results of this research will serve as a basis for further engineering application development, data analysis and efficient data usage in order to ensure robust processes for production and control processes.

Only advanced data analysis methods are able to extract complex patterns and unearth truly valuable information. Both academies have agreed to work together to improve existing techniques and to develop a roadmap guiding us to new technologies for processing and analyzing big data for engineering applications.

Dr. Baldev Raj, President, INAE; Prof. N Balakrishnan; IISc Bangalore; Prof. Nikhil Ranjan Pal, ISI, Kolkata; Dr. P Chellpandi, IGCAR; Dr. Rajeev Shorey, NIIT University; Prof. P Seshu, CSIR and Dr. Sundeep Oberoi, TCS were the Indian Speakers who presented their talks during the workshop. Among the German Speakers were Prof. Otthein Herzog; Prof. S. Wrobel Fraunhofer AIIS, Germany; Dr. N.N., Fraunhofer FIT; Prof. P. Sachsenmeier, IMAG; Prof. S. Wittig, KIT Karlsruhe; Dr.N.N., SAP Germany and Dr. S. Ferber, Bosch Software Innovations. Dr. Praveer Ashthana, DST and Dr. VK Sharma, Indian Embassy in Germany also participated in the workshop. The sessions were broadly based on the topics of perspectives of Big Data , Public Big Data, Large-Scale Modeling, Computational Aspects of Big Data and Data-oriented Production. The details of the workshop can be viewed at http://inae.in/seminar.html

In the intensive discussions the participants emphasized the need for a much closer cooperation between Indian and German research institutions even up to a joint virtual institute on Big Data and their Applications, also in the framework of a joint Indo-German Innovation Platform.

INDO-UK Joint Seminar on "Functional And Energy Materials, Manufacturing And Structures" (FAEMMS-2013)

The INDO-UK Joint Seminar on "Functional and Energy Materials, Manufacturing and Structures" (FAEMMS-2013) was jointly organized by The Indian National Academy of Engineering (INAE) and The Royal Academy of Engineering (RAEng), UK at University of Hyderabad on March 25-26, 2013. Prof. Bhanu Sankara Rao, School of Engineering Sciences and Technology, University of Hyderabad from INAE and Prof. S Ravi Silva, Director, Advanced technology Institute, University of Surrey from RAEng, UK were the coordinators of the event.

Themes of the conference were based on "Engineering a more Sustainable World for Tomorrow". The topics discussed in detail included shape memory alloys, advanced soft and hard magnetic materials, solar energy materials, thin films and coatings for sustainable solar energy, fuel cells, lithium ion batteries, performance of functional materials in aerospace structures, materials and manufacturing technologies for components in green automobiles and nano particle strengthened steels. All these materials are playing a key role in applications pertaining to automobiles, clean power generation, aerospace, defense, atomic energy and electronic industries. The research on these materials and their manufacturing technologies is currently under progress. Functional materials both in bulk and thin film form play a key role in aerospace and defense applications. Several advanced functional materials such as magnetostrictive materials, magnetocaloric materials, multiferroics and ceramic solid oxides are also emerging in recent years and have great potential for applications in future sensors and actuators as well

as in fuel cells. Li ion batteries, Hydrogen storage materials, fuel cells are playing a key role in automobile industry. Very recently, there is very keen interest in the development of high strength and nano structures steels for oil, gas and automobile parts. This seminar provided the platform to exchange the views, knowledge and ideas and hope to establish meaningful and fruitful collaborations.

This event was aimed to bring some key advanced materials' researchers from Academia, research Institutions and Industries, and also Government Stakeholders from both countries to examine the potential for co-operation and collaboration to meet our current and future infrastructure and manufacturing needs. The deliberations at the meeting were focused on materials development, advanced manufacturing, fabrication of structures and assessment of their performance.

About seven experts from across the engineering sectors of United Kingdom and abroad participated in the event. Among the Indian speakers, eighteen speakers from various industries like TATA, Thermax, Mahindra& Mahindra etc.; R&D experts from BHEL, DMRL, ARCI, NML, BARC etc. and academia experts from IITs, IISc, IACS, IICT etc. also participated in the Seminar. About 100 research scholars and other participants attended the seminar. The details of the conference can also be viewed at www.inae.in

Promoting Excellence in the Field of Engineering

Life Time Contribution Award in Engineering 2012

This award is given to an eminent Indian citizen who has made most distinguished contributions in the field of Engineering / Engineering Research / Technology, which have brought prestige to the nation and regarded as landmarks of technological development of the country.

Prof. P Rama Rao, Chairman, Governing Council, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad; and Dr. RA Mashelkar, National Research Professor, NCL, Pune and Chancellor, Academy of Scientific and Innovative Research (AcSIR) were conferred Life Time Contribution Awards in Engineering 2012.

Prof. Jai Krishna and Prof. SN Mitra Memorial Award 2012

These awards are given to an eminent engineer, engineer-scientist or a technologist for one or more of the following:

(a) Academic and scholarly achievements in any discipline of technology
(b) Outstanding research in engineering and technology and application thereof.
(c) Outstanding contributions in the management of education and research in engineering
(d) Outstanding achievements and contributions in the Indian industry, engineering services or engineering projects

Prof Jai Krishna Memorial Award is given from among the disciplines of Engineering Section I (Civil Engineering), Engineering Section III (Mechanical Engineering), Engineering Section IV (Chemical Engineering), Engineering Section VII (Aerospace Engineering) and Engineering Section VIII (Mining, Metallurgical and Materials Engineering) and Prof S N Mitra Memorial Award is given from among the disciplines of Engineering Section II (Computer Engineering and Information Technology), Engineering Section V (Electrical Engineering), Engineering Section VI (Electronics & Communication Engineering), Engineering Section IX (Energy Engineering) and Engineering Section X (Interdisciplinary Engineering and Special Fields).

Prof. Amitabha Ghosh, INSA Senior Scientist, Bengal Engineering and Science University, Howrah and Prof. N Viswanadham, Formerly Professor of Mechanical Engineering, National University of Singapore, Singapore and Deputy Executive Director, Logistics Institute Asia Pacific, and Former Executive Director, Center for Global Logistics were conferred Prof. Jai Krishna and Prof SN Mitra Memorial Awards 2012 respectively.

INAE Young Engineer Awards 2012

The Academy in 1996 instituted INAE Young Engineer Awards for excellence in design and technology transfer, innovative development and engineering research. The scheme has attracted nominations of bright young talent in the country and has become a prestigious national award since then. So far, 167 young engineers have been conferred this Award and their early recognition has encouraged the best upcoming talent to make innovative engineering and technological contributions for our national development.

The nominations for this award for the year 2012 were sought from INAE Fellowship, Engineering institutions, R&D Labs during February 2012. Out of 96 nominations, 35 were shortlisted by the Sectional Committees in their meetings held on July 27, 2012 at New Delhi.

The shortlisted candidates gave presentation of their work before the Selection Committee on October 9, 2012 at New Delhi.

Presentation for INAE Young Engineer Award 2012

The following ten candidates have been selected for conferment of Young Engineer Award 2012.

1 Dr. Dipti Ranjan Sahoo, Assistant Professor, Department of Civil Engineering, Indian Institute of Technology Delhi
(Structural Engineering)

2 Dr. Animesh Mukherjee, Assistant Professor, Department of Computer Science and Engineering, Indian Institute of Technology, Kharagpur
(Social networks, Web social media, social computation the web as virtual laboratory, human language dynamics)

3 Dr. Swagatam Das, Assistant Professor, Electronics and Communication Sciences Unit, Indian Statistical Institute, Kolkata
(Computer Science and Information Technologies(topics related to Evolutionary Computation and Swarm Intelligence, Pattern Recognition, Digital Signal Processing)

4 Dr. CS Shankar Ram, Assistant Professor, Department of Engineering Design, Indian Institute of Technology Madras, Chennai
(Automotive Engineering)

5 Dr. Gaurav Tomar, Assistant Professor, Department of Mechanical Engineering, Indian Institute of Science, Bangalore
(Two phase flows, Interfacial instabilities, Computational heat and mass transfer)

6 Dr. VC Srivastava, Assistant Professor, Department of Chemical Engineering, Indian Institute of Technology Roorkee.
(Industrial Pollution Abatement, Wastewater Treatment, Multi-component Adsorption, Desulfurization, Statistical design)

7 Dr. Partha Bhattacharyya, Assistant Professor, Department of Electronics and Telecommunication Engineering, Bengal Engineering and Science University, Howrah
(MEMS based Gas Sensors)

8 Mr. Brajnish Sitara, Scientist 'D', Inertial Navigation System Division, Directorate of Inertial

Systems, Navigation Complex, Research Centre Imarat, DRDO, Hyderabad
(Inertial Navigation)

9 Dr. VVSS Srikanth, Assistant Professor, School of Engineering Sciences and Technology, University of Hyderabad, Hyderabad.
(Synthesis, Structure-property correlation, and functionalization of carbon nanomaterials)

10 Dr. N Nishad Fathima, Senior Scientist, Chemical Laboratory, Central Leather Research Institute, Chennai
(Leather Science & Technology)

Innovative Student Projects Awardees 2012

The Academy has instituted 'Innovative Student Projects Award' since 1998 to identify innovative and creative research projects undertaken by the students at three levels, B.E./ B.Tech, ME/ M.Tech and Ph.D in Engineering Colleges.

122 nominations received at Doctoral level (37); Master's level (35) and Bachelor level (50) were examined by the Selection Committee on July 26, 2012. Out of these, 44 nominations (Doctoral level (13); Master's level (12) and Bachelor level (19) were shortlisted.
The shortlisted candidates gave presentations of their work before the Selection Committee on October 8, 2012 at New Delhi.

Presentation for Innovative Students Project Award 2012

The following sixteen theses/projects (Doctoral level (5); Master's level (5) and Bachelor level (6) have been selected for conferment of Innovative Student Projects Award 2012.

Doctoral Level

1 Dr. Amit Kumar Jain, Indian Institute of Science, Bangalore
(Control of High Power Wound Field Synchronous Motor Drives : Modelling of Salient Pole Machine Control Using VSI, LCI and Hybrid LCI/VSI Converters)

2 Dr.Shibayan Roy, Indian Institute of Science, Bangalore
(Role of Boron on the Evolution of Microstructure and Texture in Ti-6Al-4V-0.1B Alloy)

3 Dr. V Pramitha, Cochin University of Science and Technology, Kerala
(A new metal ion doped panchromatic photopolymer for holographic applications)

4 Dr. Abhijeet B Joshi, Indian Institute of Technology, Bombay, Mumbai
(Nano-Engineered Lactate Biosensor)

5 Dr. Devanjan Bhattacharya, Indian Institute of Technology Roorkee
(Development of a Geo-hazard Warning Communication System)

Master's Level

1 Mr. Sanhtosh Prabhu M, Indian Institute of Technology Kharagpur.
(Formal Verification of abstract digital controllers for hybrid systems)

2 Mr. Gokul B, Indian Institute of Technology Madras, Chennai
(Development of a Multifunctional Sensor Network with an optimized Communication Protocol for Industrial Process Monitoring)

3 Mr. Pardeep Garg, Indian Institute of Science, Bangalore
(Alkane and inert additive mixtures as working fluids for organic Rankine cycles)

4 Ms. B Nandini, Indian Institute of Technology, Kharagpur
(Novel Soft Lithographic Fabrication of Superhydrophobic Surfaces and their Durability Studies)

5 Mr. Indrajit Sarkar, Bengal Engineering and Science University Shibpur, Howrah
(Modification of Input Filter circuit to realize Stepless Communtation in Matrix Converter -PSpice Simulation Study and Experimental Verification.)

Bachelor Level

1 Joshi Kumar A.V., Madhan Prabhu T. and Mohan Raj S. Sri Sai Ram Engineering College, Chennai
(Visual Cognition: A Pragmatic Approach for Visually Impaired Using Android)

2 Mr. Sanuj Govind Agrawal, Mr. Sumit Shrikrishna Naik and Mr. Bhusan Bharat Patil S.S.B.T"s College of Engineering and Technology, Bambhori, Jalgaon Maharashtra
(Green Air Conditioner with Double Cooling Effect)

3 Surabathuni Pallav, Indian Institute of Technology, Patna
(Design and Characterization of Einstein-Szilard Refrigerator)

4 Rajnish Kumar Yadav, Indian Institute of Space Technology, Thiruvanthapuram
(On the Use of undirected Probabilistic graphical Modeling for Cognitive wireless Networks)

5 Mahadeva Subramanian H, Niranjan Balaji E and Meiyappan C Sri Venkateswara College of Enginering, Sriperumbudur
(Security Enriched Electronic Ballot Box)

6 S Hima Sundharam and M Mahalakshmi St Joseph's College of Engineering, Chennai
(Design and Implementation of Intelligent Robotic Fish)

Research Schemes

With the objective to encourage invention, investigation, research and promote high caliber of engineering-scientists, INAE has instituted four schemes, viz., INAE Chair Professorship; INAE Distinguished Professors/Technologists; Mentoring of Engineering Teachers by INAE Fellows and Mentoring of Engineering Students by INAE Fellows.
In connection with the above mentioned schemes, the following nominations were approved by the Council.

INAE Chair Professorship

1. Prof. Sankar K Pal, Indian Statistical Institute, Kolkata.

INAE Distinguished Professors/Technologists

1. Dr. SK Gupta, Central Soil Salinity Research Institute, Karnal
2. Dr. Malay Kundu, Indian Statistical Institute, Kolkata.
3. Prof. PR Mahapatra, Indian Institute of Science, Bangalore.

Mentoring of Engineering Teachers by INAE Fellows

S No	Name of Engineering Teacher	Institution of Teacher	Name of Mentor
1	Nanda Naik Korra	National Institute of Technology, Trichy	Dr T Jayakumar
2	Sandip Saha Chowdhury	Academy of Technology Hoogly (W.B.)	Prof S Chakravorti
3	Subrata Biswas	Netaji Subhash Engineering College Kolkata	Prof S Chakravorti
4	Gauri Shankar	Indian school of Mines, Dhanbad	Prof Sukumar Mishra
5	Mukesh Singh	Sri Sant Gadge Baba College of Engineering, Bhusawal,	Prof Sukumar Mishra
6	Dr Nirmal Baran Hui	National Institute of Technology Durgapur	Prof Pradip Dutta
7	Ms Supriya Bera	National Institute of Technology Durgapur	Prof Indranil Manna

S No	Name of Engineering Teacher	Institution of Teacher	Name of Mentor
8	D Sattianandan	SRM University, Kattankulathur,T.N.	Prof PK Dash
9	Dr Varun	NIT Hamirpur	Dr M.O. Garg
10	Guruswamy Revana	Acharya Nagarjuna University College of Engineering and Technology, Guntur	DR BM Reddy

Mentoring of Engineering Students by INAE Fellows

S No	Name of Engineering Teacher	Institution of Teacher	Name of Mentor
1	Sumedh Gostu	National Institute of Technology Jamshedpur	Dr S Srikanth
2	Siddharth Shiladitya Parida	VSSUT Burla	Prof DN Singh
3	N Sravan	Indian Institute of Technology Kharagpur	Prof KT Jacob
4	Dheeraj PR	Indian Institute of Technology Kharagpur	Prof KT Jacob
5	Ms Ishan Gupta	PES Institute of Technology, Bangalore	Prof B Sundar Rajan
6	Jeevan S	PES Institute of Technology, Bangalore	Prof B Sundar Rajan
7	Shaik Maimunisa	Rajiv Gandhi University of Knowledge Technologies, Kudapa	Dr M Narayana Rao
8	Ramyanangulu Kamlsetty	Rajiv Gandhi University of Knowledge Technologies, Kudapa	Dr M Narayana Rao
9	D Abhishek Sharma	BITS Pilani, Hyderabad Campus	Prof B Yegnarayana
10	Anish Mukherjee	Jadavpur University Kolkata	Prof Suman Chakraborty

S No	Name of Engineering Teacher	Institution of Teacher	Name of Mentor
11	Ms Jayanti Hazra	Jadavpur University, Kolkat	Prof Suman Chakraborty
12	Susant Kumar Nayak	RGUK, Nuzivid Campus	Dr Baldev Raj
13	Tawhidul Islam	University Institute of Technology, Burdwan	Prof Subrata chakraborty
14	Aashutosh Anand	National Institute of Technology Jamshedpur	Prof Sukumar Mishra
15	Subham Swaroop Sahoo	Veer Surendra Sai University of Technology, Burla Odisha	Prof Sukumar Mishra
16	T Ram Mohan	SASTRA University, Thanjavur	Prof Pradip Dutta
17	Balsingh G	RGUKT IIIT Basar	Dr Amol A Gokhale
18	P Rohith	Mahatma Gandhi Institute of Technology, Hyderabad	Dr Amol A Gokhale
19	Gajji Aneesha	Mahatma Gandhi Institute of Technology, Hyderabad	Prof K Bhanu Sankara Rao
20	Y Pushpalatha Devi	RGUKT, RK Valley Campus, Kalapa	Prof K Bhanu Sankara Rao
21	Mubina Shaik	RGUKT, IIIT Basar Campus	Dr SV Kamat
22	Ms Kalamalla Jyotni	RGUKT IIIT Idulapaya	Dr SV Kamat
23	G Bharat Reddy	Mahatma Gandhi Institute of Technology, Chaitanya	DR SV Joshi
24	K Meghana	Rajiv Gandhi University of Knowledge Technologies, Krishna Dist A.P.	DR SV Joshi
25	Kommineni Geethasree	Rajiv Gandhi University of Knowledge Technologies, IIIT Nuzivid,	Prof BS Murty
26	Lingisetti Kartheek	Rajiv Gandhi University of Knowledge Technologies, IIIT Nuzivid,	Prof BS Murty
27	Akshay	MNIT allahabad	Dr Sivaji Chakravorti

S No	Name of Engineering Teacher	Institution of Teacher	Name of Mentor
28	Shashank Prakash	IIT Kharagpur	Dr MP Dhir
29	Karthik NS	National Institute of Technology Karnataka Surathkal	Prof K Ramesh
30	B Bharat Ganesh Kumar	Sri Chandrasekhendra Saraswati Vishwa Maha Vidhyalaya, Kancheepuram	Prof K Ramesh
31	Kumar Vikram	National Institute of Technology Patna	Dr Vinok K Agrawal
32	Chandra Sekhar	IIT Kharagpur	Mr VK Agnihotri
33	Arya Swayamshree	Veer Surendra Sai University of Technology, Burla Odisha	Prof DN Singh
34	Ms Manisha Singh	Deendayal Chotu Ram Univeristy of Science & Technology, Murthal	Prof Sneh Anand
35	Ms Komal Tandon	Babu Banarsi Das National Institute of Technology & Management, Lucknow	Prof Sneh Anand
36	W Riyaz Ahamed	Asan Memorial College of engineering & Technology, Chengalpattu	Dr U Kamachi Mudali
37	Ms Karthika Ramesh	National Institute of Technology, Tiruchirapalli	Dr Vinay K Gupta
38	Aniket Kumar	National Institute of Techology Jamshedpur	Prof Samit K Ray
39	KS Srikanth	SCSVMV University, Kanchipuram	Capt NS Mohan Ram
40	Swasti Bhatia	University Instituteof Enginering and Technology, Panjab university, Chandigarh	Prof Samit K Ray

Research Studies

Studies on issues of national interest are undertaken by the Academy through specially constituted study groups. The objective is to bring out a comprehensive/exhaustive document covering review of national and international technological and commercial aspects, analysis of options, future trends and policy/recommendations for the future roadmap.

The following Research Studies have been completed in the recent past "Technologies for Healthcare Sector in India"; "Impact of R&D on Chemical Industry"; "Assessment of Civil Engineering Inputs for Infrastructural Development"; Research Studies on "Impact of R&D on Indian Mining Industry Performance – Identifying the new priorities and strategic initiatives"; and "Water Resource Management". Brief details of each of these Research Studies are given below.

Technologies for Healthcare Sector in India

The healthcare sector in India is witnessing a surge of activity and the beginning of what is seen as a rapid phase of growth. Engineering will indeed play a major role towards a better and deeper understanding of the technical challenges that surround the healthcare sector in India. Keeping in view the importance of above, a research study group on "Technologies for Healthcare Sector in India" was constituted comprising of Dr Rajeev Shorey as Coordinator and Dr MJ Zarabi as Member. The objective of this report was to gain a deeper understanding of the healthcare sector with a major focus on India. The research study report investigates in detail both existing and emerging technologies in the healthcare sector. More specifically, the broad topics covered in the report include key factors leading to the growth of healthcare sector in India, India's healthcare System, technologies for the healthcare sector, technical challenges that lie ahead and global medical and equipment market. Pertinent recommendations were made in the study report with a view to attracting investment; helping change the legislation and introducing IT initiatives in the healthcare sector in India.

Impact of R&D on Indian Chemical Industry

A study group comprising of Dr KV Raghavan as Coordinator and Dr DP Misra, Dr MO Garg and Dr AN Maitra as Members was constituted to undertake the research study on "Impact of R&D on Indian Chemical Industry". The basic objective of the study is to study the impact made by the R&D on Indian Chemical Industry as a whole and on all its important subsectors in terms of R&D intensity, intellectual property management, industry – university (I-U) linkages, fostering new enterprises, government funded R&D utilization and human resource management. This Research Study has clearly established that R&D impact on Indian chemical industry is non-uniform across its subsectors on account of system heterogeneities, varied scales of operation, uneven responses to globalization challenges and wide variation in human skills and innovative capabilities. In order to enhance R&D impact on the Indian chemical industry, some recommendations have been made in this report including enhancing the reach and effectiveness of government funded R&D programmes in seamless manner; adoption of an integrated approach for R&D capacity building in chemical MSME clusters; enhancing R&D intensity and investment in three prioritized turnover zones; constitution of a Technology mission to formulate

and pilot test novel I-U linkage models; establishment of technology innovation centres through PPP in frontier S&T areas; adoption of a two pronged approach to enhance Indian inventorship of patents filed in India; improving environmental brand image to sustain future growth; technology vision and foresight development for critical chemical subsectors; new growth oriented HR management policies for chemical subsectors and innovative policies to make transnational R&D and FDI as vehicles for Indian innovation.

Assessment of Civil Engineering Inputs for Infrastructural Development

The research study on "Assessment of Civil Engineering Inputs for Infrastructure Development" was undertaken by the research study group comprising Prof SS Chakraborty as Coordinator and Prof Prem Krishna, Dr Nagesh R Iyer and Dr SK Thakkar as Members. The aim of the study was to develop a position paper on Civil Engineering manpower available in the country at present and envision the needs for the ensuing immediate future. It covers emerging trends in Civil Engineering technology, the expected growth of various forms of infrastructure and developments in other disciplines of engineering where Civil Engineering plays an important supporting role. Further, the issues of quality as well as the measures for bridging the gap were addressed. The study estimated the Civil Engineering manpower requirement for meeting the infrastructural development targets. The research study focused on the broad dimensions of the issue, namely the requirement of civil engineers and their availability, and estimating the gap between the two. Further, the issues of quality as well as the measures for bridging the gap are addressed. The Report explores suitable methodologies as well as the financial resources needed. An Action Plan was outlined which included adequate number of engineering education institutions be established; Civil Engineering degree courses be mandated for engineering colleges that seek approval; a formal set-up for upgradation of Civil Engineering Education and practice be framed; the funds for enhancing the Civil Engineering education scenario and also for in-service training facilities must come from the project costs to the extent it can bear without endangering the viability of the project; and a Civil Engineering professional entity be established under the combined auspices of the Industry and the Academia for managing such a fund.

Impact of R&D on Indian Mining Industry Performance – Identifying New Priorities and Strategic Initiatives"

The INAE Research study on “Impact of R&D on Indian Mining Industry Performance - Identifying New Priorities and Strategic Initiatives", sought to assess the impact of R&D on the performance of Indian minerals sector and to evolve a concrete R&D strategy based on this appraisal. The study was undertaken by a 3-member team comprising Prof A.K. Ghose as Coordinator and Prof RN Gupta and Prof J. Bhattacharya as members. The study in effect centered on developing a R&D vision for Indian mineral industry which could help strengthen the scientific and technological base of the industry and encourage its competitiveness, based on excellence through innovation. Based on this study, the Study Group concluded that for focused effort and maximizing R&D outcomes, there was an imperative need to assemble a critical mass of resources and integrate the research efforts by pulling them together in networks of excellence in “mega” projects which could effectively address the major challenges faced by the industry in improving performance and operational effectiveness, the plethora of environmental concerns and ensuring workforce safety. A roadmap was unveiled primarily addressing the objectives; and based on this study and analysis; appropriate recommendations were made for a coherent and synergistic national R&D programme for Indian minerals sector. The study has been able to present a comprehensive assessment of the impacts of R&D on Indian mining industry performance which could help formulate future R&D initiatives of the Industry.

Water Resources Management

Water plays a critical role in meeting our needs in diverse fields – providing, inter alia, water for

drinking, agricultural and industrial uses as well as maintaining the eco-system. However, the ecosystem health has been compromised severely. Realizing the seriousness and the importance of the water issues to our programs for national well- being, INAE decided to undertake a research study to examine a few critical aspects of water supply and demand in various sectors and come up with implementable recommendations to overcome the lacunae in the water resources sector. Prof. SS Chakraborty was the Coordinator of this study group on "Water Resources Management" with Prof. S Mohan, Dr. RR Sonde, Prof Subhash Chander and Dr. NK Tyagi as Members. The study assessed the demand for water from the various sectors of the economy, their trends and the potential shift from one sector to another in the light of the changes in the composition of the economy, the food security requirements, implications of changes in the lifestyle and other factors. This study analysed inter alia water availability, water quality and water demands in a few sectors along with the water-energy linkages, at river basin level. It was suggested that the overall gap in demand and supplies would not exist and the dependability of the system would be greatly enhanced after implementation of the various recommendations in the areas of Supply Management; Demand Management - technology interventions identified for maximizing productivity; water security for domestic, industrial and other requirements and for sustainability of ecosystems. It was recommended that policies be evolved for adaptation to climate change and private participation in development and management of water resources, especially in large industrial clusters, be encouraged.

Out of the above mentioned Research Studies, the Research Study Reports on Technologies for Healthcare Sector in India"; "Assessment of Civil Engineering Inputs for Infrastructural Development"; Assessment of Civil Engineering Inputs for Infrastructural Development" and "Water Resources Management" were released during the INAE Silver Jubilee Inaugural Function held on April 20, 2012 at New Delhi.

Research Study on "Successes and Gaps in Our Metallurgical R&D Efforts"

It is known that in spite of our excellent accomplishments in metallurgy, in terms of wootz Steel, bronze icons, gold and silver ornaments, famous zari works of ancient India, zinc smelting and refining, rustless iron pillar, etc ; the country was importing most of metallurgical products needed for infrastructure such as railways and thermal power plants, at the time of independence. India has progressed, in a significant way from 1947. We are the fourth largest producer of steel in the world and are able to produce the steels and alloys needed for our strategic and other demanding programmes. It is also true that increasing quantity of finished metallurgical machineries and components are still being imported .Our capacity to export finished components rather than the ores without any value addition needs to be enhanced multifold. Thus there are gaps, challenges and opportunities. INAE entrusted the task of chronicling the developments and do the critical analysis to three experienced fellow metallurgists Shri KK Sinha, Dr. R. Krishnan and Dr. V. Ramaswamy to bring out a valuable report on "Success and Gaps in Our Metallurgical Efforts", which would be of much value to the country.

The country has been witnessing an upsurge in the production and use of metals and its alloys as manifested through use in transport vehicles; power generation and distribution systems; construction materials; bridges and in the packaging industry thereby increasing the importance of R&D in the field of Metallurgy to meet the demands of various sectors. The objective of this study was to prepare an in-depth analysis of the relevance of the goals set, the efficacy of the resources deployed, the commitment of the concerned agencies and any other factors that generally lead to the success or otherwise of R&D efforts in the field of Metallurgy.

Research and development being two different entities; research can continue without any consequences on economic performance of a country. Research, however, should lead to tangible

products, processes or improvements in existing ones and not just publications in journals. This has been the case in areas like rapid quenching, bulk metallic glasses, high temperature superconductors, nanomaterials, carbon nano- tubes, graphene etc. At the same time, researchers and developers elsewhere are trying to find out what are the possible applications or uses of such discoveries and work towards exploiting them. This requires a conscious and cultural change in our attitude. While government provides large scale funding, there is no clear cut demand of what is expected out of it. This needs a corrective action, if the end results are desired to be different. These are dealt with in the research study report.

The study covers major successes achieved and the factors that contributed to it and also why some of the efforts failed to meet the desired goals. It also reflects areas where R&D efforts have been successful but the technology transfer to industry has not taken place. The possible reasons for this were also pointed out and recommendations have been made to make our R&D activities more effective/productive. The committee interacted with key persons in government sector, private and public sector organizations to gather information for the study. With sound educational and R&D background built over the years in extraction and processing of various types of metals in the country, the study group observed that in conventional metals the country has reached a level of self sufficiency and some products are even exported. However, on account of non-availability of certain metals like Tungsten, cobalt, nickel, niobium, uranium etc, greater thrust on exploration is required. There are certain other metals like rare earths, zirconium, or chromium which are available in the country but are not being utilized sufficiently for which suitable strategies have to be evolved. Energy related and electronics related materials are not being given the importance they deserve. R&D efforts in these areas should be stepped up. If energy could be made a little cheaper than what it is today, many raw materials like iron ore, alumina, ilmenite etc can be converted into value added finished products and exported creating job opportunities. Presently large quantities of raw materials are being exported as such.

In the Department of Atomic Energy, because of strategic importance, R&D has been directed to produce finished products like zirconium or heavy water while in the defence organization, possibility of importing finished products like war- planes or submarines, reduces the incentives to produce them indigenously. In the private sector, the duty and excise structure play a strong role towards indigenous production and sales. Because of some incentives provided by the government, our country has become a leader in the production of sponge iron. Likewise it can attain leadership position in few other metals like titanium & magnesium also, with a little push. The Council of Scientific and Industrial Research has established several laboratories over the country since independence as their initial mandate was to help in finding suitable applications of regional raw materials, the exception being some of the National Laboratories, like the National Physical Laboratory, National Chemical Laboratory and the National Metallurgical Laboratory(NML). In this context the NML has done a lot of work on a national basis, serving truly as a national facility, particularly to meet the demands in mineral beneficiation and materials testing. Their component testing laboratory and their expertise in residual life estimation has been fully utilized by many service sectors. Central Glass and Ceramic Research Institute (CGCRI) has also risen to the occasion to meet the demands of special glasses and refractories for the strategic sectors and has progressed well in the fibre optic side.

Many of the private industries have their own research, engineering and development units, as they have to solve their day to day problems. At the same time energy saving and cost reduction are of great concern for these industries. In this context, The Tata Research Development and Design Centre (TRDDC) at Pune stands out as an excellent example which not only caters to Tata group of companies, but also carries out work for other industries as well. They have developed expertise in modelling and simulation techniques and are able to come out with appropriate solutions with very little enhanced scale experimentation. Of course, this necessitates extensive data logging and associated instrumentation for appropriate modelling. Other industries have kept a low key on their R&D efforts, especially due to commercial interest. R&D in public funded institutions is also dealt with in the report.

In summary, there is no denying that there is enough talent in the country to tackle and succeed in the developmental activities for materials and components. This is evident from the achievements in the nuclear, defence and space sectors. However, the question arises that if this can lead to success in these sectors, why does it not occur in other areas as well. These points are touched upon in the report.

Some of the major recommendations of the report include the academic institutions to conduct both basic research and applied research; proper recognition be given for applied research that leads to innovative solutions to development of newer processes and cost effective materials with better properties and longer life; technology incubation centres need to be set up to assist the researchers to translate their ideas into successful end products; the ultimate goal of large scale funding be to realize tangible products; documentation of know-how also be given serious consideration; Process Metallurgy as a discipline is becoming extinct and needs to be addressed forthwith; in–house Government R&D establishments such as DAE and DOS may consider project mode of working and monitoring, as DRDO adopts; CSIR laboratories conduct bench scale studies with promising results that need to be scaled to pilot level; interdisciplinary/multi-disciplinary laboratories such as National Institute for Interdisciplinary Science and Technology (NIIST) and Advanced Materials and Processes Research Institute (AMPRI), need better focus in the metallurgy/materials front; laboratories be made aware of strategic materials requirements of the country and cost effective recycling studies need attention; a larger number of modelling and simulation studies be encouraged and the Public Sector Undertakings need greater association of public sectors with major R&D labs.

Action Groups for each of the above mentioned research studies have been constituted to take necessary follow-up actions with the concerned Ministries/Departments/Industries to progress the recommendations of the research studies.

INAE Forums

One of the important objectives of the Academy is to assist the Government from time to time in formulating policies on critical technical issues. For this purpose four forums have been constituted – *INAE Forum on Engineering Education, INAE Forum on Energy, INAE Forum on Microelectronics, and INAE Forum on Technology Foresight and Management*. These forums enable giving inputs to policy makers, institutes of higher learning & research, industries, etc and also provide a platform for collaborations with Academies of Sciences in India and Academies of Engineering abroad in the framework of the International Council of Academies of Engineering and Technological Sciences (CAETS).

INAE Forum on Energy

The INAE Forum on Energy comprising of Dr Baldev Raj as Chairman and Dr KV Raghavan, Dr RR Sonde, Prof SS Murthy, Dr Ajay Mathur and Dr Purnendu Ghosh as Members; has the mandate to address all issues related to energy. During the initial deliberations regarding the tasks to be undertaken by this forum, it was decided that one of the pertinent tasks would be to give inputs to the CAETS Working Group Report on Low Carbon Energy Technologies and the other task would be to prepare a report on "Recommendations on Energy and Sustainability for India". Brief details are given below.

(a) **CAETS Working Group Report on Low Carbon Energy Technologies**

INAE is a member of the CAETS Working Group for a study on "Deployment of Low Emissions Technologies for Electric Power Generation in Response to Climate Change" constituted during the year 2009. This Working Group comprises of the Australian Academy of Technological Sciences and Engineering (ATSE); INAE; acatech, Germany; Canadian Academy of Engineering; South African Academy of Engineering; National Academy of Engineering Korea; National Academy of Engineering, USA and the Royal Academy of Engineering, UK. The first report of the Working Group on "Deployment of Low Emissions Technologies for Electric Power Generation in Response to Climate Change" was published during November 2010.

Based on suggestions and positive response from the members, this Working Group was tasked to undertake the Second Phase of the Study on "Opportunities for Low Carbon Energy Technologies for Electricity Generation to 2050". The report is focused on identifying promising initiatives to accelerate the commercial deployment of low carbon energy (LCE) technologies for electricity generation and to highlight the engineering and financial risks to be overcome to facilitate the deployment of such technologies. The following LCE technologies were assigned to the members of the Working Group: Hydroelectric- Canadian Academy of Engineering; Solar Energy - INAE; Geothermal- ATSE; Marine and Tidal Energy - Royal Academy of Engineering, UK; Wind, Biomass and Nuclear - acatech, Germany; Gas - South African Academy of Engineering, Coal - National Academy of Engineering Korea and Carbon Sequestration - ATSE. Each of the low-carbon technologies are evaluated in the report under a common set of headings viz. Current State of the Technology; Most Promising Initiatives to Accelerate Energy Deployment; Integration of Technologies for Near, Medium and Long Term

Energy Deployment; Investments and Economic Factors; Levelised Cost of Electricity (LCE); Technology Readiness levels and Timelines for Large scale Solar Energy Deployment Initiatives and Risks to Deploy LCE Technologies at Scale.

INAE was tasked with preparation of material on "Solar Energy" and "Risks to Deploy LCE Technologies at Scale". A consolidated report incorporating the inputs from the members of the INAE Energy Forum was submitted to ATSE. Material submitted by INAE on "Risks to Deploy LCE Technologies at Scale" covers the risks and barriers associated with the commercial deployment of low carbon energy (LCE) technologies such as engineering / technology; environmental; social; social; safety, financial and legal risks. The report of the working Group is under finalization. A meeting of the Working Group is being held on the sidelines of the CAETS symposium at Budapest during Jun 26-28, 2013 which will be attended by Dr Baldev Raj, President, INAE. The objective of the meeting is to discuss the dissemination of the report and the next activities for the Working Group.

(b) **Report on "INAE Recommendations on Energy and Sustainability for India"**
An important activity undertaken by this forum is preparation of a comprehensive report on "INAE Recommendations on Energy and Sustainability for India". Two meetings of the Energy Forum have been held on Feb 15, 2011 at New Delhi and on Feb 22, 2012 at Thermax, Pune wherein the outline of the report was deliberated upon. The report shall be a concise document of 10-12 pages containing suitable actionable recommendations for the concerned Ministries/Departments on various relevant aspects in the field of energy. The topics being covered in the report are Projections/ Modelling/ Data –Supply and Demand/ Gaps; Technology Assessment- Methodology and Infrastructural Linkage; Need for Hybrid Energy Technology Options; Energy Efficiency as an Interface for all Energy Options; Human Resource Challenges/ Mechanisms in Energy for India; Research, Development & Deployment (RD&D) in Specific Domains and Mechanisms for Deployment; Open Access Synergy –Global/ National; Parity between Electricity and other forms of Energy; Linked Model for energy-water and food and Final Recommendations on Empowered Committee. This report will be finalized during a meeting of the INAE Energy Forum being planned shortly.

INAE Forum on Engineering Education

The following two schemes have been launched by INAE Forum on Engineering Education recently.

AICTE-INAE Teachers Research Fellowship scheme

A joint scheme – "AICTE- INAE Teachers Research Fellowship Scheme" for Engineering Teachers has been already launched to pursue Doctoral Research in Central Laboratories in order to promote a research culture amongst the faculty in AICTE approved engineering institutions.

Under this scheme, engineering teachers in AICTE approved engineering colleges/institutions shall be sponsored to pursue research in Council of Scientific and Industrial Research (CSIR)/ Defence Research and Development Organization (DRDO)/ Department of Space (DoS)/ Department of Atomic Energy (DAE) laboratories leading to the award of a Ph.D degree in the chosen field of study. The Ph.D degree will be awarded by the concerned organizations of CSIR, DRDO, DoS and DAE.

To formulate the guidelines and methodology for implementation of this scheme, a Steering Committee has been formed with experts from INAE, CII, CSIR, DRDO, DOS and DAE. Detailed guidelines formulated by the Steering Committee were approved by AICTE Executive Committee. The representatives of CSIR/DRDO/DOS/DAE were also requested to intimate the disciplines of engineering in which Ph.D programmes can be offered and maximum number of candidates which can be accommodated in their laboratories during the first year of the proposed scheme. After receipt of this information, applications were invited from the eligible candidates from the engineering colleges. These

applications were scrutinized by the Steering Committee and the first batch of selected candidates has been advised to report to the concerned laboratories for the ensuing session.

AICTE-INAE Travel Grant Scheme for Engineering Students

AICTE-INAE Travel Grant Scheme for Engineering Students has been launched recently to provide financial support for engineering students to present papers abroad The objective of the scheme is to provide partial travel assistance and registration fees to Bachelors and Masters Level engineering students for presenting a research paper in an international scientific event (conference/seminar/symposium/workshop etc) in order to encourage engineering students to engage in research.

Third/Fourth year B.E./B.Tech; First/Second year M.E./M.Tech; or Fourth/Fifth year Integrated M.Tech Level engineering students from AICTE approved Engineering institutions are eligible under the scheme. The applicant should have an invitation for presenting a research paper which has been accepted in a conference/seminar/symposium/workshop abroad. A student is eligible only once in three years for financial support under the subject scheme. A Steering committee comprising of suitable experts from each of the ten engineering sections has been constituted.

INAE Forum on Microelectronics

INAE Forum on Microelectronics comprising of Dr MJ Zarabi, as Chairman and Prof AB Bhattacharyya; Dr Aloknath De; Prof PP Chakrabarti; Prof JM Vasi; Dr G Venkatesh and Mr AS Kiran Kumar as Members has the mandate to address all issues related to Microelectronics and to appropriately network with other agencies concerned with this area. The members of the Forum deliberated on issues related to India's capabilities-strengths and areas of improvement in the sphere of silicon design. They also explored global and domestic opportunities to find a way of intensifying the design activities in India.

This Forum organized MOS-AK/GSA India2012-International Workshop on Device Modeling of Microsystems during Mar 16-18, 2012. The objective of the workshop was to classify the most important directions for the future development of the microelectronic device models, not limiting the discussion to compact models, but including physical, analytical and numerical models, to clearly identify areas that need further research and possible contact points between the different modeling domains. This event envisaged strengthening of a network and discussion forum among experts in the field, enhancing open platform for information exchange related to compact/Spice modeling and Verilog-A standardization, bringing people in the compact modeling field together and obtaining feedback from technology developers, circuit designers, and CAD tool vendors. The workshop also was envisaged to serve as a platform for launch of MOS-AK/GSA India as a forum that will help galvanize the microelectronics modeling community in India.

INAE Forum on Technology Foresight and Management

A proposal to constitute an INAE Forum on Technology Foresight and Management was approved in the Governing Council meeting of the Academy held on July 27, 2012 at New Delhi. The Forum comprises of Mr. VK Agarwal as Chairman and Mr. YP Anand, Prof. Prem Vrat, Dr. CR Prasad and Mr. AK Anand as members, and four co-opted members Mr. KP Singh Mr. SC Gupta, Mr. VN Mathur and Mr. AK Gupta.

Since the domain of National Challenges is very wide and keeps on changing from time to time, the forum decided to address the following as a broad guide and could suitably modify the list as required:

- Food Production and Utilization and Conservation of Water.
- Energy Generation and Utilities.
- Manufacturing Technologies.
- Mass Transit Systems.
- Building and Construction Technologies.

The Forum decided to evolve solutions keeping in view the issues of sustainable development, poverty reduction, and climate change in focus and suggest appropriate technologies accordingly. Further, suitable Engineering Management techniques will be employed to find cost effective and optimal solutions. For formulation of the Recommendations/Solutions, the Forum could also invite specialists as required and / or conduct Workshops.

First Meeting of the Forum was held on Oct 9, 2012 where the broad action plan was drawn up. Subsequently, meetings have been held on Nov 9, 2013, Jan11, 2013 and Mar 15, 2013. After discussions, the Forum Members have selected the following five National Challenges for detailed study / examination with a view to foresee the needed futuristic technologies and to evolve suitable engineering management solutions. This will be done keeping in focus the aspects of sustainable development, climate change, and poverty-reduction / inclusive growth.

(a) Energy – Major thrust on Solar Energy

Energy is fundamental to growth and economic progress. Dr. Michio Kaku in his book 'Physics of the Future (2011)' highlights the role of Energy by quoting novelist Jerry Pournelle as under :

"Food and pollution are not primary problems: they are energy problems. Given sufficient energy we can produce as much food as we like, if need be, by high-intensity means such as hydroponics and greenhouses. Pollution is similar : given enough energy, pollutants can be transformed into manageable products; if need be, disassembled into their constituent products."

While the energy sector is vital for development, its emissions are large and growing. The two major sectors of 'electricity' and 'transport' together account for over 78% (65% from electricity +13% from transport), of energy related emissions in India. Growing energy needs for growth / development (about 3-4 times the current levels in next 25 years) and growing concerns about the rising Green House Gas (GHG) emissions point toward renewable options like solar energy, hydropower, wind power, etc.

The Integrated Energy Policy (2006) of the GOI indicates a potential of 1200 Mtoe each for the Solar – Photovoltaic and Solar – Thermal in our country, i.e., a total of 2400 Mtoe. When seen in the backdrop of current Total Primary Energy requirement of 600-650 Mtoe the Solar Power has the potential to meet even the future Energy needs.

The Forum Members felt that with the increasing costs of the fossil fuel based power supply (besides the pollution aspect) and reducing costs of the Solar Power (especially the Solar –Photovoltaic) and in view of its huge potential in our Country the Solar Power option needed much greater thrust even beyond the targets as fixed in Jawaharlal Nehru National Solar Mission (JNNSM). But here one major problem is (besides the need for making Solar Power commercially viable) the need for 'Storage' of energy during day hours for use in other periods. This becomes particularly relevant if the Solar Power has to find a dominant place in the energy mix. Various options and technologies are accordingly being examined for giving a major thrust to Solar Power.

(b) Water Management

Access to water and sanitation at an affordable price has to be recognized as the basic right of all human beings. The World Economic Forum in their latest Report (2013) have identified Water Supply crisis as one of the top five global societal risks both in terms of 'livelihood' and 'impact'. Water scarcity already affects more than 40% of the world population. Even though water is seemingly abundant (70% of Earth's surface is

covered with water) but the real issue is the availability of fresh water suitable for human use which is less than 1% of the Earth's available water. The Forum intends to examine the matter in depth to suggest suitable Technological / Engineering Management solutions for improved availability / accessibility of water suitable for drinking (both for urban and rural areas) as also for irrigation purposes.

(c) Agriculture – Waste reduction and its Use

Our country does not fare well in terms of agricultural yields or productivity. Further, there are wide yield gaps among various crops across the country. Improvements in yields and reduced wastage of foodgrains hold the key for India to remain self-sufficient on food front. Further, sustainable agricultural strategy needs that concerns about land and water degradation due to soil erosion, soil salinity, water-logging, excessive application of nutrients, and over exploitation of water resources are adequately addressed. The Technology Foresight and Management exercise in addition to suitably addressing the issues concerning the Energy-Water-Food nexus intends to concentrate on reducing the agriculture related wastes and also on their effective utilization.

(d) Transport – Making it Greener

The vision for transport is to be guided by a modal mix that will lead to an efficient, sustainable, economical, safe, reliable, environment-friendly, and regionally balanced transport system. More than 90% of the traffic in our country is carried by Road/Rail. The Rail is 4-6 times fuel efficient vis-à-vis Road and uses lesser land. However, since 1950-51 the market share for Rail in Freight traffic has fallen from 89% to 30% and for the Passenger traffic from 69% to 15%. Efforts to improve the share of environmental-friendly transport mode viz., the Rail have not made the necessary dent. In addition, Water transport even though currently carrying about 5% traffic has also not received the required thrust even though it is more or less similar to Rail from environmental considerations. The Forum will study and address these and other related issues including the aspects of fuel efficiency / reduced pollution of various transport modes to suggest suitable technologies to make the transport system Greener using appropriate engineering management techniques.

(e) Waste Management

A 'waste' is 'a resource remaining unutilized' or 'a resource out of place'. Waste has critical socio-economic-health-environmental implications and the efficient / effective management of waste is the hallmark of a sustainable society / system. Growing resource and environmental constraints are making the need for waste management even more important / relevant. Minimization of waste generation (prevention / reduction), optimal waste recovery (reuse/recycling) and the effective waste treatment and disposal are the need of the hour. Suitable waste-to-energy (WTE) approaches also need to be explored. The Forum intends to examine the matter holistically to suggest suitable technological / managerial / legal / regulatory measures.

INAE e-Newsletter

With effect from September 2009, INAE monthly electronic newsletter has been started replacing the erstwhile printed copies of quarterly newsletter. This monthly electronic newsletter contains engineering and technology updates and aspects of frontiers of engineering as well as the news regarding INAE activities. Inputs regarding technology updates are being taken from various sources such as journals/ newsletters from DRDO, DAE, DOS, CSIR, S&T Report, Embassy of India in Japan and also from websites pertaining to technology review/updates. This also includes important innovative ideas, which can be absorbed for advancement of innovative engineering products. The monthly INAE e-Newsletter is being sent to the fellowship through email and is also uploaded on the INAE website.

Annals of INAE

The Annals of the INAE containing the text of the lectures delivered by Life Time Contribution Awardees; Professor Jai Krishna and Prof. SN Mitra Memorial Awardees, newly elected Fellows of the Academy and INAE Young Engineer Awardees during the year has been printed and distributed to the Fellowship of the Academy.

INAE Annual Convention

The Annual Convention of the Indian National Academy of Engineering was held on Dec 6-7, 2012 at Rabindranath Tagore Auditorium, CBRI, Roorkee. The major scientific and engineering highlights of the Convention were the following technical presentations:

Presentations by newly elected Fellows

- Prof. Debasish Roy : An Extended Principle of Pseudo-Stochastic Filtering for Structural Optimization and Control
- Mr. M Gopalakrishnan : Mega Hydro Structures – Bold, Innovative and Impressive Solutions for a Large Dam with engineering challenges : Tehri Dam
- Dr. HM Suryawanshi : Power Converters with Improved Performance
- Prof. S Bandyopadhyay : A Computational Perspective on the Regulatory Network of TFs, microRNAs and genes
- Prof. Anindya Chatterjee : Order Reduction in Some Dynamic Systems
- Dr. BM Reddy : Design of Efficient Catalysts for Auto Exhaust Purification and other Applications
- Prof. SV Kulkarni : Advanced Electromagnetic and Coupled Field Computations For Improving Performance and Reliability of Power Transformers
- Prof. Govindarajan Ramaswamy : Compiling for Heterogeneous Accelerator-Based Multicore Architectures
- Dr. SV Joshi : Solution Precursor Plasma Spraying : Opening New Vistas in Surface Engineering
- Dr. Tessy Thomas : Technology Leap in Agni Systems

Presentations by Young Engineer Awardees 2012

- Dr. Partha Bhattacharyya : Development of MEMS based Low Temperature, Low Power Methane Sensor for Underground Coalmine Environment
- Dr. C. S. Shankar Ram : Modelling, Analysis and Control of Electro-Pneumatic Brakes for Commercial Vehicles
- Dr. Brajnish Sitara : Strategies for Long Duration Aided Inertial Navigation
- Dr. Animesh Mukherjee : Algorithms for Computational Social Science
- Dr. Dipti Ranjan Sahoo : Improving Seismic Performance of Existing Deficient RC Frames using Aluminum Shear Yielding Devices
- Dr. VC Srivastava : Studies on Treatment of Wastewater by Physico-Chemical snd Electrochemical Methods, snd Desulphurization of Liquid Fuels
- Dr. Gaurav Tomar : Interfacial Flows: Instabilities during Adhesion, Dewetting, Film Boiling and Atomization
- Dr. VVSS Srikant : Novel Carbon Nanomaterials

The 24th Annual General Meeting of Fellows was held in the afternoon on Dec 6, 2012. During the Induction Ceremony, twelve Fellows were formally admitted into the Academy. The Grand Award Ceremony was held at 5 PM on the same day.

Dignitories sitting on dais during Annual Convention

The Academy has instituted Innovative Students Projects Award since 1998 to identify innovative and creative projects undertaken by the students at three levels B.E./ B. Tech, M.E/M.Tech and PhD in engineering colleges. This Award recognizes innovative and creative projects and theses of students and research scholars in engineering institutions, since an early recognition of merit and talent can often mark the beginning of a brilliant career. Five candidates at Doctoral level, five at Master's level and six at Bachelor level were given Innovative Student Projects Awards.

To recognize outstanding contributions made by young engineers to any branch of Engineering, the INAE Young Engineer Award was instituted in 1996 for engineering research, excellence in engineering design, technology development and technology transfer. Ten candidates were awarded INAE Young Engineer Award.

Prof. SN Mitra and Jai Krishna Memorial Awards are given to an eminent engineer, engineer-scientist or a technologist for academic and scholarly achievements in any discipline of technology. Prof Jai Krishna Award is given from among the disciplines of Civil Engineering, Mechanical Engineering, Chemical Engineering, Aerospace Engineering and Mining, Metallurgical and Materials Engineering. Prof. Amitabha Ghosh, INSA Senior Scientist, Bengal Engineering and Science University, Howrah was conferred Prof. Jai Krishna Memorial Award 2012. Prof S N Mitra Memorial Award is given from among the disciplines of Computer and Information Technologies, Electrical Engineering, Electronics & Communication Engineering, Energy Engineering; and Interdisciplinary Engineering and Special Fields. Prof. N Viswanadham, Formerly Professor of Mechanical Engineering, National University of Singapore, Singapore and Deputy Executive Director, Logistics Institute Asia Pacific, and Former Executive Director, Center for Global Logistics was conferred the Prof. SN Mitra Memorial Award 2012.

Prof. Amitabha Ghosh receiving Prof. Jai Krishna Memorial Award

Prof. N Viswanadham reciving Prof. SN Mitra Memorial Award

The Lifetime Contribution Award is given to an eminent Indian citizen who has made most distinguished contributions in the field of Engineering / Engineering Research / Technology, which have brought prestige to the nation and regarded as landmarks of technological development of the country. Prof. P Rama Rao, Chairman, Governing Council, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad; and Dr. RA Mashelkar, National Research Professor, NCL, Pune and Chancellor, Academy of Scientific and Innovative Research (AcSIR) were conferred Life Time Contribution Awards in Engineering 2012. Life Time Contribution Award lectures were delivered by Prof. P Rama Rao and Dr. RA Mashelkar. Prof Jai Krishna and Prof. SN Mitra Memorial lectures were delivered earlier in the day by Prof. Amitabha Ghosh and Prof. N Viswanadham respectively.

Prof. P Rama Rao receiving Life Time Award

Dr. RA Mashelkar receiving Life Time Award

The Fellowship

Engineering Section-I

1. Prof. MC Deo, Department of Civil Engineering, Indian Institute of Technology Bombay, Mumbai.
2. Mr. MM Madan, Director (Hydel), GVK Group, Gurgaon.

Engineering Section-II

1. Prof. Shalabh Bhatnagar, Department of Computer Science and Automation, Indian Institute of Science, Bangalore.
2 Prof. S Sudarshan, Institute Chair Professor, Computer Science and Engineering Department, Indian Institute of Technology Bombay, Mumbai.
3 Prof. Pallab Dasgupta, Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur.
4 Mr. K Ananth Krishnan, Vice-President and Chief Technology Officer, Tata Consultancy Services Ltd., Chennai.

Engineering Section-III

1. Prof. C Balaji, Department of Mechanical Engineering, Indian Institute of Technology Madras, Chennai.
2 Dr. CP Ramanarayanan, Director, Vehicle Research & Development Establishment (V.R.D.E.), DRDO, Ahmednagar.
3 Dr. PA Lakshminarayanan, Chief Technical Officer, Simpson & Co. Ltd., Chennai.
4 Mr. Chetan Maini, Chief of Strategy & Technology, Mahendra Reva Electric Vehicles, Bangalore
5. Dr. PL Narasimhan, Textile machinery design expert and TVS Chair Professor, Indian Institute of Technology Kharagpur.

Engineering Section-IV

1 Prof. KG Ayappa, Department of Chemical Engineering, Indian Institute of Science, Bangalore.
2 Prof. Shankar Narasimhan, Department of Chemical Engineering, Indian Institute of Technology Madras, Chennai.
3 Dr. KSMS Raghavarao, Senior Principal Scientist & Head, Department of Food Engineering, Central Food Technological Research Institute (CFTRI), Mysore.
4 Mr. Sudhir Vasudeva, CMD, ONGC & Chairman, ONGC Group of Companies, New Delhi

Engineering Section-V

1 Prof. G Bhuvaneswari, Department of Electrical Engineering, IIT Delhi
2 Prof. Ashok Kumar Pradhan, Department of Electrical Engineering, IIT Kharagpur
3 Mr. K Sreekumar, Vice-President, Heavy Engineering, Larsen & Toubro Ltd., Mumbai
4. Prof. R Subbayyan, Former Vice-Chancellor, Bharathiar University, Coimbatore.

Engineering Section-VI

1 Prof. Debatosh Guha, Institute of Radio Physics and Electronics, University of Calcutta, Kolkata.
2 Prof. Vinod Sharma, Professor & Chairman, Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore.
3 Dr. Sukhdev Roy, Associate Professor, Department of Physics and Computer Science, Dayalbagh Educational Institute (Deemed University), Agra.
4 Mr. CK Pithawa, Distinguished Scientist & Head, Electronics Division, Bhabha Atomic Research Centre (BARC), Mumbai.

Engineering Section-VII

1 Prof. Joseph Mathew, Department of Aerospace Engineering, Indian Institute of Science, Bangalore.
2 Mr. P Venugopalan, Director, Defence Research & Development Laboratory (DRDL), Hyderabad.
3 Mr. PS Veeraraghavan, Distinguished Scientist, ISRO & Director, Vikram Sarabhai Space Centre (VSSC), Trivandrum.

Engineering Section-VIII

1 Prof. AJ Pal, Senior Professor, Department of Solid State Physics, Indian Association for the Cultivation of Science, Kolkata.
2 Dr. SV Kamat, Scientist 'G', Head, Functional Material Division, Defence Metallurgical Research Laboratory (DMRL), Hyderabad.
3 Dr. S Tarafder, Senior Principal Scientist, CSIR-National Metallurgical Laboratory, Jamshedpur.
4 Mr. M Narayana Rao, Chairman & Managing Director, Mishra Dhatu Nigam Ltd., Hyderabad.
5. Mr. K Balarama Moorthy, Formerly Chief Executive, Nuclear Complex, Hyderabad

Engineering Section-IX

1 Dr. (Smt) SB Roy, Head, Uranium Extraction Division, Facility for Electromagnetic Systems, Bhabha Atomic Research Centre (BARC), Visakhapatnam.
2 Dr. Shashank Chaturvedi, Head, Computational Analysis Division, Bhabha Atomic Research Centre (BARC), Mumbai.

Engineering Section-X

1 Prof. Manoj Kumar Tiwari, Department of Industrial Engineering & Management, Indian Institute of Technology, Kharagpur.
2 Dr. AB Mandal, Director, Central Leather Research Institute (CLRI), Chennai.
3 Mr. Natarajan Chandrasekaran, CEO & MD, Tata Consultancy Services (TCS), Mumbai.

Election of Foreign Fellows

1. Prof. David John Ewins, Professor of Vibration Engineering, Mechanical Engineering Department, Imperial College, London, UK.
2. Dr. K Rajashekara, Chief Technologist, Propulsion & Power Systems Engineering, Rolls-Royce Corporation, USA.
3. Dr. Nambirajan Seshadri, Senior Vice-President, GM (Mobility) & CTO (Wireless), Broadcom Corporation, USA.
4. Prof. (Dr.) Jae-Chun Lee, Distinguished Principal Researcher, Mineral Resources Research Division, Korea Institute of Goescience & Mineral Resources (KGAM) and Adjunct Professor, Resources Recycling, School of Engineering, University of Science & Technology, Korea

Lectures and other event including those organized by Local Chapters

INAE Kolkata Local Chapter

INAE Kolkata Local Chapter organized Engineer's Day Lecture entitled "Simulation of Multi-Fluid System : Understanding Drop Impact" which was delivered by Prof. Gautam Biswas, Formerly Professor, Indian Institute of Technology Kanpur and Director, CSIR-Central Mechanical Engineering Research Institute, Durgapur on Sep 14, 2012 at CSCR Seminar Room, Kolkata.

Multi-fluid systems play an important role in many natural and industrial processes such as rising bubbles in bubble column reactors, boiling, ink jet printing, painting, biological systems, rain drop impact phenomenon etc to mention few. Albeit the existence of a number of experimental, theoretical analysis and numerical studies on multiphase flows, a full understanding of the behavior of multi-fluid system is still lacking. The various numerical techniques are deployed to solve these multi-fluid systems are like volume of fluid method (VOF), level set method (LS), coupled level set and volume of fluid method (CLSVOF), front tracking method (FT) etc. We have used the CLSVOF method to investigate the partial coalescence phenomena during drop impact on liquid-liquid interface.

Our study deals with the understanding of drop dynamics during partial coalescence. When a drop of liquid 1 falls through liquid 2 to eventually hit the liquid 2-liquid 1 interface, its initial impact on the interface can produce daughter droplets of liquid 1. In some cases, a partial coalescence cascade governed by self-similar capillary-inertial dynamics is observed, where the fall of the secondary droplets in turn continues to produce further daughter droplets. Whenever the horizontal momentum in the liquid column, formed due impact of primary drop, is more than the vertical momentum, secondary drop is formed. A transition regime from partial to complete coalescence is defined based on oscillation of the neck radius.

INAE Kolkata Local Chapter organized a lecture on "Heroes of Indian Science" which was delivered by Prof. Kankan Bhattacharyya, Director, Indian Association for the Cultivation of Science, Jadavpur, Kolkata on Dec 26, 2012 at CSCR Seminar Room, Indian Statistical Institute, Kolkata.

Honours and Awards

Republic Day Award

The following INAE Fellows have been conferred with the prestigious awards on the occasion of the Republic Day on Jan 26, 2013.

Padma Vibhushan

- Prof. Yash Pal
- Prof. Roddam Narasimha

Padma Bhushan

- Dr. Apathukatha Sivathanu Pillai
- Dr Vijay Kumar Saraswat
- Dr. B.N. Suresh
- Prof. Satya N. Atluri

Padma Shri

- Shri Avinash Chander
- Prof. Sanjay Govind Dhande
- Prof. Sankar Kumar Pal
- Prof Manindra Agrawal

Other Awards

1. Dr. Baldev Raj, President-Research, PSG Institutions, Coimbatore has been conferred with Prof. Brahm Prakash Memorial Medal by Indian National Science Academy.
2. Prof. Prem Krishna, Formerly Professor & Head of Civil Engg. Department, IIT Roorkee has been conferred with Distinguished Alumnus Award 2012 of IIT Roorkee. He has also been conferred the ACCE(I) Gaurav Award 2012 in recognition of his most significant contributions in Civil Engineering Consultancy by the Association of Consulting Civil Engineers (India).
3. Dr. Surendra Pal, Former Prof. Satish Dhawan Professor, Senior Adviser- Satellite Navigation (ISRO) and President, Institution of Electronics & Telecommunication Engineers-India has been conferred with BITS Pilani Distinguished Alumni Award 2012 in recognition of his significant and outstanding contributions to academic teaching and research. The award was given during BITS-Hyderabad Campus Convocation held on Aug 12, 2012. Dr. Pal was also conferred with Prof. S.N. Ghosh Award in recognition of his contribution in the field of to Electrical Communication. The award was given by IETE, J.K .Institute and Allahabad University on 09th March at a function at Allahabad
4. Dr. Sanak Mishra, Chief Executive Officer, Greenfield Projects India, ArcelorMittal New Delhi has been conferred with JRD Tata Award for Excellence in Corporate Leadership in Metallurgical Industries" by the Indian Institute of Metals (IIM). The Award was given during National Metallurgists Day and Annual Meeting on November 16-17, 2012 at Jamshedpur.

5. Dr. K Bhanu Sankara Rao, Professor and Dean, School of Engineering Sciences & Technology, University of Hyderabad, Hyderabad has received 2012 National Metallurgist Award from Ministry of Steel, Govt. of India on Nov 16, 2012 during Gold Jubilee National Metallurgists Day celebrations at Jamshedpur. The award has been conferred in recognition of for his significant contributions towards the development of structural, core and steam generator materials for fast breeder reactors, in the research areas of creep, fatigue, and creep-fatigue interactions in steels and superalloys and in the development of materials for aerospace applications.
6. Dr. BSK Naidu, Chairman, Great Lakes Institute of Energy Management and Research, Gurgaon has been awarded the highest honour of the American Academy of Water Resources Engg. (AAWRE) "*Honorary Diplomate Water Resources Engineer*" in recognition of his advanced expertise, extensive experience, strong ethics, commitment and sustained noteworthy contributions to the advancement of the water resources engineering profession. This brought him to the elite group of 30-most eminent scientists in the world, selected since the creation of AAWRE. The award was conferred upon him during the AAWRE Ceremony held at the "World Water & Environmental Resources Congress" in Albuquerque, New Mexico on 21st May'2012.
7. Prof. KL Chopra, Former Director, Indian Institute of Technology, Kharagpur has been selected for the Distinguished Academician Award for 2012 by Indian Institute of Technology Patna. The award was conferred on him during the Ist Convocation of IIT Patna on June 15, 2012.
8. Dr. FC Kohli, Tata Consultancy Services Ltd., Mumbai has been selected by IEEE for conferment of the Founders Medal 2012 at a function held in Boston on June 30, 2012.
9. Professor K. Ramesh, Department of Applied Mechanics, IIT Madras, has received the 2012 Zandman Award from the Society for Experimental Mechanics (SEM), USA for significant contributions to the development of measurements or applications utilizing photoelastic coatings. The award was given at a glittering ceremony on 13th June 2012, at Coasta Mesa, California as part of the SEM XII International Congress on Experimental Mechanics. For further details see: http://sem.org/HON-Zandman.asp
10. Dr. V Adimurthy, Prof. Satish Dhawan Professor, Dean (R&D), Indian Institute of Space Science & Technology (IIST), ISRO, Trivandrum has been awarded with Padma Shri Award which was conferred at a ceremony at Rashtrapati Bhawan on April 4, 2012.
11. Prof. PK Mishra, Emeritus Professor, School of Mechanical Sciences, IIT Bhubaneswar, Odhisa has been awarded the prestigious Life Time Achievement Award for his contributions to science and technology at the AIMTDR 2012 held at Jadavpur University, Kolkata.
12. Professor Ajoy K. Ghose, former Director, Indian School of Mines, Dhanbad received the Golden Jubilee Life Time Achievement Award from the Indian Mining & Engineering Journal on 4th May, 2012 for his Life Time contribution in the field of Higher Education and Research in Mining
13. Prof. Gautam Biswas, Director and JC Bose National Fellow, CSIR-Central Mechanical Engineering Research Institute (CMERI), Durgapur has been conferred with Distinguished Alumnus Award by Honorable President of India, H.E. Pranab Mukherjee on the occasion of Convocation of Bengal Engineering and Science University (BESU) Shibpur on January 19, 2013.
14. Dr. U. Kamachi Mudali, Associate Director, CSTG, IGCAR, Kalpakkam received "Vocational

Excellence Award" from Rotary Club of Chennai Port City, "Group Achievement Award" from Department of Atomic Energy, Mumbai, and was conferred with prestigious "Fellow Honour" of National Association of Corrosion Engineers (NACE), USA, for outstanding contributions in corrosion science, engineering and technology of materials used in nuclear and allied industries.

15. Prof. VS Borkar, Department of Electrical Engineering, Indian Institute of Technology, Mumbai has been conferred with IBM Sponsored University Research Award.
16. Dr R.K.Bhandari, formerly Director, Central Building Research Institute, Roorkee became the first Indian recipient of the prestigious Varnes Medal for the year 2012 for professional excellence in landslide research and practice. The medal, the highest award of the International Consortium of Landslides (ICL), was conferred on him on 22 November 2012 at the UNESCO Headquarters in Paris.
17. Prof. Rajeev Sangal, Director, International Institute of Information Technology(IIIT), Hyderabad has been honoured with Fellowship of Computer Society of India on Dec 2, 2012 at CSI Annual Convention, Kolkata.
18. Dr. Ashish K Lele, Scientist E-, Complex Fluids and Polymer Engineering Group, National Chemical Laboratory, Pune has received Infosys award for 2012 in the field of Engineering and Computational Sciences
19. Dr. M Ramamoorty, Formerly Director, ERDA, Vadodara and formerly Director, CPRI, Bangalore has been conferred with Pandit Madan Mohan Malavya Memorial Award for Excellence in Power System Research instituted by Banaras Hindu University in 2012 on the occasion of its 150th Birth Anniversary.
20. Prof. Pallab Dasgupta, Department of Computer Science & Engineering, Indian Institute of Technology Kharagpur, Kharagpur has been awarded the Technomentor Award 2012 (in Jan 2013) by the India Electronics and Semiconductor Association (IESA) in recognition of his contributions in the field of semiconductors/electronics
21. Prof. Sanghamitra Bandyopadhyay, Machine Intelligence Unit, Indian Statistical Institute, Kolkata has been conferred with INAE Silver Jubilee Young Engineers Award 2012 and the National Women Bioscientist Award 2012 (Young), Department of Biotechnology, Govt. of India.
22. Dr. S Gopalakrishnan, Department of Aerospace Engineering, Indian Institute of Science, Bangalore has received the Distinguished Alumni Award, IIT Madras, Chennai, India
23. Prof. Dipak Mazumdar, INAE Chair Professor, Ministry of Steel (GoI) Chair Professor, Department of Materials Science and Engineering, Indian Institute of Technology, Kanpur has received the 2012 SAIL Gold Medal for the best paper published in the Transaction of IIM for the year 2011 from the Indian Institute of Metals during Golden Jubilee National Metallurgists Day celebrations at Jamshedpur on Nov 16, 2012.
24. Prof. M R Madhav, Professor Emeritus and Visiting Professor, IIT Hyderabad was conferred the Vishwakarma Award 2013 for Achievement for Academicians by Construction Industry Development Council, on March 7, 2013 at New Delhi.
25. Prof. Aniruddha B Pandit, UGC Research Scientist C and Professor of Chemical Engineering and Dean (RCRM) at the Institute of Chemical Technology, Mumbai was awarded INSA teacher award in its introductory year 2012 on the 27th of December 2012 during INSA anniversary meeting in NCL, Pune.
26. Prof. K. Ramesh, Department of Applied Mechanics, IIT Madras, has received the 2012

Zandman Award from the Society for Experimental Mechanics (SEM), USA for significant contributions to the development of measurements or applications utilizing photoelastic coatings. The award was given at a glittering ceremony on 13th June 2012, at Coasta Mesa, California as part of the SEM XII International Congress on Experimental Mechanics. He is the first Indian to receive this award since it was instituted by SEM in 1989.

27. Dr. BN Kalyani, Chairman & Managing Director, Bharat Forge Ltd., Pune has been conferred with Lifetime Achievement Award at the Asian Business Leaders Forum at Abu Dhabi on November 27, 2012 and also received the Cross of Order of Merit of the Federal Republic of Germany for his services to the Nation, by the hands of H. E. Mr. Michael Steiner, German Ambassador in Delhi on Nov 7, 2012.
28. Dr. RB Grover, Principal Adviser, DAE and Director, Homi Bhabha National Institute, Department of Atomic Energy, Mumbai has received the Lifetime Achievement Award of the Department of Atomic Energy for the year 2011. The award was given away by Prime Minister at a function in New Delhi on 15th January 2013.
29. Dr. E Sreedharan, Formerly CMD, Konkan Railway and Formerly Managing Director, Delhi Metro Rail Corporation, New Delhi has received Eminent Engineer Award 2012 from Engineering Council of India; AIMA Managing India Awards 2012 from AIMA, New Delhi; Sri Shanmukhananda Diamond Jubilee Award 2012 on July 17, 2012; Forbes India Life Time Achievement Award 2012; The India Business Leader Award 2012 by CNBC TV 18, Mumbai; Sree Chithrathirunal National Award; SR Jindal Prize 2012; The BKS-CETA Technocrat Life Time Achievement Award; Malayala Manorama newsmaker 2012 Award; and YB Chavan Pratishthan Award.
30. Prof. ML Munjal, Honorary Professor & INAE Distinguished Professor, Department of Mechanical Engineering, Indian Institute of Science, Bangalore has been conferred the prestigious "Pt. Jawaharlal Nehru National Award" in the field of Engineering & Technology for the year 2010 in recognition of his outstanding contribution in the field of Noise Pollution Control.
31. Dr. Srikumar Banerjee, Homi Bhabha Chair Professor, Bhabha Atomic Research Centre and Former Chairman, Atomic Energy Commission and Secretary, Department of Atomic Energy has been awarded The William J. Kroll Zirconium Medal by ASTM International for the year 2012 in recognition of outstanding contributions to the field of Physical Metallurgy of Zirconium Alloys in the areas of Phase Transformations and their application to the industrial fabrication of nuclear reactor components. The award was given in the International Conference on Zirconium in Nuclear Industry held in Hyderabad in February 2013. He was also awarded the Platinum Metal of The Indian Institute of Metals during the National Metallurgist's Days celebrations at Jamshedpur on November 16, 2012.

News of Fellows

1. Dr. Baldev Raj, President-Research, PSG Institutions, Coimbatore has delivered First Faraday Award Lecture under the auspices of NACE International India Gateway Section and National Science Day Lecture to Officers of Defence Research and Development Organisation. He has been in the Circle of Advisors to the Vice Chancellor, Cambridge University; Chairman, Board of Governors, IIT, Gandhinagar; Chairman, Board of Governors, NIT, Puducherry; Chairman, Governing Council,

IIMT, Bhubaneswar, Orissa; Member, Board of Governors, Srinivasa Ramanujam Centre for Basic Sciences, Kerala, Science & Technology Commission; Member, Apex Committee on Higher Education, MHRD and Member of the Court of JNU, New Delhi and Central University, Jammu.

2. Dr. PS Goel, Formerly Secretary, Ministry of Earth Sciences & Chairman, Earth Commission; and Director, ISRO Satellite Centre, Bangalore.; Formerly Chairman, Recruitment and Assessment Centre, DRDO, Ministry of Defence, Govt. of India has taken over as Prof. M.G.K Menon DRDO Chair Honorary Distinguished Professor, ISRO, Research Centre Imarat (RCI), Hyderabad.

3. Dr Purnendu Ghosh, Executive Director, Birla Institute of Scientific Research, Jaipur has published a book titled "The Better Half" which is a collection of poems and essays in which he has tried to capture and express some of his everyday experiences and instant thoughts. Brief details of the book may be viewed on the link http://www.profpghosh.net/thebetterhalf.html.

4. Dr. Bhakta B Rath, Associate Director of Research, Materials Science and Component Technology Directorate, Naval Research Laboratory, USA has been elected as Fellow of The American Association for the Advancement of Science (AAAS) in recognition of his outstanding contributions in materials science and engineering and for leadership in advancing research and technology to support national security.

5. Prof. Ashok Misra, Chairman, Intellectual Ventures, Bangalore and Former Director, IIT Bombay has been elected as a Visiting Fellow of Trinity College, London, UK. Prof Misra has been appointed as an Independent Director on the Board of Jubilant Industries Limited and a member on the Board of Governors of IIT Delhi by MHRD, first Chairman of the JEE Apex Board by MHRD and a member of the IIT Council by the President of

   India, in his capacity as the Visitor of the IITs.

6. Dr. S. Pal, Dr. Surendra Pal, Former Prof. Satish Dhawan Professor, Senior Adviser-Satellite Navigation (ISRO) and PRESIDENT, Institution of Electronics & Telecommunication Engineers-India has been elected as President of Institution of Electronics and Telecom Engineers (India), for the year 2012-2013 and also Fellow of Institute of Engineering Technology (UK).

7. Dr. Sanak Mishra, Chief Executive Officer, Greenfield Projects India, ArcelorMittal India Ltd. , New Delhi has been re-elected as the Chairperson of the International Organization of Materials, Metals & Minerals Societies (IOMMMS) in recognition of his outstanding achievements and dedication to the professional work.

8. Dr. K Bhanu Sankara Rao, Professor and Dean, School of Engineering Sciences & Technology, University of Hyderabad, has been elected as a member of the ASM

   International Nomination Committee for the year 2013. This is the

   first time a person from outside North America has been elected to this prestigious committee. He has been actively associated in various capacities with ASM International publications, International Materials Reviews, Technical Books

Committee, Metallurgical and Materials Transactions and Materials Engineering and Performance.

9. Prof. Gautam Biswas, Director and JC Bose National Fellow, CSIR-Central Mechanical Engineering Research Institute (CMERI), Mahatma Gandhi Avenue, Durgapur has become INSA Fellow with effect from Jan 1, 2013.
10. Prof. Indranil Manna, Director, CSIR-Central Glass & Ceramic Research Institute, Kolkata has taken over as Director, Indian Institute of Technology Kanpur w.e.f. November 7, 2012.
11. Prof. SS Murthy, Formerly Professor, Department of Electrical Engineering, Indian Institute of Technology, New Delhi has become IEEE Fellow.
12. Prof. DN Singh, Department of Civil Engineering, Indian institute of Technology, Bombay, Mumbai has become Editor-in-Chief of "Environmental Geotechnics" a new international, cross-disciplinary Journal for high quality research designed to build, showcase and nurture multidisciplinary research in the arena of geoenvironmental engineering. Details regarding this journal are given at the website http://www.icevirtuallibrary.com/content/serial/envgeo.
13. Prof. B Yegnanarayana, Microsoft Chair, International Institute of Information Technology, Gachibowli, Hyderabad has become IEEE Fellow in recognition of his contributions to digital signal processing research and education w.e.f. Jan 1, 2013.
14. Prof. VS Borkar, Department of Electrical Engineering, Indian Institute of Technology, Mumbai has become Fellow of the Third World Academy of and Fellow of the American Mathematical Society.
15. Prof. SK Kaushik, Former Professor & Head Civil Engineering, IIT,Roorkee has been elected as Fellow of Punjab Academy of Sciences, Patiala (FPAS) and has been appointed Honorary Distinguished Research Professor at ITM University,Gurgaon.
16. Prof. P Rama Rao, Chairman, Governing Council, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderbad has been elected as Foreign Associate of National Academy of Engineering, USA.
17. Dr. Pradip, Vice-President, TCS, Chief Scientist and Head, Process Engineering Innovation Lab., Tata Research Development and Design Centre (TRDDC), Pune has been elected as Foreign Associate of National Academy of Engineering, USA.
18. Shri Ratan N Tata, Chairman, Tata Industries Ltd., Mumbai has been elected as Foreign Associate of National Academy of Engineering, USA.
19. Dr. B.K. Dutta, Distinguished Scientist & Head, Computational Mechanics Section, Reactor Safety Division, Bhabha Atomic Research Centre, Mumbai has been appointed Dean of Homi Bhabha National Institute from 1st December 2012
20. Prof. PK Sen, Department of Applied Mechanics, Indian Institute of Technology, New Delhi has been awarded Doctor of Science, Honoris Causa (D.Sc. Hon. Caus.) by Aston University, Birmingham, U.K. in July 2012.
21. Dr. S Gopalakrishnan, Department of Aerospace Engineering, Indian Institute of

Science, Bangalore has become Fellow of Indian Academy of Sciences (FASc), Bangalore w.e.f. January 2013

22. Prof. V P Radhakrishnan, Professor Emeritus, Indian Institute of Space Science and Technology (IIST), Trivandrum together with his doctoral scholar Mr.V.S.Sooraj, at the Indian Institute of Space Science and Technology, Thiruvananthapuram, got the First Prize for their research work at the exhibition of Academia Projects at the International Machine Tool Exhibition (IMTEX 2013) held in Bangalore from January 24-30th, 2013
23. Dr. BN Kalyani, Chairman & Managing Director, Bharat Forge Ltd., Pune has been honoured with Doctor of Science (Honoris Causa) by IIT Kharagpur for his outstanding contribution to Entrepreneurship and in making Bharat Forge the world leader in forging – at the hands of President of India H.E. Pranab Mukherjee on Sep 15, 2012
24. Dr. H. C. Visvesvaraya, former Vice Chancellor, University of Roorkee was conferred "Doctor of Science" (Honoris Causa)degree along with Hon'ble Sri Pranab Mukherjee and Sri Kumar Mangalam Birla by the Visvesvaraya Technological University at the University's 11th Annual Convocation on 8th April 2012.
25. Dr. Soumitro Banerjee, Professor of the Indian Institute of Science Education & Research, Kolkata, has been elected as Fellow of the Third World Academy of Sciences (TWAS).
26. Prof. Ahindra Ghosh, Formerly Professor, Department of Materials & Metallurgical Engineering, IIT Kanpur conferred with Honorary Membership of the Indian Institute of Metals in recognition of his distinguished services and significant contributions to the Metallurgical Profession, Education and Research. It was awarded on 17th November, 2012 during the NMD –ATM celebration of the Institute.
27. Prof. Dipak Mazumder, INAE Chair Professor, Ministry of Steel (GoI) Chair Professor, Department of Materials Science and Engineering, Indian Institute of Technology, Kanpur has received Fellowship of the Indian Academy of Sciences
28. Dr. E Sreedharan, Formerly CMD, Konkan Railway and Formerly Managing Director, Delhi Metro Rail Corporation, New Delhi was conferred Doctorate of Science by JMTUK on Aug 6, 2012 and Doctor of Science (Honoris Causa), from Padampath Singhania University, Jaipur on Sep 27, 2012 and Doctor of Lit. from Jadavpur University, Kolkata on Dec 24, 2012.

Governing Council

1 Dr. Baldev Raj, President-Research, PSG Institutions, Coimbatore.
2 Dr. PS Goel, Prof. M.G.K Menon DRDO Chair, Honorary Distinguished Professor, ISRO, Research Centre Imarat (RCI), Hyderabad.
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10 Dr. CR Prasad, Chairman & Managing Director, Everest Power Private Limited, Gurgaon.
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13 Prof. Sanjay Mittal, Department of Aerospace Engineering, Indian Institute of Technology Kanpur
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15 Mr. HL Bajaj, Technical Member, Appellate Tribunal for Electricity, New Delhi
16 Prof. Prasun K Roy, The Tata innovation Fellow & Principal Investigator, Indian Brain Grid, National Neuro-Imaging Facility, National Brain Research Centre, Gurgaon

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17 Dr. V Rao Aiyagari, Advisor, Public Health Foundation of India, New Delhi

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18 Prof. Basudeb Barman, Former Member of Parliament, Lok Sabha and Formerly Vice-Chancellor, University of Kalyani

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19 Prof. Anurag Sharma, Physics Department, Indian Institute of Technology, Delhi

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20 Prof. Manindra Agrawal, Department of Computer Science & Engg., Indian Institute of Technology, Kanpur.

National Academy of Sciences (India)

21 Prof. SC Dutta Roy, Formerly Professor, Dept of Electrical Engineering, Indian Institute of Technology, Delhi.

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22 Dr. Surendra Pal, Prof. Satish Dhawan Professor & Senior Adviser, Satellite Navigation (ISRO), ISRO Satellite Centre, Bangalore

The Institution of Engineers (India)

23 Prof. DV Singh, Former Director of IIT Roorkee and Former Vice-Chancellor, University of Roorkee.

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24 Mr. Anjan Das, Executive Director – Technology, Confederation of Indian Industry (CII), New Delhi

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Dr. Kamachi Mudali

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Mr. SC Gupta
Mr. VN Mathur
Mr. AK Gupta

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Prof. SP Mehrotra
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Dr. Purnendu Ghosh

Statement of Accounts

2012-13

INDIAN NATIONAL ACADEMY OF ENGINEERING

MEHRA MALHOLRA & CO.
CHARTERED ACCOUNTANTS

Phone : 25733778
16/A/7 W.E.A.
KAROL BAGH
NEW DELHI – 110 005

THE MEMBERS
INDIAN NATIONAL ACADEMY OF ENGINEERING
NEW DELHI – 110 016

AUDITORS REPORT

We report that we have audited the Balance Sheet of INDIAN NATIONAL ACADEMY OF ENGINEERING as at March 31, 2013 and also the Income and Expenditure Account for the year ended on that day annexed thereto. These financial statements are the responsibility of the Academy's Management. Our responsibility is to express an opinion on these financial statements based on our Audit.

We conducted our Audit in accordance with auditing standards generally accepted in India. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An Audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An Audit also includes assessing the accounting principles used and significant estimates made by the management, as well as evaluating the overall financial statement presentation. We believe that our Audit provides a reasonable basis for our opinion.

Subject to the above :

i) We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit.

ii) In our opinion, proper books of account as required by the law have been kept by the Academy so far as appears from our examination of those books.

iii) The Balance Sheet and the Income and Expenditure Account dealt with by this report are in agreement with the books of account.

iv) In our opinion, the Balance Sheet and Income and expenditure Account dealt with by this report comply with the accounting standards.

v) In our opinion and to the best of our information and according to the explanations given to us, the said accounts, read with accounting policies and Notes to Accounts thereon, give a true and fair view in conformity with the accounting principles generally accepted in India :
   a) In the case of Balance Sheet, of the state of affairs of the Academy as at March 31, 2013; and
   b) In the case of Income and Expenditure Account, of the surplus of Income over Expenditure of the Academy for the year ended on March 31, 2013.

For MEHRA MALHOTRA & CO
CHARTERED ACCOUNTANTS

(Sd/-)

(ARUNKUMAR MEHRA)
PARTNER
(Membership No. 80827)
(Reg. No. : 001052 N)

Place : New Delhi
Dated : July 26, 2013

BALANCE SHEET AS AT 31ST MARCH, 2013

(Amt in Rs)

	As at **31.3.2013**	As at **31.3.2012**
CORPUS/CAPITAL FUND AND LIABILITIES		
GENERAL FUND	2,88,95,963	2,51,50,879
EARMARKED FUNDS	4,75,83,531	3,84,37,933
CURRENT LIABILITIES AND PROVISIONS	1,59,79,797	65,80,666
TOTAL	**9,24,59,291**	**7,01,69,478**
ASSETS		
FIXED ASSETS	5,66,743	6,08,809
INVESTMENTS	8,46,03,034	6,26,19,266
CURRENT ASSETS, LOANS & ADVANCES	72,89,514	69,41,403
TOTAL	**9,24,59,291**	**7,01,69,478**

As per our report of even date

For MEHRA MALHOTRA & CO
CHARTERED ACCOUNTANTS

Sd/-
(ARUN KUMAR MEHRA)
Partner
(Membership No. 80827)
(Reg. No. : 001052N)

Place : New Delhi
Dated : July 26, 2013

On behalf of the Council:

Sd/-
(Dr. Baldev Raj)
President

Sd/-
(Prof. Prem Krishna)
Vice-President (Finance & Establishment)

Sd/-
(Brig SC Marwaha)
Executive Secretary

Sd/-
(Bhuwan Adhlakha)
Manager (F & A)

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2013

(Amt in Rs)

	Current Year 2012-13	Previous Year 2011-12
INCOME		
Grants and Sponsorships	4,11,67,296	4,09,22,420
Delegate Registration Fees etc.	2,15,854	21,54,411
TOTAL	**4,13,83,150**	**4,30,76,831**
EXPENDITURE		
(1) Engineering Activities		
i) Seminars / Conferences / Symposiums / Workshops	41,33,012	1,30,46,345
ii) INAE Chair , Distinguished Professors & Mentoring Schemes	73,62,487	47,91,178
iii) Research Studies/ Projects	3,56,404	27,28,157
iv) INAE Awards	32,45,421	31,92,704
v) Academia-Industry Interaction	18,30,846	16,00,305
vi) INAE Forums	1,22,740	1,13,302
vii) Academy Meetings	15,66,064	13,73,038
viii) Annual Convention	12,66,064	5,76,041
ix) International Affairs	31,18,626	11,68,497
x) INAE Publications	11,13,738	17,62,908
xi) Financial Assistance for Engineering Activities	3,50,000	4,07,600
xii) INAE Silver Jubilee Activities	44,25,279	29,42,093
(2) Establishment expenses	1,20,76,064	74,57,393
(3) Depreciation	1,16,305	1,59,704
(4) Disposal of Assets	3,915	-
(5) Transfer to General Fund	2,96,185	17,57,567
TOTAL	**4,13,83,150**	**4,30,76,831**

As per our report of even date

For MEHRA MALHOTRA & CO
CHARTERED ACCOUNTANTS

Sd/-
(ARUN KUMAR MEHRA)
Partner
(Membership No. 80827)
(Reg. No. : 001052N)

Place : New Delhi
Dated : July 26, 2013

On behalf of the Council:

Sd/-
(Dr. Baldev Raj)
President

Sd/-
(Prof. Prem Krishna)
Vice-President (Finance & Establishment)

Sd/-
(Brig SC Marwaha)
Executive Secretary

Sd/-
(Bhuwan Adhlakha)
Manager (F & A)

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Registered under the Societies Registration Act 1860 (XXI of 1860) No : S-17673 of 20 April 1987

Bankers :
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New Delhi (India)
State Bank of India, IP Estate Branch
New Delhi (India)

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Indian National Academy of Engineering

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