First Pan-IIT + IISc Workshop
on IMPacting Research, INnovation and Technology

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
11th May 2015
The highest education is that which does not merely give us information but makes our life in HARMONY with all existence.

Rabindranath Tagore
If science is pursuing the fundamental question ‘KNOW-WHY?’, engineering is devoted to seeking “KNOW-HOW?”

Thus engineering is to provide solutions to societal needs, challenges and aspirations

India with two-third (~ 800 million) of its 1.22 billion population (17.5 % of the world population) below 35 years of age is projected to be the youngest nation of the world by 2020 (average age = 29 years)

Despite having a GDP of $ 1.87 trillion (ranking 10th or even 4th in PPP terms), is confronted with certain stark realities like: poverty, hunger, health care concern, security threat, basic amenity scarcity (housing, water, employment) and lack of ‘appropriate’ education

Engineering community must provide solution to problems of energy, defense, sustainability, security and education
INDIA AT A GLANCE – RELEVANT FACTS

- **Size:** Seventh-largest **AREA** (3,287,263 km²), 2.4 % earth’s surface – a sub-continent
- **Diversity:** 36 states and union territories, 29 official languages, 8 major religious groups (Hindus 84 %)
- **Per capita income:** Rs. 5,729 per month in 2012-13 (< $ 100)
- **Population below poverty line** = 22%, **HDI** = 134th, **unemployment** = 7.8%,
- **Literacy rate** = 74 %; Education level: at primary = 93%, secondary = 69% and post-secondary = 25%
- **19th largest exporter** but **10th largest importer**
- **Early education:** Gurukul, then **Taxila** (6th century BC) and **Nalanda** (5th century AD)
- **Education in India is fast changing from traditional to modern system of education** (e.g. IITs and IISc)
Learning means measurable and relatively permanent change in behavior through experience, instruction, or study. Learning cannot be measured, but its result can be.

GURUKUL - THE RESPECTFUL GAINS THE KNOWLEDGE

Kanad (600 BC)  
Aryabhatta (476-550 AD)
Current Stages of Education in India

Source: Development of Education in India 1990-92
# Educational Institutions in India (2013-14)

## School Education

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>790640</td>
</tr>
<tr>
<td>Upper Primary</td>
<td>401079</td>
</tr>
<tr>
<td>Secondary</td>
<td>131287</td>
</tr>
<tr>
<td>Senior Secondary</td>
<td>102558</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14,25,564</strong></td>
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</table>

## Higher Education: Universities

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
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<tbody>
<tr>
<td>Central University</td>
<td>42</td>
</tr>
<tr>
<td>State Public University</td>
<td>310</td>
</tr>
<tr>
<td>Deemed University</td>
<td>127</td>
</tr>
<tr>
<td>State Private University</td>
<td>143</td>
</tr>
<tr>
<td>Central Open University</td>
<td>1</td>
</tr>
<tr>
<td>State Open University</td>
<td>13</td>
</tr>
<tr>
<td>Institution of National Importance</td>
<td>68</td>
</tr>
<tr>
<td>Institutions under State Legislature Act</td>
<td>5</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>712</strong></td>
</tr>
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</table>

## Higher Education: Colleges

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diploma Level Technical</td>
<td>3541</td>
</tr>
<tr>
<td>PGDM</td>
<td>392</td>
</tr>
<tr>
<td>Diploma Level Nursing</td>
<td>2674</td>
</tr>
<tr>
<td>Diploma Level Teacher Training</td>
<td>4706</td>
</tr>
<tr>
<td>Institute under Ministries</td>
<td>132</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11445</strong></td>
</tr>
</tbody>
</table>

## Data Source:
- For School Education: U-DISE-2013-2014(Provisional)
- For Higher Education: AISHE Portal (www.aishe.gov.in)
Engineering Graduates: What do they study?

Nearly 50% of all under-graduates appear in GATE. Subject-wise break-up (top 5 branches) for candidates appeared in GATE 2014*

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Number of candidates appeared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering</td>
<td>90872</td>
</tr>
<tr>
<td>Computer Science and Information Technology</td>
<td>155190</td>
</tr>
<tr>
<td>Electronics and Communication Engineering</td>
<td>216367</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>141799</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>185578</td>
</tr>
<tr>
<td>Others</td>
<td>99350</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>889156</strong></td>
</tr>
</tbody>
</table>

*http://en.wikipedia.org/wiki/Graduate_Aptitude_Test_in_Engineering
Growth Pattern of GER in India

State-Wise GER in India

GER Pattern Among Religious Groups in India

World Wide Status of GER

Gross Enrollment Ratio
Transition of Higher Secondary to Higher Education

<table>
<thead>
<tr>
<th>Year</th>
<th>12th Pass-outs (in 000's)</th>
<th>Enrolment in HEIs (in 000's)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-08</td>
<td>6566</td>
<td>4036</td>
</tr>
<tr>
<td>2008-09</td>
<td>7013</td>
<td>4327</td>
</tr>
<tr>
<td>2009-10</td>
<td>7496</td>
<td>5064</td>
</tr>
</tbody>
</table>

Doctorates (PhDs) Produced (per year)

- India
- China
- US

Expenditure on Education (% of GDP)

- <4%
- 4-6%
- >6%
- No data

Country-wise Share of Major R&D Investment

<table>
<thead>
<tr>
<th>Country</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>0.80%</td>
</tr>
<tr>
<td>Brazil</td>
<td>1.10%</td>
</tr>
<tr>
<td>Russia</td>
<td>1.10%</td>
</tr>
<tr>
<td>China</td>
<td>1.40%</td>
</tr>
<tr>
<td>Israel</td>
<td>4.80%</td>
</tr>
<tr>
<td>United States</td>
<td>2.70%</td>
</tr>
<tr>
<td>Japan</td>
<td>3.40%</td>
</tr>
</tbody>
</table>
Outlay on General/Higher Education in India (% of GDP)

<table>
<thead>
<tr>
<th>Year</th>
<th>Education Expenditure (as % of GDP)</th>
<th>Higher Education as % GDP</th>
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</thead>
<tbody>
<tr>
<td>2006-07</td>
<td>3.64</td>
<td>1.14</td>
</tr>
<tr>
<td>2007-08</td>
<td>3.4</td>
<td>1.09</td>
</tr>
<tr>
<td>2008-09</td>
<td>3.77</td>
<td>1.23</td>
</tr>
<tr>
<td>2009-10</td>
<td>3.85</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Source: Analysis of Budgeted Expenditure on Education, MHRD

Employment Distribution in India

<table>
<thead>
<tr>
<th>Sector</th>
<th>Share</th>
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<tbody>
<tr>
<td>Agriculture &amp; Allied Activities</td>
<td>8.25</td>
</tr>
<tr>
<td>Rural Development</td>
<td>4.85</td>
</tr>
<tr>
<td>Irrigation &amp; Flood Control</td>
<td>0.84</td>
</tr>
<tr>
<td>Energy</td>
<td>0.88</td>
</tr>
<tr>
<td>Industry &amp; Minerals</td>
<td>3.32</td>
</tr>
<tr>
<td>Transport</td>
<td>23.72</td>
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<tr>
<td>Transport &amp; Communications</td>
<td>28.91</td>
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<tr>
<td>Science, Technology &amp; Environment</td>
<td>16.30</td>
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<tr>
<td>General Economic Services</td>
<td>6.15</td>
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<tr>
<td>Others</td>
<td>2.13</td>
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<tr>
<td>Teacher Training</td>
<td>2.18</td>
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<tr>
<td>Polytechnics</td>
<td>2.47</td>
</tr>
<tr>
<td>Engineering, technical &amp; architecture</td>
<td>7</td>
</tr>
<tr>
<td>Medical</td>
<td>10</td>
</tr>
<tr>
<td>Arts, science &amp; commerce</td>
<td>56</td>
</tr>
</tbody>
</table>

www.planningcommission.gov.in
Ten Important Technology Domains and Milestones

***
Opportunities for IITs to Lead and Deliver

Presented by: Indranil Manna, IIT Kanpur
At the Visitor’s Conference, Rashtrapati Bhavan, 22 August 2014
I. Energy Harvesting and Energy Security

- **Solar/Renewable resources**: Harvesting, Key materials, Design, H-Storage, Wind, Fuel cells (specific power/energy/cost/life), SOFC
- **Hybrid power systems**: Design, Grid connectivity, Micro-grid, Distribution/stability, Gas hydrates, Smart materials/switches
- **Thermal/Super-thermal power stations**: Capacity expansion and utilization, Efficiency in generation/distribution, Coal gasification (CTL/GTL), Pollution control, Coal/water/fly ash/environment issues
- **Nuclear power**: Reliability, Safety, Structures, Modeling, Fusion reactor (ITER), Loss of coolant simulation, Thermal engineering
- **Oil and Natural Gas**: Exploration, Refining, Gasification, Viscofier
- **Flexible electronics**: Solar energy harvesting, Devices and sensors, Flat panel displays, Large area solar cells/tiles
II. Sustainable Healthcare

• **Public health**: Policy on nutrition, sanitation, water, hospital
• **Bio-sciences**: Bio-informatics, Genomics/Gene-therapy, Drug design/delivery, Proteomics, Bio-scaffold, Synthetic blood
• **Bio-engineering**: Regenerative medicine, Trials, Tissue engineering, Therapeutics, Prosthesis/implants, Biomedical tools
• **Modern healthcare**: Tele-medicine, Health monitoring/diagnostic devices/tools/kit, Sensors, Actuators, Artificial organ and transplantation, Bio-compatibility
• **Traditional medicines**: Ayurveda, yoga and aura sciences
III. River Science and Water Resources

- **River health**: River health protocol, Space regulation, Flood management, River based transportation, agriculture and jobs
- **Aviral and nirmal dhara**: Hydro-meteorological and geomorphic mapping, River linking, Inter-basin water sharing, Water regulation, Waste/effluent/sewage treatment
- **Water policy**: Industrial/domestic water management, Water recycling/recharging, Rain water harvesting, Membrane or osmotic purification, Sludge treatment, Desalination
- **Ocean engineering**: Energy, oil, gas, mineral resource mining, Wind and tidal energy, Off-shore engineering
IV. Sustainable, Green and Smart Cities

- **Infrastructure**: Low cost and durable design, New/alternate building materials, Smart structures (pre-cast/fabricated)
- **Durability**: Structural health monitoring, Retrofitting, Life assessment, Smart security/surveillance, Energy economy
- **Environment**: Green norms/specifications, Waste utilization and recycling (waste to wealth), Pollution monitoring/control
- **Transportation**: Rapid and mass transport system, Intelligent traffic management, River transport, Water front design
- **Power**: Solar PV microgrid, Smart grid, Biomass utilization
- **Healthcare**: IT enabled monitoring, Disease prevention
V. Manufacturing Engineering

- **Small/large scale manufacturing:** Product design, Data analysis, Life cycle analysis, Intelligent decision system, AI
- **Rapid manufacturing:** 3-D printing, Robotics, Computer aided manufacturing systems, Additive manufacturing, Joining
- **Micro and nano-fabrication:** Precision components, Miniature machining, MEMS/NEMS, Micro/nano-lithography, ICs
- **Unmanned aerial systems:** UAVs, Drones, Guided balloons
- **Conventional manufacturing:** Innovations in areas like textile, automobile, metals, rubber, plastics, pottery, glassware, electrical, electronics, communication, defense
- **VLFM:** IITK + IITM + IIMC + JICA
VI. Nanoscience and Nanotechnology

- **Nanomaterials**: Design, synthesis, characterization of NSMs (semiconductor, composites, metals, ceramics), Nanomaterial for catalysis, memory chips, energy harvesting/storage
- **Nanoscience**: Tailoring of shape/size/morphology selection, Size dependent properties, Metamaterials, Nano-porosity, Nanofluid, Nano-battery, Nano-dots, Nano-robots
- **Nanotechnology**: Nanometric device fabrication and system engineering, Sensors, Actuators, Nano-photonics, Health monitoring devices, Thermal devices, Magnetic switches, Optical devices, Smart phone based applications
VII. Computer and Information Science

- **New area**: Data analytics, Big data, Cloud computing, VLSI
- **National need**: Network and cyber security, Image processing, Verification, Surveillance, Fake product detection
- **Challenges**: Real time monitoring and decision making tools, Integrate through easy information gateway, Unique identity system/card, VLSI hardware, Data link cards
- **Societal need**: Semantic web, Language/speech processing technology, Digital rights management, Firewall framework
- **Problems**: Ethical/societal issues in digital world, Accessibility and dissemination of data/information, Net addiction
VIII. Agro-Bio-Nano Technology

**Sustainable agriculture:** Solar PV driven water pumping based on crop need, Water harvesting and recycling, Smart-phone based sensors for moisture, nutrients and crop management

**IT Solutions:** Cloud-based information base for each farm, Digital Mandi, Advisory broadcast on planting, pest control, Crop protection, Food value preservation/processing

**Bio-technology:** Micronutrient (Fe/Zn) fortification, Biologically diverse agriculture, Genetically modified and high yielding food crops (productivity), IP solutions and protection

**Nano-Biotechnology:** Novel veterinary vaccines, Intelligent fertilizers, Bio-sensors, Membrane filtration reactors
IX. Outreach and Mass Education Program

- **New approach:** IT enabled platforms, tools and models, Online test/examination and certification
- **Training:** Large classes, On-line/on-job empowerment of professionals, Intelligent/interactive tutoring and training
- **Supplementary tools:** e-learning models, MOOCs, Flipped classroom, Lecture repository (NPTEL), Virtual laboratory and easy pace experiments, Web based tool kits
- **Challenge:** Source/course material creation, Model for sharing, Authenticity, Accreditation, Reaching out at low cost
- **Novelty/Benefit:** Skill + Scale + Speed
X. Advanced Materials

- **New materials**: Design, synthesis, fabrication and processing of new structural/functional materials, New techniques
- **Tailored materials**: Bio-inspired/bio-medical materials and systems, Compositionally/functionally graded materials
- **Engineering materials**: High specific strength materials for automobiles/aviation industry, High temperature resistant materials for strategic sectors (space, atomic energy, defense), Advanced textile products, Sustainable process technology to convert minerals to metals
- **Electronic materials**: Wide band gap materials, Quantum structures, Opto-electronic devices and optical fibers
Summary and Conclusions

In last 50 odd years, IITs have established themselves:
- International brand name for quality education
- Backbone of knowledge eco-system in engineering
- Seat for technology development and entrepreneurship

What IITs should do now:
- Partner, develop and deliver complete technology
- Lead globally in selected domains of Science & Tech
- Help the country improve its manufacturing skill/base
- Create technological solution to large societal problems
- Help the country bridge the gap in manpower training, improve national infrastructure, fortify economy, create more jobs, prove useful partner to PSU/industry, and strengthen strategic sectors (DAE/DoD/DoS)

Thank you and namaskar!
20th Century: A Century of Innovation

A Century of Innovation

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronic
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household Appliances
16. Health Technologies
17. Petroleum and Petrochemical
18. Laser and Fiber Optics
19. Nuclear Technologies
20. High-performance Materials

Twenty Engineering Achievements That Transformed Our Lives

Foreword by Neil Armstrong
Afterword by Arthur C. Clarke

IFEES Engineering Education 2014
The National Academy of Engineering
Grand Challenges Committee
**Grand Challenges for Engineering (USA):**

- A major national policy initiative was launched in USA by *National Academy of Engineering, USA* at the behest of *National Science Foundation, USA*.
- Started in February 2008 to define the *21st Century’s Grand Engineering Challenges*.
- The committee of 18 experts from academia, industry, media, government agency, financial/policy institutions were given the task to identify major challenges that await sustainable engineering solutions.
- The four major goals were identified as *sustainability, health, reducing vulnerability and joy of living*.
- The Committee through global consultation with more than 50 subject matter experts drawn from 40 different countries, identified 14 topics as game changing Grand Challenges.
Grand Challenges Committee:

- **William Perry**, Committee Chair, (Former Secretary of Defense, U.S. Department of Defense), Michael and Barbara Berberian Professor, Stanford University
- **Alec Broers**, Chairman, S & T Select Committee, United Kingdom House of Lords
- **Farouk El-Baz**, Professor & Director, Center for Remote Sensing, Boston University
- **Wesley Harris**, Head and Charles Stark Draper Professor of Aeronautics, MIT
- **Bernadine Healy**, Health Editor and Columnist, U.S. News & World Report
- **W. Daniel Hillis**, Chairman and Co-Founder, Applied Minds, Inc.
- **Calestous Juma**, Professor, International Development, Harvard University
- **Dean Kamen**, Founder and President, DEKA Research and Development Corp.
- **Raymond Kurzweil**, Chairman & Chief Executive Officer, Kurzweil Technologies, Inc.
- **Robert Langer**, Institute Professor, Massachusetts Institute of Technology
- **Jaime Lerner**, Architect and Urban Planner, Instituto Jaime Lerner
- **Bindu Lohani**, DG & Chief Compliance Officer, Asian Development Bank
- **Jane Lubchenco**, Professor of Marine Biology, Oregon State University
- **Mario Molina**, Professor of Chemistry and Biochemistry, University of California
- **Larry Page**, Co-Founder and President of Products, Google, Inc.
- **J. Craig Venter**, President, The J. Craig Venter Institute
- **Jackie Ying**, Executive Director, Institute of Bioengineering and Nanotechnology
14 Grand Challenges for Engineering in USA in 21\textsuperscript{st} Century

- Make solar energy economical
- Manage the nitrogen cycle
- Advance health informatics
- Prevent nuclear terror
- Advance personalized learning

- Provide energy from fusion
- Provide access to clean water
- Engineer better medicines
- Secure cyberspace
- Engineer the tools of scientific discovery

- Develop carbon sequestration methods
- Restore and improve urban infrastructure
- Reverse-engineer the brain
- Enhance virtual reality
Fourteen Grand Challenges*

1. Make solar energy economical
2. Provide access to clean water
3. Restore and improve urban infrastructure
4. Manage the nitrogen cycle
5. Advance health informatics
6. Secure cyberspace
7. Advance personalized learning
8. Develop carbon sequestration methods
9. Reverse-engineer the brain
10. Engineer better medicines
11. Enhance virtual reality
12. Provide energy from fusion
13. Prevent nuclear terror
14. Engineer the tools of scientific discovery

*National Academy of Engineering, USA
Yannis C. Yortsos, University of Southern California
Four Themes

Sustainability, Health, Security, Enriching life

- Energy
- Environment
- Global Warming
- Sustainability

- Reducing Vulnerability to Human and Natural Threats

- Improve Medicine and Healthcare Delivery

- Expand and Enhance Human Capability And Joy
Indo-US Dialogue on Grand Challenges

Symposium: INAE-NAE JOINT SYMPOSIUM ON ENGINEERING EDUCATION IN THE 21ST CENTURY – ISSUES RELATED TO GRAND CHALLENGES

Date: December 18-19, 2014

Venue: NAE Head Quarters, Washington DC, USA

Participants: Indranil Manna (IIT Kanpur), Tarun Mohindra (Embassy of India, Washington DC), B. S. Murty (IIT Madras), Amlan Jyoti Pal (IACS Kolkata), Deepak B. Phatak and V. Ramagopal Rao (IIT Bombay), Rajeev Shorey (DIT, GoI), B Ganapathy (TCS, USA)

Outcome: Discussion on GCSP, Sharing of ideas/thoughts/notes, Exchange projects/visits, Plan for follow up actions

Follow up: 2nd INAE-NAE Symposium on October 17-18 2015

Can we connect INAE-NAE dialogue on GC to IMPRINT?
As you are aware that the Government of India is focussing on “Make in India” with a view to enhance competitive strength of Indian Industries through Research and innovation in key sectors of Indian Economy. A framework on Impacting Research, Innovation and Technology or IMPRINT India including Terms of Reference and Research Groups along with details is enclosed.
Mandate I: Education Policy

AIM: To develop a comprehensive perspective and policy on Education in India – ways to strengthen and improve education system in order to:

- Create an informed and ethically conscious society imbued with a scientific temperament
- Foster capabilities of conceptualisation, logical thinking and analysis
- Nurture creativity and innovation
- Relate learning with life
- Have clear learning outcomes and ways of assessing them
- Strengthen competencies along a learning continuum (from school to higher education levels) specially in Science and Mathematics
- Reflect the objectives stated above in the management, pedagogy/curriculum, teaching-learning materials and assessment methods of the teaching-learning processes of science, engineering and mathematics at all levels
- Prepare teachers for such tasks
- Encourage community involvement and ownership for creating a meaningful and relevant education system
Mandate II: Research Policy

AIM: To recommend ways to assess the nation’s research & technology needs specially in terms of the new development priorities articulated and the status of our readiness in terms of manpower, research infrastructure, and resources:

- To project the areas of research that need to be strengthened in a short-medium and long term period so that India can become self-sufficient in critical technology areas and develop its indigenous technical capacities.
- To recommend ways in which the societal impact of research and technology can be augmented.
- To identify at least 10 centres of excellence that can be set up/strengthened in partnership with other institutes and with industry to advance fundamental and applied research in the areas identified and to create an eco-system of research, design innovation and technology transfer.
- To prepare a comprehensive time-plan for developing a strong world-class R&D system in the areas under study and in ways that impact the well-being of society and the National Agenda of development.
- To identify resources that are available and assess the additional requirement (in terms of manpower, infrastructure, technology, finances) and to recommend feasible ways of mobilising resources.
IMpacting Research, INnovation and Technology
[IMPRINT]

An initiative of MHRD to make an impact through research and innovation for engineering and technology

Policy Initiative

Not Technology Development

Technology Innovation

Education Policy for Inculcating Scientific Temperament and Innovation Skills

Research Roadmap for Technology Readiness
IMPRINT

Education Policy for Inculcating Scientific Temperament and Innovation Skills

School (STEM) → University (UG/PG levels) → Research Univ + R&D Labs (PDF/PhD/Projects)

Interest in S&T → Engineering Branches → Manpower + Knowledge

Interdisciplinary
IMPRINT
Research Roadmap for Technology Readiness

- Competence and Capability
- Infrastructure
- Technology
  - Product
  - Process
- Goalposts
- 10 Domains/Themes
  - Targets
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Domain</th>
<th>Nodal Institute</th>
<th>Participating Institutes</th>
<th>The Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Health care</td>
<td>IIT Kharagpur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Computer Science &amp; ICT</td>
<td>IIT Kharagpur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Energy</td>
<td>IIT Bombay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sustainable urban design</td>
<td>IIT Roorkee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Nano-technology hardware</td>
<td>IIT Bombay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Water resources and River Systems</td>
<td>IIT Kanpur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Advance materials</td>
<td>IIT Kanpur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Manufacturing</td>
<td>IIT Madras</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Defence</td>
<td>IIT Madras</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Environment Science and Climate Change</td>
<td>IISc Bangalore</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Planning of Key Approach I

PLAN Ahead:

a) Timeframe
b) Strategy
c) Milestones
d) Roadmap
e) Funding

- Define/Identify: Title, Aim/objective, Scope, Challenges, Topics, Deliverable
- Reorient, Realign, Revise teaching and research for Focus and Impact
- Declare, pursue, discuss, review, compile the policy
- Policy on (a) education and (b) research
Planning of Key Approach II

IMPRINT

Domains ➔ Themes ➔ Tasks ➔ Targets

Topics/Tasks/Thesis/Projects/Assignments

UG ➔ Focus ➔ Approach Solution
PG ➔ Continuity ➔ Develop Technology
PhD ➔ Complementarity ➔ Achieve Leadership

Sustained initiative

Focus
Continuity
Complementarity
Sustained initiative

Approach Solution
Develop Technology
Achieve Leadership
1. Health Care: Profs Bushra Ateeq, J G Rao, S Panda, V Verma, K Balani, D Katti, Ashok Kumar
5. Nano-Technology Hardware: Profs S Panda, S A Ramakrishna, J Akhtar
8. Manufacturing: Profs J Ramkumar, V K Jain, Bisakh Bhattacharya, Arvind Kumar, Shantanu Bhattacharya
10. Environment Science and Climate Change: Profs Mukesh Sharma, S Tripathi, Abhas Singh, Tarun Gupta, K Mandal
Way Forward – Logical Approach

Step I 1st Workshop at IIT Kanpur

II Formation of teams (Domain – Theme - Group - Subgroup)

III Selection of Domain Chair/Theme Coordinator/Group Head

IV Internal discussion (within Group/Theme/Domain)

V Study current status in India and define international benchmark

VI Identify centres of excellence in India and abroad (academic institutions, research laboratories, industry, government departments and policy/funding agencies) for consultation

VII Project target technological challenges and define suitable road map to pursue such goals with clear benchmarks and deliverables

VIII Define engineering background and knowledge base needed to pursue #VII and create an advice charter for modifying school/college/university curriculum in the concerned domain

IX Examine infrastructure requirement and availability and suggest suitable augmentation plan to implement #VII

X Finalize the Comprehensive Document on (a) Education Policy and (b) Research Plan as per the charter of IMPRINT India
VISION of IITs:
The basic function of IITs is production of scientists and engineers of the highest caliber … Goals & tasks of the institutes should relate continuously to changes taking place in the socio-economic development of the country and … rapidly exploding universe of knowledge in science & technology.
The highest education is that which does not merely give us information but makes our life in HARMONY with all existence - Rabindranath Tagore

Education is the kindling of a flame, not the filling of a vessel — Socrates

Concluding Remarks

- IMPRINT is an opportunity for the higher echelon institutes in India to integrate, mutually complement and deliver what the country demands and aspires
- Policy is our immediate mandate, technology (products and processes) is the next goal
- The ultimate target is inclusive growth, empowerment, prosperity and dignity of the nation
- Let us start the dialogue and move forward

Thanks very much for your kind attention