Investing in the Development Curriculum
A teaching and research paradigm for national development\textsuperscript{1}, .

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\textsuperscript{1}A detailed argument appeared in the journal \textit{Current Science, vol. 102, no. 11} June 2012, pg. 1510.
Organization of the talk

- The demands of development and the supply.
- The development curriculum and action research
  - the Development Research Institute (DRI)
  - the Development Professional (DP)
- The proposal— MoRD Fellowships
- Outcomes and the way forward.
- The knowledge and skills—case study
The Development Demand

- Increasing aspirations
  - *sadak, bijlee, paani*-engineering services
- Scarce Resources
  - *climate change*-added unpredictability
- Rising Inequalities
  - asset and skill poverty, livelihoods
- **Wealth creation as well as wealth redistribution**

**Governance under stress**

- capacity technical and applied social sciences skills
- outcome orientation, stress on planning coordination
- R&D needs for both day-to-day and long-term
The Governance Structure

The Demand
People
Sarpanch, MLAs
Collector, CEO

The Supply
Line Departments
Programs
Projects

Coordination and Monitoring
Gram Sabha
District Planning Comm.
Jan Sunwai

strong

weak
The current status

- **The Supply**: Poor capacity to deliver
  - poor morale, poor conditions, poor institutional structure

- **The Demand**: Poor capacity of monitor
  - distracted by poverty, failing education system, failing resources

- **The Monitor**: Poor outcome, poor skills
  - no independent capacity, infrequent meetings, no new knowledge
Development and Education

- The development sector poses important problems worthy of research and active engagement of research and educational institutes.

- Current set of companies may not have sufficient incentives to address these problems.
- These companies also do not have the need for the 5,00,000 p.a. or so engineering aspirants.

- The training of engineers is biased to employee-training and not towards skills needed to participate in the development sector.
- The research, if at all, does not match development demands.

Thus there is a supply-demand mismatch in both the corporate and the development sector!
University/Institutional participation in regional development problem — formulation and solution.

Curriculum modification to allow students to take projects with local content and a focus on R&D for regional needs.

University as an important mediator.

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**The Demand**
- People
- Sarpanch, MLAs
- Collector, CEO

**The Supply**
- Line Departments
- Programs
- Projects

**Coordination and Monitoring**
- Gram Sabha
- District Planning Comm.
- Jan Sunwai

**The DRI**
The response

A curriculum for engineers in knowledge formation

- **Remedial**—field, stake-holder and outcome driven.
- **Intellectual**—the socio-economic discourse, inter-disciplinarity
- **Developmental**—the bottom 80%, core sectors of water, energy, food etc.
  - CSOs, NGOs, SHGs, MLAs, state agencies, and also those beneath the market and the state.

A supply-demand strategy

- knowledge products which deliver value
- *development professionals* trained in knowledge products
- positions in implementation agencies of state, companies, NGOs, district collector etc.,

Above all...

A pedagogy of the engineer who will grapple directly with society.
Centre for Technology Alternatives for Rural Areas

- An academic center of IIT-Bombay, started in 1985
- To study and to develop solutions for problems from rural India

Initial work:
- Agricultural machines and implements
- Energy and drudgery saving devices
- KVIC nodal center
  - Herbal oils extraction process
- Bio-diesel from waste oil
Later work

- **2005**: Check-dam at Gudwanwadi, 85m, 20,000 cu.m. for Rs. 25 lakhs
- **2009**: Vertical Shaft Brick Kiln in Narangi, Pen *taluka*

Department ⇒ End-Use ⇒ Stakeholders
Civil, CSE ⇐ Drinking Water ⇐ Gudwanwadi
The programs

Department ⇒ End-Use ⇒ Stakeholders
Civil, CSE ⇐ Drinking Water ⇐ Gudwanwadi

The True Engineer

- Design
  - Civil
  - Econo.
  - Maths.
  - IT
  - Analyse
  - Synthesize

- Modelling
  - Identify Problem
  - Deploy

Domain Knowledge
Creative Skills
Societal Skills

- 2007: M.Tech. program in Technology and Development
- 2010: TDSL-interaction with other departments and UGs
Core Faculty

- **Anand Rao** - Energy and Environment, Climate Change
- **N. C. Narayanan** - Water and Governance, Development Theory
- **N. Shah** - Food, Agriculture and Agro-Industry
- **Priya Jadhav** - Electricity, Energy
- **Amit Arora** - Agriculture, bio-mass systems.
- **A. W. Date** - Appropriate Tech.
- **Milind Sohoni** - Water, Optimization
- **Om Damani** - Water, modeling
- **Puru Kulkarni** - Water, public systems

Adjunct Faculty (some):

- **Bakul Rao** - Environment Analysis and Assessment
- **S. Wagle** - Policy and Governance
- **Prasad Modak** - Environment
- **Satish Agnihotri** - Governance
The T&D core operational values

- **Concrete beneficiary/stake-holder** - the bottom 80%, households, hamlets, gram-panchayats, villages, towns and cities
- **Basic areas** - soil, water, energy, livelihoods, public health
  - end-user defined or demand-driven
- **Concrete deliverable** - as close to implementation as possible
  - solutions and knowledge - technology, policy, study, capacity

Objectives of the M.Tech./Ph.D. program

To produce the development practioner/innovator

- Analyse ”development” situations and design solutions
- Build on grassroot understanding to work on national/global issues
Drinking water system for Boriwali GP (Karjat tal.)

Development problems demand:

- field-work and inter-disciplinarity
- creativity, innovation, honesty and hardwork
The design of courses

- Foremost learn the real **Engineering loop**: analyse, design, deploy, satisfy
- **Accept Inter-disciplinarity**
- **Engage**-with the unorganized sector, directly or through the State or the Market, if present. Through NGOs, CSOs
- **Build discourse**-through seminars, within courses
- **Do Field work**-sensitization, proofing, **participative** and beyond

Perspective
3-4 common courses

Skills
2-3 common courses

Sectors
Domain coursework and electives

Practice
Fieldwork and delivery specifics
The current M.Tech./Ph.D. in T&D

Coursework

- Perspective—philosophical nuts and bolts
  Development Theory, Appropriate Technology, Policy and Governance

- Sectors—the knowledge base
  Water, Soil and Agriculture, Energy, Environment

- Skills—to bring rigour to field work
  Social Sci. Res. Meth, System Dynamics, Project Mgt. and Analysis

- Field work—10 week structured rural stay, field visits

- Two-Stage Project—Ideally
  - 1st Stage—Situation and alternatives—Appreciation
  - 2nd Stage—Technology or Policy—Generation
Supervised Learning in Tech. and Dev. (TDSL)

- Unique opportunity for faculty members to float live development projects and for students to take them
- Guidance and Liaison from CTARA
- **Objectives**: extension, field study, entrepreneurship in the public space. Also pre-research

<table>
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<th>TD491</th>
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<td>6</td>
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<tr>
<td>Title</td>
<td>Study</td>
<td>Analysis</td>
<td>Design</td>
</tr>
<tr>
<td>Reporting</td>
<td>IIT</td>
<td>+stakeholders</td>
<td>+ stakeholder</td>
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</table>

- Since January 2011, 7th offering—extremely popular—80 students this semester, 200+ students overall
Selected M.Tech. Projects

- Study and design of cages for aqua-culture
- Development of nutritional supplement for malnourished children
- Design enhancement and dissemination of improved cooking chulha in a village

- A process model for regulation in infrastructure development
- Analysis of groundwater regulation in various states of India

- Simulation of hybrid energy systems for village applications using HOMER
- Convergence of NREGS and Watershed improvement programs in Kerala
- Assessment of Herbal Initiatives in a Rural System
TDSL Sampler

- North Karjat Tal. Drinking water scheme - Design
- Rural Bio-gas Alternatives - Two case studies - Study
- The Anjap-Sugave multi-village scheme-a failure analysis - Analysis
- Transport provisioning in Karjat taluka - Study
- Incentives from Medical companies to retailers - Study
- Karjat City Development plan - Design

This semester - Devices for public hospitals, IT in education, water, energy, meters, GW policy, and so on.

- Budding consultants, entrepreneurs, researchers - Opportunities in the development agenda
Some pictures
Snapshots
Snapshots
Snapshots
Snapshots
Snapshots
The TDCC-The Consultancy Incubator

- to respond to consultancy and knowledge needs of civil society
- to liaison between student output, stake-holders and delivery
- to position CTARA with implementation, govt, agencies and to develop thematic output

- consolidation and standards for knowledge products
- to train other colleges in such products and programs
- to create a market for development

Grow as number of projects grow- 1-2 people needed soon
Yearly reports on expenditure and value generated-first economic and eventually financial viability
The Vision in Development Action

- IIT should be known for its excellence through delivery and engagement
  - innovative and creative projects which deliver
  - known not for who gets in but what comes out
- A pedagogy of engineering - colleges as local solution and knowledge providers
  - to develop courses, modules and projects
- An engagement and presence with government and implementation agencies, local bodies and civil society
- To intellectualize the role of the university/institute and to mediate on behalf of society

Foremost

To make engineering inclusive and social so as to deliver development
The long view

Plan: School of Technology and Development

- Collaboration with key departments
- graduate roughly 60-100 development-enabled engineers into the market.

Streams:

- Sectors, Programs and Projects
  - How do we improve outcomes? How do we design programs.

- Policy and Implementation.
  - How does grid influence growth.
  - Is Karjat taluka well-served in public transport?

- Innovation-in product, process and practice.
  - Can bio-gas be made cheaper and better?
  - Can we instrument for deeper GW monitoring?
University/Institutional participation in regional development problem — formulation and solution.

Curriculum modification to allow students to take projects with local content and a focus on R&D for regional needs.

University as an important mediator.
The Development Research Institute

- Broad research and teaching—both engineering and applied social sciences
- Commitment to excellence in R&D
- Interest in and knowledge of governance, development
- Flexible academic programs

Foremost

- Have a rigorous program to train the *development professional!*
- Recognize the importance of inter-disciplinarity and field work.
- Use the best tools and methods to further development.
The Development Professionals

- **The District Development Coordinator:**
  - reports to planning body and Collector

- **The Program Coordinator:**
  - reports to program manager

- Monitor, coordinate and improve outcomes
- Formulate medium/long term R&D and interact with DRI

- **The Social Entrepreneur**
  - innovate in the energy, food, water, etc. development sectors.
  - mentoring and access by DRI

**Belief**

- These positions *will* deliver value.
- Collaboration with DRI will bring efficiency and new knowledge and practices.
The Proposal

- 10 2-year MoRD/Development fellowships.
- Starting in IIInd year M.Tech and continuing for one year in program office, field, state agencies.
- Rs. 13.00 lakhs each, includes both years, access to faculty time and facilities
- DRI to publicize with States
- DRI to assist in consultancy and R&D.
- 2 faculty positions and support-staff.

This will help ...
- incentivize the formation of DRIs
- define a new profession –Development Professional
Long-term outcomes

- A profession alligned to development needs and a training to suit it.
- A multitude of DRIs–IIT Mandi, RIT Islampur and so on.
- A development discourse within engineering and applied social sciences academia
- **A betterment in the lives of our people.**
Thanks
Case studies from Drinking water
Mograj GP and habitations
Mograj GP - according to DDWS and actual!

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<th>habitationName</th>
<th>SchemeNameDP</th>
<th>SanctionYear</th>
<th>SchemeType</th>
<th>estimated Cost</th>
<th>DateOfCommenecement</th>
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<td>DUG WELL</td>
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<td>Seasonal</td>
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<td>Openwell</td>
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</table>

**Recommendations:** Technical review, watch the yield tests, protect source from competitive users.
Tanker-fed villages

160 out of 1700 were tanker fed. 60 repeatedly so!

Largely in the 4 tribal talukas: Jawhar, Mokhada, Murbad and Shahpur.

Fraction of ST population.

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<td>Tanker</td>
<td>0.97</td>
<td>0.93</td>
<td>0.74</td>
<td>0.62</td>
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<tr>
<td>Taluka</td>
<td>0.97</td>
<td>0.91</td>
<td>0.24</td>
<td>0.35</td>
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Mean elevation (in m.):

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<td>Tanker</td>
<td>344</td>
<td>361</td>
<td>123</td>
<td>197</td>
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<tr>
<td>Taluka</td>
<td>320</td>
<td>350</td>
<td>126</td>
<td>132</td>
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</tbody>
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More analysis

Location of large rural regional drinking water schemes

Location of rivers and lakes

Data from MRSAC, Census 2001, District administrative offices
Applicable R&D with DRI
A Rural-Regional scheme design.

Latitude, longitude, elevation, population and growth rate.
The designed network

17 ESRs and a 2-loop network.
A close-up

Hundreds of nodes and edges. Pipes along roads.
Finally...

Estimated Net Investment for design population of 81,400.

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<th>lpcd</th>
<th>per capita</th>
<th>crores</th>
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<td>200</td>
<td>Rs.7051</td>
<td>Rs. 57</td>
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<tr>
<td>40</td>
<td>Rs. 2119</td>
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</table>

Energy costs (at Rs. 5 per unit, pumping efficiency 75%)

- **200 lcpd** - Rs.400 per capita per annum
- **40 lpcd** - Rs. 79 per capita per annum
- Energy cost per 1000 litre Rs. 4.56

Net investment for piped water at both norms of 40/200 lpcd to north Karjat is economically feasible.
Karjat City—a small taluka town in Maharashtra

- Request from Municipal Council to analyse City Development Plan.
- **Ongoing work**—water, sewerage, solid waste, municipal budget and so on.
- **Skills**: GIS, simulations, social and governance analysis

**Water system.**

- 3 zones OK but higher capital costs, 1 zone poorly designed.
- Pump efficiencies lower (51%, 60%) than standard (70%).
- Financial stress—unmetered connection, commercial and residential
- Competition with private bore-wells