



Prof. Winter: “Engage the end user in the design process”

MIT Professor shares research experience on product development for a humanitarian challenge

Prof. Amos Winter, Assistant Professor at Department of Mechanical Engineering, MIT and Director of Global Engineering and Research (GEAR) Lab, MIT, visited Tata

Centre, IIT Bombay on January 17th, 2015. He addressed the audience on the topic of, “Using Emerging Market Constraints to Innovate Global Solutions” and in particular, focused on technology solutions that apply mechanical design theory to create simple, user-centered product designs for use in constrained environments.

The audience were guided through the mechanics of an all-terrain wheelchair designed for developing countries to enable the physically challenged people travel to their workplaces through unconstructed roads. Leveraged Freedom Chair (LFC) invented by Prof. Winter uses arm powered levers to yield highly effective mechanical advantage. One of the LFC models targets sub-\$200 price point to achieve depth of outreach by serving low income customers in rural communities. The favorable price performance ratio of LFC makes it affordable for the society for which it is designed. It has an edge over similar products as it was

designed to be compatible with resource-constrained environments.

Prof. Winter attributed success of this technological solution to three main factors - continuous interactions with stakeholders, a thorough understanding of socio-economic and technical constraints and the efforts to define the problem totally independent of the solution. He also highlighted the necessity to consider the post-research phases of technology transfer, manufacturability and marketing and distribution channels, even when doing the research. ■■■

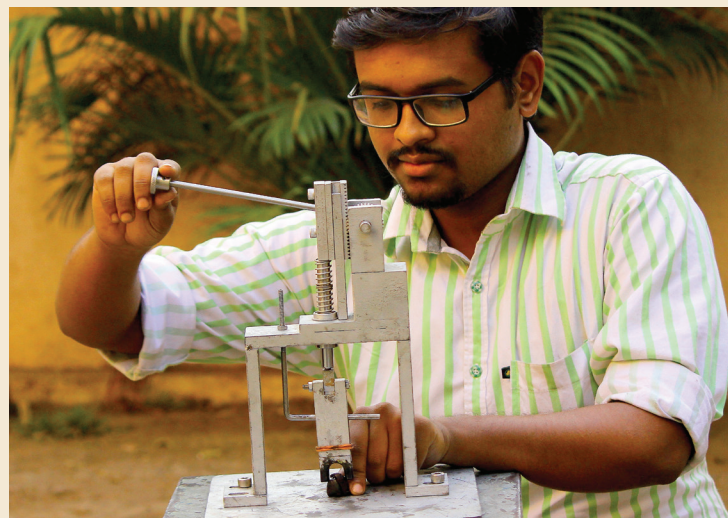
Events & Highlights :

- Workshop on Challenges in Affordable Housing organized by Prof. Vijay Bapat, Prof. Uday Athavankar in association with Tata Centre
- Faculty members, working on Tata Centre Projects, from IIT Bombay visit the sister Tata Centre at MIT, Boston

Appropriate Technology Design



Traditional De-shelling of Nuts



Newly developed technology for De-shelling

Nut-Cracking Device to improve the livelihood of Tribal Women

Shreejit Kunjir, a Tata affiliate under the guidance of Prof. Bhandarkar, Dept of Mech.Engineering, IITB has developed a marking-nut cracker device that can potentially double the productivity and minimize health problems of Tribal

Women whose livelihood is dependent on extracting kernels and oil from these nuts. Shreejit is a Masters student with Centre for Technology Alternatives for Rural Areas (CTARA) at IIT Bombay.



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TATA Fellows undergo an intensive workshop on Innovation, Fabrication and Entrepreneurship

The projects that Tata Fellows took for their Masters theses demand the students to understand the process of building concrete engineering solutions. Tata Centre conducted a three week program for the Fellows during the December winter break, to train them in hands-on skills. This included an intensive workshop on “Innovation, Fabrication and Entrepreneurship” by Rajesh Nair, a successful entrepreneur and a Visiting Scholar at the MIT Tata Center, mentored nearly 30 Tata Fellows and affiliates.

Four groups, formed with complementary skills and technical domains started to engage in rigorous problem identification exercises. They chose a broad technological domain and identified acute problems with potential technological solutions. The insights gleaned from the Gadchiroli village field visit allowed the teams to explore problems of rural dwellers. Raj and other mentors constantly stressed the importance of separating problem identification from the personal perception of the solution, a valuable input for trained engineers prone to biases.

Participants conducted interviews, surveys and field visits. One of the groups visited hostel messes to record daily water consumption with a view to minimising its wastage. Another group conducted pop-surveys to gauge public reaction to a potential bicycle-pooling system on Campus. Based on the collected data, the teams presented a system-level analysis of the problem and solution.

Having decided their system-level problems, the teams ideated and brainstormed to arrive at precise details of their solutions with sketching and calculations. Raj guided the teams in arriving at concrete solutions with established innovation component. The members took up different tasks such as component sourcing, fabrication, co-ordination with fabrication workshops and raced against time to build product

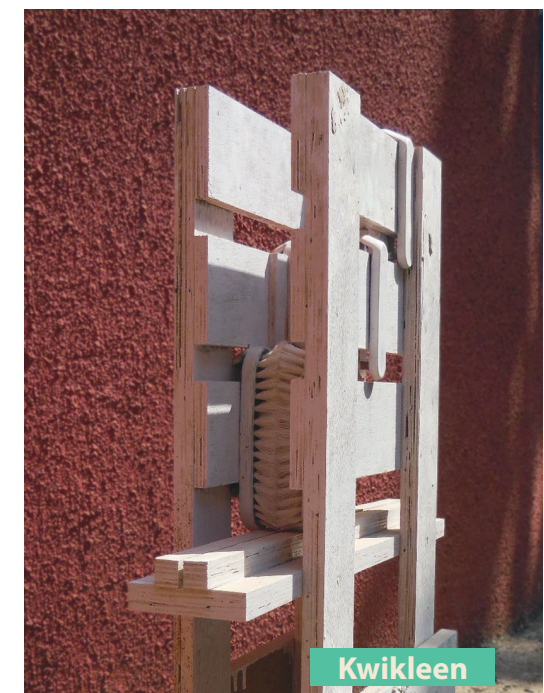


Cycool

prototypes, soldering circuits, cutting wood, and writing software; as well as performing financial analyses, business model selection and branding activities for their product. Teams constantly documented the entire innovation process through photographs and journals.

Following product prototypes were presented to the Institute community at the end of the workshop:

- ‘Buzzkill’ – A device to kill mosquito larvae
- ‘Kwikleen’ – A novel dishwasher to reduce water wastage
- ‘Cycool’ – An innovative cycle pooling solution for IIT
- ‘Ricer’ – A device for rural farmers to reduce effort in rice transplantation



Kwikleen



Buzzkill



Tete-a-Tete with Prof. Dhirendra Bahadur (MEMS)

Project: Functional nano-hybrids towards translational research in multi-mode therapeutics for ovarian and breast cancer.

In collaboration with Advanced Centre for Treatment Research and Education in Cancer (ACTREC), funded by Tata Centre for Technology and Design (TCTD).

Prof Bahadur is attempting to create a synergy between two cancer treatment modalities – Hyperthermia, which is raising the temperature of a local region within the cancer tissues to above 42 °C to destroy the malignant tumors; and chemotherapy in targeted drug delivery to the cancer cells only by encapsulating the drug on a multi-functional polymer nano-hybrid that releases the drug when it meets certain criteria such as pH, temperature etc.

In vitro and in vivo tests on mice with ovarian and cervical cancer have shown a significant improvement by this dual therapy approach, as is portrayed by regression /inhibition of the growth of tumors as compared to the control specimen.

TCTD: What is your motivation to research in the field of Cancer Treatment?

DB: My earlier work on magnetic nanoparticles was a kind of motivation that slowly led me into materials for bio medical applications, where I have been working for the past decade, specially investigating the applications of such lossy magnetic nanoparticles in cancer treatment and drug delivery. Besides, the cancer patients are themselves a tremendous source of inspiration. The idea of giving something back to the society is a great driving force.

TCTD: What is the novelty of this approach towards cancer treatment?

DB: Several multi-functional magnetic nanohybrids that can be applied for both therapeutic as well as diagnostic applications for the cancer have been developed by our group. These can also be used for dual therapy – thermal therapy in synergy

with chemotherapy. We have made several hybrids consisting of inorganic (mostly magnetic oxides) and organic (lipids, hydrogels, dendrimers, etc.) components together. The drug is then either attached or encapsulated within the hybrid. Following this, an AC magnetic field is applied. The organic component is made pH or temperature sensitive. Due to the lossy nature of the magnetic nano particles, the temperature rises and as it reaches about 42° c, the hyperthermia works and drug is released. This mode of therapy has been extensively tried and had been found very successful in small animal model.

Another novel thing about this approach is the near absence of side effects, which otherwise is a big concern in the existing therapeutic modalities.

TCTD: What are the challenges in this project?

DB: At present our institute does not have an animal house for in vivo testing of our formulations (We may get one in a couple of years). Animal experiments need several ethical and regulatory body clearances from the government and for larger animals getting these is extremely difficult. Thanks to the Tata Memorial Hospital (ACTREC is its research center), which is perhaps the best Cancer Treatment centre in the country, is collaborating with us on this subject. Generally, terminal patients are willing to opt for these trials. However we shall have to first get the results tested through small and large animal model, and then aim to do human trials within 3 years.

TCTD: What would be the impact of the project?

DB: If we can replicate the results in human trials, the impact would be unimaginable. Whosoever choses to carry on this work can become a billionaire when it succeeds but we must have patience while taking the research to completion.

TCTD: What would be your advice to budding researchers?

DB: The field of nanotechnology and cancer theranostics has a great potential. As I said before the sky is the limit. In this field all that one needs is Dedication, Patience and Perseverance. This is true for any other field too. Once you have these basic values just keep moving forward and don't look back. ■■■



Life in a Resource Constrained Community

Week-long field study on understanding challenges in rural Maharashtra

The Society for Education, Action and Research in Community Health (SEARCH), with a vision to empower youth to lead a purposeful life, is an NGO founded by Drs. Abhay and Rani Bang at Gadchiroli - a tribal dominated district in eastern Maharashtra. This NGO arranged a six-day workshop from 8 -13 December 2014, for the team from Tata Centre for Technology and Design at IIT Bombay to explore rural living, identify and understand local problems and attempt to find appropriate solutions.

The doctor couple are known to have revolutionized healthcare for poorest Indians, besides being social activists. The participants saw demonstration of their Home-Based Newborn Care (HBNC) Model that has resulted in 70% reductions in neonatal mortality rate and has been endorsed by WHO and UNICEF for roll out in Africa. The Fellows were sensitized about surgical care and clarifications on various aspects of adolescence. Dr. Abhay explained the development process of a Breath Counter to diagnose pneumonia, recognised as a chief source of Acute Respiratory Infections (ARI) in children under the age of five.

The participatory workshop started with the Fellows contributing Shramdaan which literally means donating one's hard work. The Fellows picked up sickles and spades and weeded out tall grasses and bushes early in the morning. Later they went on for their one-day village stay in various rural settlements dispersed around the SEARCH campus. "We stayed and dined in a tribal hamlet that had about forty households, a few ponds, rice fields and plenty of cattle (for farming and not for milk!). I stayed with a farmer-cum-village health worker who went door to door to treat people for malaria" says Gaurav Singh, one of the participants.

family members were busy through the day and women sometimes appeared overburdened, yet all seemed content. As we returned to SEARCH campus, I missed their hospitality despite their limited resource constraints. I realised that they had a strong sense of community feeling and led a frugal life", observes Umang Shah, one of the Fellows. Dr. Abhay also explained the Swabhav – Swadharm – Yugdharma (SSY) technique which helps in framing clear goals in one's life, lead the visitors to introspect about working towards causes of such social relevance. A documentary film focusing on farmers' suicides in Vidarbha was screened for the participants.



The group interacted with the Chief Conservator of Forests at Gadchiroli to learn about various forest based livelihoods of the tribal people. "While trekking in the forest jungles, we observed people being aware of local self governance and closely associated with forest produces like Tendu (*Diospyros melanoxylon*) leaves, bamboo, timber, Mahua (*Madhuca longifolia*) apart from farming. All the

The workshop concluded with groups of Fellows proposing solutions along themes of Energy, Access, Livelihood and Health. The workshop raised several questions; helped brainstorming and brought out several insights felt to be very relevant for the nature of projects that Fellows are involved in. ■■■