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TURNING POINT

Tata Centre for Technology and Design
IIT Bombay

Tata Centre Newsletter, January 2020

Special Edition

TCTD Yatra 2019 – A journey of discovery and empathy building

There was fun and togetherness through the TCTD Yatra, and we believe that these acts of kindness and selflessness that the Tata Fellows experienced will unknowingly sow the seeds of social change within themselves.

The TCTD Yatra has been a great learning experience not just for the Tata Fellows but also the faculty members and staff at TCTD, IIT Bombay. This most recent Yatra, the third one in succession, was an eight-day program in December 2019, and had the Fellows travel from Mumbai to Madurai, Hubbali and Goa. The trip exposed the Fellows and staff to the remarkable work being done in the various organizations across domains such as Aravind Eye Care in healthcare, Akshaya Patra Foundation in food, Deshpande Educational Trust in livelihoods, Kalkeri Sangeet Vidyalaya in education, SELCO in energy and Goa Waste Management Corporation in waste management.

The first visit was to Aravind Eye Care System, in Madurai, one of the largest eye care providers in the world. We got an opportunity to visit a local eye camp, visit the base hospitals (both paid and free

The Tata Fellows at Akshaya Patra Foundation, Hubballi

Scoring on hardware for telepathology

The telepathology project is a case study that has focused on the challenge of creating ultra-low cost hardware.

LAB TO MARKET CONNECT

The project – Development of a telepathology framework - has hardware and software components: the hardware itself requires an advanced understanding of concepts in optics, mechanical engineering, electronics, and software engineering, towards achieving micrometer-level precision in image capture. In addition, a tele/digital pathology experience has required secure data handling on a cloud platform, with pattern recognition features added on as desired by end users. Assembling together the relevant talent and working out precision manufacturing options while keeping to targeted cost ceilings have been among the major challenges of the project so far.

The engineering story reveals that the objective has been to reduce the cost of the product down by an order of magnitude, from more than Rs 1 crore to less than Rs 10 lakh; and sourcing of high quality but cheap components has been a real struggle. A few sites capable of precision manufacturing of the sort required here exist in the country but they cater primarily to MNCs' R&D efforts, and are not amenable to working with startups with limited budgets.

Having to work beyond these has forced the team to pick up higher skill sets, feels the faculty mentor. The hardware is currently ready for deployment. The software architecture has been developed in parallel, and is now capable of capturing data from the hardware and processing it to generate tissue scans of high quality. Once the tissue samples are digitized, remote centres could help with the reviewing the images and providing high quality diagnoses; equivalent to those that would be obtained by physically sending in tissue samples for analysis by an expert pathologist. The use of the scanner - called AeonScan - facilitates a rapid turnaround of a pathology diagnosis which could in extreme cases take more than a month, when initiated from a surgical procedure in a small town. The technology is being evaluated by the rest of the pathology ecosystem. Tests are currently being carried out by an expert pathologist at St John's Hospital, Bengaluru. St. John's is a referral centre for relatively rare conditions such as Hirschsprung's disease, a disease which affects neonates and requires surgical removal of nonfunctional parts of a newborn's intestine. The hospital is expected to help evaluate the efficacy of the pathology right from a rural health centre to the specialist tertiary care department. The Nazareth Hospital, in Meghalaya, is another that is about to test the telepathology framework. The Cachar Cancer Centre, in Silchar, is ready to test the framework for evaluation of Pap smear and liquid cytology samples, towards arriving at a diagnosis of cervical cancer.

Additionally, there are `things-to-do' with skilling of paramedics and working on the competence of local medical centres. The skilling set should ideally speak of a quality assurance system that ensures the samples are correctly processed so that the framework benefits from such digitization. This study could help evaluate the entire ecosystem using the digital pathology in the telemedicine framework. It could also encourage the use of the Pathology as a Service (PAAS), in Tier 2 and Tier 3 cities.

The solution developed has uses beyond healthcare, for example, in the identification of minute defects in other domains including microelectronics and on metal surfaces. This will also prompt the building of a business model that will target licensing the technology to multiple partners. The next challenge that the team is working on is on putting together a manufacturing base in or near IIT Bombay, towards fabricating several copies of the finished prototype.
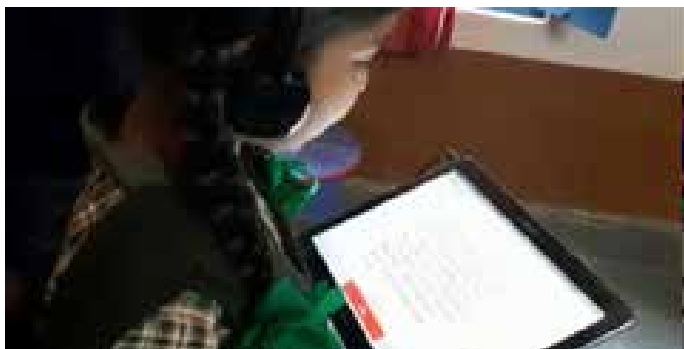
Team TCTD

The telepathology set up

Collaborating to assess spoken language fluency

The automated spoken language fluency assessment system has been trained and successfully validated on data collected so far.
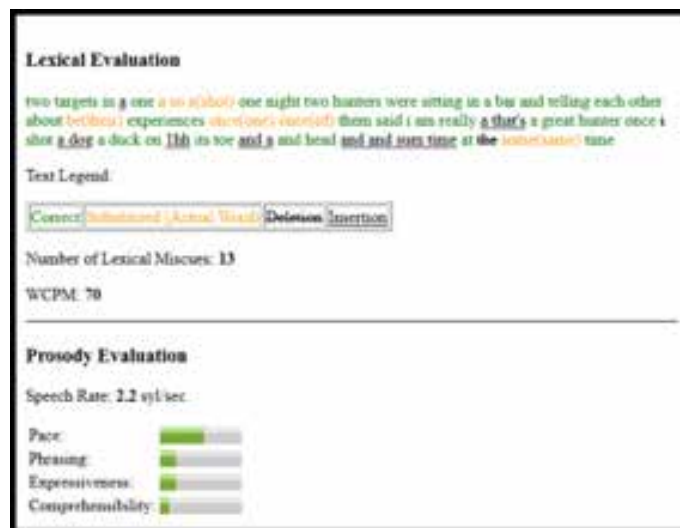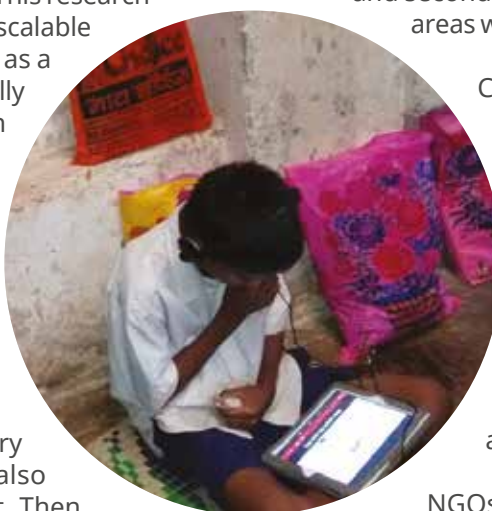
A Class 6 student recording a story in Bellaravada, Karnataka

An example report generated for a student

- An MoU discussion with Pratham for collaboration around a customized digital solution for automating the ASER test.
- A one-day pilot successfully conducted in Bellaravada, Hubli, Karnataka with the Deshpande Foundation Skill in Village team.
- Data collection exercise carried out with 30 children of Dosti Foundation School in Mumbra, near Mumbai.
- Field trials to be conducted in Navjyoti India Foundation (NIF) centers in New Delhi and Haryana soon.

These are some of the ongoing interactions that speak of the TCTD-funded Education project Automatically Assessing Spoken Language Fluency. This research project aims to provide an affordable, scalable technology solution that can be used as a literacy assessment tool while potentially providing feedback on pronunciation and fluency based on audio recordings of reading. Thus, struggling learners in low resource settings can benefit from a digital aid in the context of spoken language training in this project led by Prof Preeti Rao, Dept. of Electrical Engineering.

Presently, a system has been developed wherein the student can listen to a story (from a narrator) on a device and also read the story out loud and record it. Then automatic speech recognition, signal processing and machine learning algorithms are used to analyze the recorded speech and provide ratings based on standard rubrics such as the correct number of words spoken per minute (WCPM) as well as fluency attributes which predict how well the reader grouped words into phrases, paused at appropriate places and used expressive variation to convey the meaning effectively.

The content for reading is available in the form of story text displayed on a mobile device. The level of difficulty for reading can be customized from one line per page to paragraphs according to the reading ability of the student. Though the current focus of the project is English language, the developed methodology can be applied to vernacular languages as well. The current target audience is primary and secondary school students especially in rural areas with lack of exposure to spoken English.

Currently, field data collection has been initiated with the collaboration of IITB Campus School using a customized reading and recording app. Expert raters (retired English teachers) have been enlisted to provide feedback in specially designed interfaces. The system has been trained and successfully validated on the data collected so far (about 100 children). It is currently available as an API call for recorded audio uploads.

NGOs in remedial education have shown interest in the project. Efforts are on to collaborate with such teams to carry out pilots that involve field data collection and analyses on their selected populations to obtain the much needed feedback and validation to progress further towards a fully integrated system.

The project team

LAB TO MARKET CONNECT

Market tie-ups to reclaim waste sand

This TCTD project is tying up with two entrepreneurial entities to disseminate the technology among small-scale sand foundries, and help reclaim waste green sand.

In mid-2019, we last reported about field-testing the technology developed by the TCTD project – Process design for the reclamation of waste sand from small foundries. The project team led by Prof Gajananrao Jadhav, Dept of Earth Sciences & Engineering, and Prof Sanjay Mahajani, Dept of Chemical Engineering, has even better market connect news to tell.

The team has collaborated with a start-up to assess the techno-economic feasibility in the reclaiming waste green sand process, using the novel pilot plant built by IIT Bombay in Kolhapur, and the demonstration of the commercial aspects. This plant is expected to be used by local foundries and help them get partially or fully independent on the fresh sand and costs associated with them.

Furthermore, the project team will soon be shaking hands with another private limited company helmed by Dr Shashank Mandre, who has been associated with Government Polytechnic, Kolhapur, to initiate the capacity build-up of the developed technology. Incidentally, this academic institution has been assisting the TCTD project with its presence in Kolhapur for over three years now. Dr Mandre will now lead the entrepreneurial plan of commercialising the technology.

The focus of this TCTD project has been to help all small-scale sand foundries particularly those which reclaim only green sand. The existing solutions for sand reclamation in the market are designed with large scale (3-5 tonnes of waste sand per hour) foundries in mind. They are capital intensive with both thermal and mechanical reclamation facilities. From market assessment, there appears to be no product available in the market which can reclaim waste green sand and recycle purely as green sand.

TCTD's two-stage attrition device has ensured the quality of reclaimed sand at an economical rate and the quality of casting has also met the requirement of the foundry. The two-stage mechanical attrition device developed and patented successfully by the team has reduced the clay content from a whopping 12 per cent to 2.2 per cent. The cost of the reclaimed sand has turned out to be Re 1/kg, much less compared to the cost of fresh sand between Rs. 2.5 - 3.5/kg.

While these collaborations will help disseminate the developed technology widely in Kolhapur and across the other clusters as well, the project team is working on bringing some more effective solutions to the market where waste sand will be reclaimed thermally or chemically, and can also be used for making core in foundries.

Team TCTD

TCTD pilot plant for sand reclamation, commissioned at Govt. Polytechnic, Kolhapur

Molds are prepared using reclaimed sand

Commercial interest in the biogas scrubber

After successful field trials with the biogas scrubber, two organisations that have helped testing the prototype have shown interest in to commercialise the technology.

LAB TO MARKET CONNECT

The biogas scrubber

The biogas scrubber set up

The features of the biogas scrubber from the TCTD project - Compact efficient modular water based biogas scrubber – like modularity, no compressor requirement and high affordability have attracted a lot of interest after the field tests in 2019. After successful trials of scrubbing off the gases from 68 to 90 per cent, Prof. Milind V Rane and his team from the Dept. of Mechanical Engineering, are likely to transfer the technology to one of the organisations that has tested it. Grassroots Energy Technologies India Pvt Ltd, Bengaluru, is expected to be one of those to whom the upgraded version of the biogas scrubber will be licensed out shortly.

With the objective of scrubbing off the undesirable hydrogen sulphide and carbon dioxide from biogas and also attempting to make the process affordable and consume less power, the project team has developed a cost-effective, modular, and scalable rotating disk-based mass exchanging scrubber. The scrubber uses rotating contacting devices that enable high surface densities, thereby ensuring good contact between gas and water. This technique also enables the gas to pass through the scrubbing section without any pressure drop. All these features have helped the initial costs to be reduced significantly compared to conventional technologies. The team is working on the final version of the prototype at IIT Bombay, before it is handed over to the potential licensee.

This first prototype was sent to MSA Bioenergy, the bio-energy wing of Muni Seva Ashram, Vadodara (Gujarat), for successful field testing earlier. This entity has shown commercial interest in the upgraded version of the same technology. On approval, the technology is expected to be handed over to them too through another license agreement.

Team TCTD

Project-specific partnerships with MAVIM

Focussed partnerships have been entered into with MAVIM to help diffusion of technologies for two TCTD projects.

LAB TO MARKET CONNECT

Jaggery plant at Kolhapur

Gasifier setup in IIT Bombay campus

TCTD has initiated project-specific partnerships for two of its innovations – mobile jaggery units and gasifier based community cooking system – with Mahila Arthik Vikas Mahamandal (MAVIM), in late 2019. These innovations relate to the projects titled Feasibility study of jaggery making and related products and Gasifier based cook-stoves to manage garden waste respectively. The former project has been mentored by Prof Sanjay Mahajani, Dept of Chemical Engineering and Prof Narendra Shah, CTARA, while the latter is led by Prof Mahajani.

Facilitated under the Department of Women and Child Development of Government of Maharashtra, the project partner MAVIM focuses on grassroots institution building, microfinance services, enterprise development activities and women empowerment/social equity. Its work runs across 35 districts and 259 towns in the state, covering over 15 lakh women members from about 1.3 lakh SHGs. For both the mentioned Food & Agriculture and Waste Management projects, MAVIM will help in sharing the farmers' data and community mobilization activity, to help better diffusion of the technologies. Field projects in the districts of Kolhapur, Amravati and Yavatmal, in Maharashtra, have been undertaken.

For the diffusion of the mobile jaggery unit, a decentralised model has been proposed. In this model, the mobile jaggery unit goes to the farm and the sugarcane can then be used immediately after harvesting. The field trials of the mobile jaggery manufacturing unit are to be conducted through community managed resource centres (CMRCs)

and SHGs. It is envisioned that IIT Bombay will train the CMRCs and SHGs in production, packaging, storage of jaggery products during this season. Meanwhile, this TCTD project team's talks requesting external funding have reached an advanced stage.

For the diffusion of the gasifier-based community cooking, a model with the local and circular economy has been proposed. The gasifier will be located at and used by the Ashram schools for cooking applications. In this model, women SHGs will produce the fuel pellets required for the gasifier. For making the pellets, agro residue will be purchased from the local farmers. In this model, SHGs will earn income through employment. Ashram schools are expected to benefit with cleaner fuel and saving on costs eventually, and the farmers will get additional income for their agro residue. Proposals for external funding have been jointly developed and submitted to government organisations like Manav Vikas Mission and Integrated Tribal Development Program (ITDP) for end-to-end field demonstration.

Team TCTD

Cotton stalk for animal feed project secures external funding

FOOD & AGRICULTURE

The next phase of this Food & Agriculture project has secured external funding and has been making steady progress since October 2019.

A much-needed fillip has been received by the TCTD funded-seed project - Study of Pre-treatment (Bio-Chemical and Steam) of Cotton-stalks for Beneficiation as Animal-Feed – as it secured additional funding from the Government of Maharashtra, in 2019. Guided by Prof Madhu Vinjamur, Dept of Chemical Engineering, Prof Narendra Shah, CTARA, and Dr Suhas Zambre, in-vivo digestibility trials on small ruminants were conducted in Nagpur Veterinary College (NVC), as part of the seed project. An expected seasonal shortfall in April and May experienced every year has catalysed government support to feed the animals in those crucial months.

With a revision of the objective to study the effect of beneficiation on larger ruminants, the project team has secured a translational grant of Rs 1.6 crore from Rajiv Gandhi Science & Technology Commission (RGSTC), Maharashtra, in October 2019. This grant will support the pilot testing on larger ruminants at the Central Research Station (CRS) in Urulikanchan, near Pune. In this next phase, IIT Bombay will partner with NVC and BAIF to give training to goat rearing and milk rearing farmers, so that they benefit from such technology development. They are also expected to substantiate the findings from the seed project and bring in relevant benefits to both sets of farmers.

BAIF has significant presence in the animal husbandry sector, and in finding animals at identified farmers' sites. BAIF's role will involve helping to monitor weight gain, milk yield, ability to digest and user-friendliness of the newly developed animal feed products.

The students and faculty team from NVC have been involved with the team from TCTD, IIT Bombay, since the first phase of the project. This team will do the supplementary experiments of working with alternative roughages (using gram straw, tur chunni, cotton stalk) on small ruminants in Nagpur, and bigger ruminants in the facility at Urulikanchan.

The IIT Bombay team proposes to design the study, work out the specifications of equipment required for the setting up of the 2 tons/day plant, help set it up and participate in the interpretation of the results obtained through the demonstrations at NVC and Urulikanchan. The plan is to set up a 2 ton/day plant in the CRS facility, based on the pilot plant in NVC. The animal feed developed by this plant will be distributed among 30 dairy farmers. The feed given to the ruminants will be monitored for outcomes through this second phase - weight gain and milk yield per day. IIT Bombay will be the Coordinating Institute for this multi-institutional project.

Team TCTD

LAB TO MARKET CONNECT

Silverware – of powders, inks and pastes

We have silver powders, nanowires to inks and pastes for all your creative or engineering needs. Tell us what you need and we will have a solution...

Our current pursuit started with a project - Development of indigenous screen-printable silver paste for solar PV- making silver pastes for use in manufacturing of solar cells. Many of you would have noticed that the solar cells have these visible gridlines on its surface. Those gridlines are essentially current collectors which enable the collection of electrons or the power that we get out of the solar cells. These gridlines are printed using a very special silver powder based paste. This paste is printed on the solar cells using screen printing, essentially the same technique as used for printing designs on T-shirts or that used for making business cards. The silver paste is a significant fraction of the cost of the solar cells and it is our goal to make that paste locally in India to attempt to drive the cost of solar cells.

While working on these pastes for solar cell applications, we discovered that there are many more uses of silver starting from educational kits to crockery to antibacterial textiles and various kinds of circuits. We are able to make silver powders of different shapes, sizes as well as silver nanowires. And these powders can be utilized to make inks for making pens with which we can make electrically conducting lines on paper, textile etc. Children / hobbyists can use these pens for making simple circuits. We can make silver adhesives to make electrical connections in samples for research or repair circuits locally. We have also made pastes for making the underlying membranes that enable keyboards to function.

So essentially, we make silver powders, inks and pastes and can customize it to needs that you have or can imagine. One of the team members is soon going to be offering some of these products through a start-up. So please let us know of your needs!
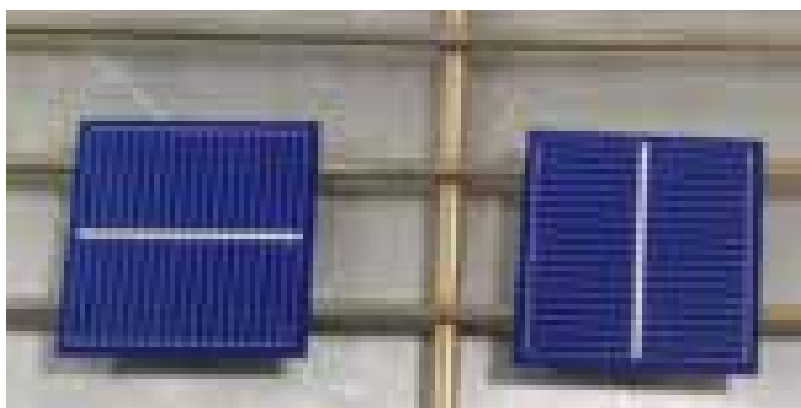
The project team

Silver nanowires

Silver powders
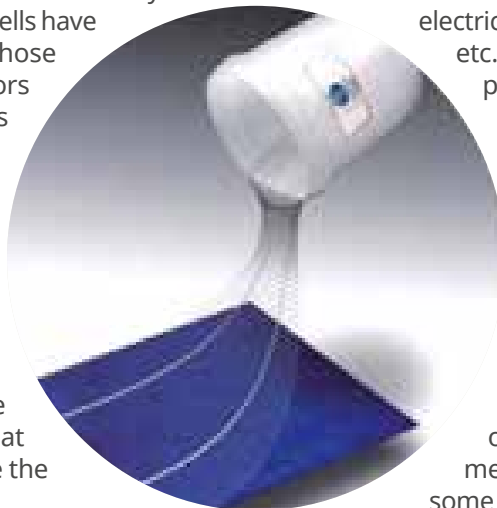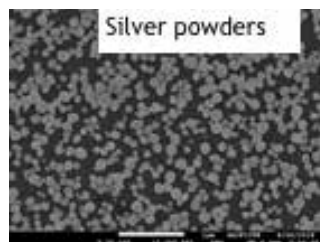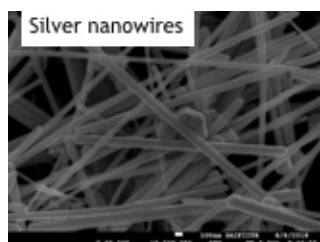
Screen printed conducting silver pattern

Screen-printable silver paste
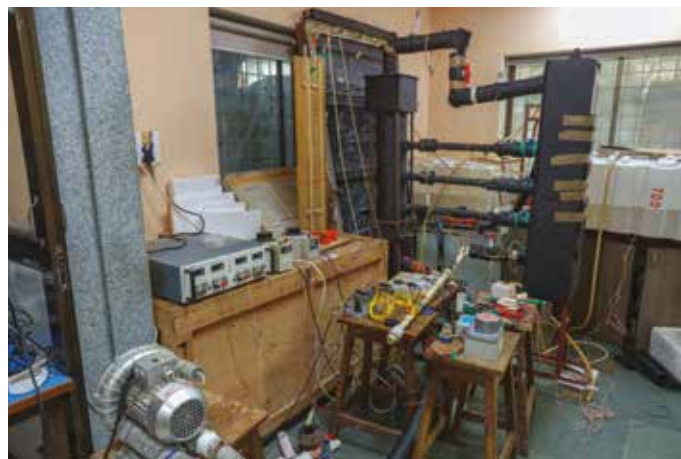

Solar cells made with our silver pastes

Field-testing the HDH desalination system

WATER

The features of the system's energy efficiency, modularity, no membrane requirement and high affordability have attracted a lot of interest.


Testing the humidifier

Lab prototype at work

LAB TO MARKET CONNECT

Several parts of India are under water stressed, water scarce or absolute water scarcity category owing to growing population and inefficient use of groundwater resources. Typical household solutions at remote locations seem to be water purification by boiling or reverse osmosis (RO). Another community-level solution seems to be transportation of purified water from nearby RO plant. These solutions are not dependable owing to many operational constraints. Solar driven humidification-dehumidification (HDH) desalination offers an elegant safe drinking water solution for off- and weak-grid locations because of its inherent advantages of sub-boiling operation, ability to handle high TDS water and membrane-free operation (hence, very low maintenance requirement).

Prof. Shankar Krishnan and his team from the Dept. of Mechanical Engineering developed a cost-effective, solar-driven, compact and modular HDH system. The HDH system utilizes a novel solar humidifier and dehumidifier components that enable energy efficient operation, ease of assembly and cleaning. The solar humidifier demonstrated allows integration of water and air heating as well as humidification in one unit. This technique also enables the air to pass through the humidifier section without an appreciable pressure drop. All these features have helped the initial capital costs to be reduced significantly compared to conventional technologies. The lab-scale system was found to successfully treat the water while ensuring ease of operation and lower operational costs.
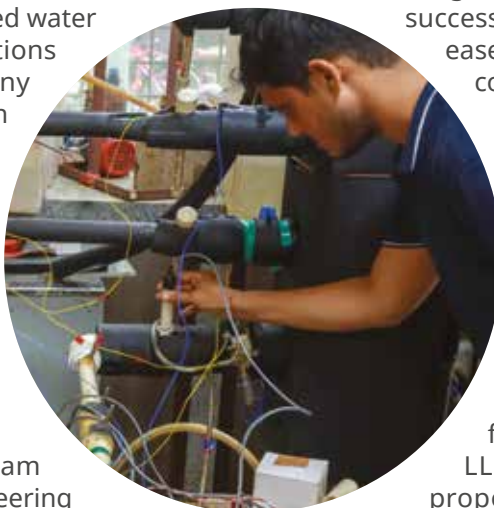
Following the success at lab scale, the IITB team is seeking partners for: (a) field testing, (b) manufacturing, to further reduce capital cost, and (c) commercialization via licensing.

The SELCO-India team has expressed interest in performing field trials and work is ongoing to for implementing field-trials. GreenPebble Technologies LLP and IITB team have submitted proposals to extend the technology for industrial wastewater treatment. The IITB team team is also, concomitantly, working on further improving energy efficiency and water production.

The project team

How Shall We Walk Together?

If we are to trust teachers to do what it takes to turn young lives around, *as we must*, then it behooves us to invest in their capacity as educators. If we are to offer quality education to our children, that they can avail of with zest and keenness, we must raise our sights from competitive (exam-oriented) learning to relative autonomy of and active engagement with content and method.

LAB TO MARKET CONNECT

"Let's walk to four different destinations during our next meet – a hill, a lake, a temple... and someplace else. We will find objects on our way, and become inspired by the surroundings to make sculptures at each destination. We could become characters in our own stories, along with the companions we find on our way." The most recent LETS workshop with art instructors (at the Agastya International Foundation in Kuppam, Andhra Pradesh) ended on this anticipatory note a few weeks ago (November 2019).

There were other thoughts and ideas that informed this interaction over five days: what do we describe, and what is it that describes us? How do we express that which fascinates us in what is around us? How do we creatively address what bothers us? These tangled threads unraveled through doodling, dialogue, and exercises in critical thinking, active listening, argument and interruption, laughter and disagreement. This was the fifth of our teacher workshops, and a new experiment in relaxing into idea generation and interchange rather than focusing on product creation or particular outcome.

This is important for many reasons, as we have come to learn through practice, failure, assessment of failure, and renewed practice. The first is that trained, respected, responsible teachers understand and exercise the advantage of autonomy and decision-making more easily, and are more likely to communicate then offer that advantage to students. The second, and perhaps more intransigent, reason is that in our country, interaction between urban and rural areas is made more tangled by the presence of hierarchies generated out of social and economic difference. Making such differences *phantasmal* rather than real demands self-conscious effort from all sides. Our workshop exercise is wedded to leveling these differences, and allowing collaboration to become in reality what it may mean in discourse.

A new experiment with teachers
Ideas, intent, and the making of a high-quality product

When talking about education in India we are often met with an array of distressing statistics. According to the Organization for Economic Cooperation and Development (OECD) report of 2019, the number of students per teacher in both primary and secondary schools in India is one of the highest among OECD and partner countries (24 to 37 per teacher). This crippling ratio is coupled with a lack of autonomy in pedagogical decision-making. Teachers are expected to adhere to strict, state-prescribed curricula and timelines, external inspections and evaluations, and a focus on numbers of students rolling out of class, then school, often with less than basic literacy and numeracy

Crowding around the interactive app at the village library in Kuppam

Don't need a stand at the village library in Kuppam

Seduced by The Monster and The Little Boy at the village library in Kuppam

skills (as the ASER or Annual Status of Education Reports show year after year). The larger idea of teaching children to learn how to learn, or preparing them for life (as any education should be obliged to do), is lost in the lamentation of the scale of the problem. We forget the human in the numbers.

Our workshops with teachers feed into LETS' intention of collaboratively creating content, as stated earlier, designing books (16, at last count), creating animation films based on those books (3 ready, and 3 actively in the making), reading, listening and telling stories to learn. And they do so by fostering autonomy and enthusiasm, supporting decision-making and disagreement, creating time and space for experimentation with and potential failure of new ideas in pedagogy and play amongst participants. There are no quick results, but many happy ones. The focus is on the human nature of learning and the social basis of education.

We know by now that any intervention using information and communication technologies (ICT) is fraught. As an OECD study showed (*"Students, Computers And Learning: Making The Connection,"* 2015), researchers were unable to discover any "appreciable improvement in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education". It also said that technology is of little help in bridging the skill-gap between advantaged and disadvantaged students, reminding us again of the role of the guiding hand. Teachers enable eagerness to learn, enhance confidence in a student to try and try again when faced with failure or challenged by a complex problem. So it is that our mobile app and animation films that aid reading, prosody, and pronunciation in books from the LETS repository become properly useful only when accompanied by the enthusiasm and commitment of a motivated teacher. It is in this spirit that we work with rural-school teachers and village libraries to create content, and to measure impact of the long-term use of the LETS app and books on English language proficiencies of participating students.

The app reads stories and allows children to interact with the analog book rather than the phone screen. It allows them to listen to stories they have told us in books they have drawn alongside their teachers and our design team. We have deployed mobile phones with stands, and multiple sets of books in ten village libraries in two states (Maharashtra and Andhra Pradesh) in November 2019. We will conduct this experiment for a period of three months, collecting data on frequency of use of specific books, number of page turns, repetitions, readings, and the impact of all this on language learning.

Conditions in village libraries almost always fall short of the exemplary. Low light situations abound even where power is sporadically available, forcing us to rethink our design to include a rechargeable lamp on the stand; roughhousing with stands compels experiments with new materials. Some rooms are too small; porches permit rain. And all of this mediates the opportunity for students to read their culture and their stories back into language – English, in this instance – to unshackle imagination and empower minds.

Thus shall we walk together.

Alka Hingorani and Jinal Sangoi

Independent use at the village library in Kuppam

Students undertstanding the process at eye screening camps - Aravind Eye Care, Madurai

Biggest Akshaya Patra kitchen, Hubballi

Patients waiting for their eye tests and check up - Aravind Eye Care, Madurai

Alert and awake - asking questions at Akshaya Patra at 6 am, after a late night debriefing session

Continued from Pg 1

sections), and see their manufacturing facility, Aurolabs. It was impressive to see how a social organisation has scaled up in three decades, without losing the core values of G. Venkataswamy, popularly known as 'Dr V', the founder and former chairman of Aravind Eye Hospitals. The Lions Aravind Institute of Community Ophthalmology which is the training and consulting arm of Aravind Eye Care System, shared the Aravind model and showed the Tata Fellows the various aspects of this social organisation. The Fellows saw that Aravind, with its mission to 'eliminate needless blindness', has been providing large volume, high quality and affordable care.

The cultural visits that interspaced the itinerary in Madurai included the Gandhi Memorial Museum and the Meenakshi temple where some students got adventurous by wearing dhotis. The south Indian cuisine was enjoyed thoroughly at the famous original Murugan Idli where we tried their signature dishes like Podi idli on banana leaves and Jigarthanda, a south Indian version of the Falooda!

From Madurai, we continued our journey to Hubballi. We visited the Akshaya Patra kitchen first, which is their largest kitchen cooking 14 tonnes of rice and 25000 litres of sambar every day!!! The Akshaya Patra Foundation is an NGO in India implementing the Mid-Day Meal Scheme. True to its vision of 'unlimited food for education' Akshaya Patra's largest kitchen, located in Hubballi-Dharwad, prepares daily meals for 185,000 children in less than five hours.

The energy was palpable and infectious with the Tata Fellows waking up at 5 am to start their session with loads of curious questions to learn more and see how this massive quantity of food was prepared in just five hours. We enjoyed the breakfast meal and could not get enough of the tasty and nutritious food! Thank you Akshaya Patra for not just feeding us but wholeheartedly feeding millions of hungry children, who get only one square meal a day.

The next visit was to this beautiful school with a difference, Kalkeri Sangeet Vidyalaya (KSV) - `A school for music and more'. This residential school provides education in academics and performing arts to children from socially and economically disadvantaged backgrounds.

Walking through this four acre plus serene campus, tucked in a dense forest, with cobb structures and classrooms, where 200 plus students were playing musical instruments or singing in rhythm in their classrooms, the chorus of the prayer by the kids before the meal put us all in a meditative trance. Post the meal, the entire place was bustling with children curious to know where we were from.

Musical bliss at Kalkeri Sangeet Vidyalaya

Mr. Vivek Pawar, CEO, Deshpande Foundation addressing the Fellows

Away from such energy, the Deshpande Educational Trust, a pioneering residential skill development organization, had the CEO, Mr. Vivek Pawar, giving us an overview of how they provided an ecosystem to nurture entrepreneur mindsets in order to impact the grassroot problems through innovation, collaboration and sustainability.

Meeting the entrepreneurs at the Sandbox Start-ups showed us the subsidized co-working spaces, board rooms and meeting rooms that were provided by the Trust. The Yuva entrepreneurship platform and the Edge program for teaching young start-ups were a lot of learning. With 77 start-ups working across a range of domains, we had the opportunity of interacting with quite a few interesting entrepreneurs.

The Navodyami setup seen helping micro-entrepreneurs expand their businesses, the visit to the Navalgund taluka for the farm ponds where we interacted with the farmers on the financial and social model of water conservation and the Skill in the Village program with Class 7 students presenting English conversations nonchalantly, were visits packed with information and interest.

The final day at Hubballi was spent learning about the application of solar interventions, facilitated by the SELCO Foundation. The Durga colony with solar panels enabling two bulbs in every home, the blacksmith blower site in Adargunchi village showing the blacksmiths use solar energy to run their equipment, a family taking wedding orders to make 1500 rotis a day with the solar panel installed on their terrace and the Vishwa Dharma Institute of Physically Challenged where the students had a solar-run

Fellows spending time with the children at Vishwa Dharma Institute of Physically Challenged

hostel lighting system, were all revelations in themselves. The IIT Bombay group was humbled to see how different quarters of the communities overcame their challenges through technology and optimise their applications.

The last leg of the Yatra was the visit to the Goa Waste Management Corporation plant. We were taken inside the plant where all the garbage was processed. While the processes inside had the technical features, the surroundings of this plant were quite pleasant with no trace of smell and bright with natural light and colorful flowers, trees, etc. This was because of the smart use of used coconuts to filter the air passed through the garbage. A meeting with the Commissioner of Goa, Mr. Sanjit Rodrigues, had questions and comments from the Fellows about the waste management effort in Goa.

Mr Sanjit Rodrigues, Head, Corporation of the City of Panaji (CCP) addressing the Fellows

The schedule was immersive and hectic with the days starting at 6 am and ending sometimes way past midnight. The visits had the Fellows interacting with inspirational change-makers, allowing them to share, debate and discuss ideas. Apart from the informative sessions, the Fellows got to try new cuisines, visit new places and also experience a crazy ATR-72 landing!

The Yatra gave us the opportunity to know of people and movements who actually worked towards creating social impact. The faculty members, Prof. Arti Kalro and Prof. Shishir Jha from SJMSOM, and Prof. Alka Hingorani, from IDC School of Design, constantly made us deliberate on issues like technology for social impact, creating sustainable models and more. They encouraged us to think of at least one change that we were going to decide to carry and imbibe in our lives.

Team TCTD

Testimonials...
The Tata Fellows speak..

TCTD Yatra 2019

TCTD Yatra 2019 was an engaging journey which helped us gain an innate understanding of the factors outside the lab affecting innovations.... Debriefing was a fun activity where we gained perspective of the scenario at ground zero through intense discussions, making it a thoroughly immersive experience.... Arun Jha

The most amazing experience of the trip was how these social enterprises were able to maximize the use of technology, work selflessly and still remain sustainable enough to scale up to have a maximum social impact.... Seera Vijaya Shalini

It was not just a Yatra, but a journey which brought about a sense of social responsibility. How simple ideas could bring gigantic changes in the world through pure vision and action!.... Acharan Jain

Kalkeri Sangeet Vidyalaya was the highlight. They have combined performing arts and academics in a rural setting for the under-privileged children so effectively.... Manoj Yadav

The Yatra showed the different challenges faced by the social organizations and ways in which they were able to tackle them. And the solutions were not just technical innovations but also managerial, financial and also social.... Prakalp Shandilya

TCTD Yatra was about people and places. It was an insightful experience and a perspective to look at the social issues and their solutions with a more humanitarian approach.... Sayali Khare

We met lots of enthusiastic people who changed our perception about education and life, and inspired us to do something for society. Such exposure ignites ideas in our minds.... Haridarshan Patel

It was a complete journey for young and vibrant innovators to start with, pave their way and reach out on their goals. This experience connected the people, places and innovations as a whole!... Akanksha Shrestha

What amazed me the most was how some simple, thoughtful ideas and innovations could completely alter the lives of so many. I hope, we also will be able to do our bit to change lives positively.... Alwin Thomas

The Yatra brought in a sense of social responsibility in each one of us. It helped us to understand the various challenges faced by the social enterprises. Aravind Eye Care and Kalkeri Sangeet Vidyalaya were the highlights.... Minu Martin

It was an eye-opening journey that awakened us to the fact that we as individuals need to change for the better before expecting change in others.... Satya Prakash Singh

An awesome experience, it made me to think out of the box. And more importantly, we learnt how to solve societal problems which is actually a problem for society.... Sudhakar Katiyar

I couldn't understand how to start giving back to society responsibly, and this is what I got to learn from the TCTD Yatra. We only have to give our small contributions to make a big impact.... Pawan Kannaujiya

It turned out as a complete package of learning in empathy, running a sustainable business, scaling up, rectifying problems through evidence-based management, and definitely triggered a sense to be more useful.... Shiwani Pareek

The Yatra gave us a wonderful and special experience to think out of the lab. How a small change in design and/or technology can change lives!.... Harsh Raaz

New appointments in the EC

A new Executive Committee has been appointed to help take the vision of Tata Centre forward.

The Executive Committee (EC) has played a significant role in the decisions and implementation of the objectives at TCTD, IIT Bombay. The team of faculty members from across disciplines at IIT Bombay has been involved in refining the program's structure over the years and taking decisions on all executive matters of relevance. Right from defining the Centre's mandate of working towards designing technology solutions for maximum social impact in resource-constrained communities to the execution of the action plans that have followed through regular discussion, the EC has brought in much value.

With Prof Santosh Noronha, Dept of Chemical Engineering, taking over as the new Professor-in-charge from October 2019, a new EC has been invited to help take the vision of the Centre forward. TCTD, IIT Bombay, looks forward to their involvement and welcomes their continued association.

TCTD
Executive Committee

Prof Alka Hingorani,
IDC School of Design

Prof Arti Kalro,
Shailesh J Mehta School Of Management

Prof Debjani Paul,
Dept of Biosciences & Bioengineering

Prof Kameswari Chebrolu,
Dept of Computer Science & Engineering

Prof Love Sarin,
Desai-Sethi Centre for Entrepreneurship

Prof Parag Bhargava,
Dept. of Metallurgical Engineering & Materials Science

Prof Sanjay Mahajani,
Dept of Chemical Engineering

Prof Santosh Noronha,
Dept of Chemical Engineering

Prof Shireesh Kedare,
Dept of Energy Sciences & Engineering

Prof Shishir Jha,
Shailesh J Mehta School Of Management

Prof S Srinivas,
Dept of Energy Sciences & Engineering

Patents

TCTD, IITB has had a fair share of projects that have applied for patent disclosure.

■ Education   ■ Energy   ■ Food & Agriculture   ■ Healthcare   ■ Waste Management   ■ Water

01. **Project: Low power transceiver for wireless communication**
Faculty: Prof Jayanta Mukherjee, Electrical Engineering Department
Domain: Energy
Patent applied for Low power, off-chip inductor-less MICS band receiver

02. **Project: Development of Advanced Dark Colour Cool Roof Coatings**
Faculty: Prof Anand S Khanna, Metallurgical Engineering & Materials Science
Domain: Energy
Patent applied for A water based system for concrete substrates

03. **Project: Development of Advanced Dark Colour Cool Roof Coatings**
Faculty: Prof Anand S Khanna, Metallurgical Engineering & Materials Science
Domain: Energy
Patent applied for A solvent-based system for metal roofing substrates

04. **Project: Through the earth communication for underground mines**
Faculty: Prof Ashutosh Patri & Prof Jayanta Mukherjee, Electrical Engineering Department
Domain: Energy
Patent applied for Hybrid Communication System for Underground Mines

05. **Project: Hemosorb-Haemostatic dressing for trauma care**
Faculty: Prof Rohit Srivastava, Department of Biosciences and Bioengineering
Domain: Healthcare
Patent applied for Hemosorb–haeomstatic dressing

06. **Project: Cervical Cancer Screening**
Faculty: Prof Santosh Noronha, Dept of Chemical Engineering
Domain: Healthcare
Patent applied for Menstrual cup inserter

07. **Project: Process design for the reclamation of waste sand from small foundrie**s
Faculty: Prof Gajananrao N Jadhav, Dept of Earth Sciences & Prof Sanjay Mahajani, Dept of Chemical Engineering
Domain: Waste Management
Patent applied for Multi stage attrition device for reclamation of waste foundry sand

08. **Project: Process design for the reclamation of waste sand from small foundries**
Faculty: Prof Gajananrao N Jadhav, Dept of Earth Sciences & Prof Sanjay Mahajani, Dept of Chemical Engineering
Inventors: Moiz Mohd Khan, Manvendra Singh
Domain: Waste Management
Patent applied for A method and device for reclaiming green waste foundry sand

09. **Project: Humidification-Dehumidification Desalination System**
Faculty: Prof Shankar Krishnan, Dept of Mechanical Engineering
Inventors: Pankaj Avhad
Domain: Water
Patent applied for Low Temperature Desalination System

10. **Project: A mobile phone microscope with applications in point-of-care diagnostics and health education**
Faculty: Prof Debjani Paul, Dept of Biosciences & Bioengineering
Domain: Healthcare
Patent applied for A Mobile Phone Microscope

11. **Project: Developing CAR-T cell technology platform for cancer immunotherapy**
Faculty: Prof Rahul Purwar, Dept of Biosciences & Bioengineering
Domain: Healthcare
Patent applied for Methods and compositions for treatment of CD19+ cancers using anti CD19 CAR constructs

12. **Project: Gasifier sased cook-stoves to manage garden waste**
Faculty: Prof Sanjay Mahajani, Dept of Chemical Engineering
Inventors: Dr Sonal Thengane, Prabodh Gadkari
Domain: Waste Management
Patent applied for Downdraft Gasification Assembly for High Ash Biomass Feedstock

13. **Project: Enabling livelihood generation in tribal & marginal farmers through a commercialization project on utilization of agro residues to grow edible mushrooms**
Faculty: Prof Sanjay Mahajani, Dept of Chemical Engineering
Inventor: Chandrakala Sharma
Domain: Food & Agriculture
Patent applied for Development of an efficient protocol for Oyster Mushroom Cultivation in rural areas

14. **Project: Feasibility study of jaggery making and related products**
Faculty: Prof Sanjay Mahajani, Dept of Chemical Engineering
Inventor: Prof Sanjay Mahajani
Domain: Food & Agriculture
Patent applied for An apparatus for moulding deformable materials

15. **Project: Feasibility study of jaggery making and related products**
Faculty: Prof Sanjay Mahajani, Dept of Chemical Engineering
Inventor: Prof Sanjay Mahajani
Domain: Food & Agriculture
Patent applied for An Apparatus for Crystallizing Sucrose Present in Jaggery Syrup

16. **Project: Design of puncture proof tires and tubes**
Faculty: Prof Mahesh Tirumkudulu, Dept of Chemical Engineering
Inventor: Prof Mahesh Tirumkudulu
Domain: Energy
Patent applied for A Thermally Stable Tire Sealant

17. **Project: Development of household or community composting system for food waste recycling**
Faculty: Prof Anurag Garg, Centre for Environmental Science & Engineering
Domain: Waste Management
Patent applied for Rotary Drum Composting System for Household Wet Biodegradable Waste Stabilization

18. **Project: Evaluation of the performance of traditional seed storages and design and development of seed storage system for community level seed banks and marginal farmers**
Faculty: Prof Narendra Shah, CTARA; Prof Upendra Bhandarkar, Dept of Mechanical Engineering
Domain: Food & Agriculture
Patent applied for Design and Development of a decentralized seed storage unit

19. **Project: TCTD Chemplay**
Faculty: Prof. Sanjay Mahajani, Dept of Chemical Engineering; External faculty - Dr Nitin Bhate, Dr Pradnya Gokhale, Mrs Shalini Kumar
Domain: Education
TCTD CHEMPLAY, a kit designed to teach important concepts in Chemistry
in a play-way manner, is published under a CC BY-NC-ND license.

20. **Project: LETS Learn English Through Stories**
Faculty: Prof. Alka Hingorani, IDC School of Design
Domain: Education
A series of books that facilitate English language learning (LETS) using stories and illustrations that emphasize self-learning and co-creation, is published under a CC BY-NC-ND license.

21. **Project: Translation to pre-clinical and clinical trials of low cost bone and near net shape graft for Dental and orthopedic bone reconstruction**
Faculty: Prof Jayesh Bellare, Deepak Gupta and Atul Kumar Singh, Dept. of Chemical Engineering
Domain: Healthcare
Patent applied for 3D-Printing of scaffold constructs for patient-specific regenerative medicine and in vitro disease models.

22. **Project: Collaboration through designers and craft communities**
Faculty: Prof Nina Sabnani, IDC School of Design
Domain: Education
The Centre-funded movie `Hum Chitra Banate Hain' or `We Make Images' was awarded the National Award for the Best Animation Film in the non-feature films category at the 64th National Film Awards for 2016, from the then President of India. This movie also won much critical acclaim and accolades at different national and international events, and many other film festivals.

23. **Project: A digital aid for language (Hindi) teaching and learning**
Faculty: Prof Malhar Kulkarni, Dept of HSS; Prof Pushpak Bhattacharyya, Prof Preethi Jyothi, Dept of CSE; Prof Aniruddha Joshi, IDC School of Design
Domain: Education
Patent applied for Hindi Shabdamitra - a digital aid for language learning and teaching.

24. **Project: Detection and sensing of arsenic in drinking water**
Faculty: Prof Rajdip Bandhyopadhyaya, Dept of Chem Engg
Domain: Water
Patent applied for Methylcobalamin functionalized gold nanoparticles as a novel nanocomposite material for detection and measurement of arsenic in water.

25. **Project: Development of a point-of-care test for the detection of pathogens causing urinary tract infections**
Faculty: Prof Rinti Banerjee, Dept of BioSciences and Bioengineering
Domain: Healthcare
Patent applied for A Substrate For Entrapment And Detection Of Bacteria, Process for its Preparation And A Point of Care.

26. **Project: Spoken language training on mobile device**
Faculty: Prof Preeti Rao, Dept. of Electrical Engineering
Domain: Education
Patent applied for Automatic Assessment of Prosodic Fluency from Recorded Speech

27. **Project: Value addition of cashew apple through processing and preservation**
Faculty: Prof Amit Arora, Centre for Technology Alternatives for Rural Areas (CTARA)
Domain: Food & Agriculture
Patent applied for Development of a nutrient dense-low tannin cashew apple-based beverage blend

28. **Project: Feasibility study of jaggery making and related products**
Faculty: Prof Sanjay Mahajani, Dept of Chemical Engineering
Inventor: Prof Sanjay Mahajani
Domain: Food & Agriculture
Patent applied for A non-chemical process for highly crystalline powder jaggery

29. **Project: Feasibility study of jaggery making and related products**
Faculty: Prof Sanjay Mahajani, Dept of Chemical Engineering
Inventor: Prof Sanjay Mahajani
Domain: Food & Agriculture
Patent applied for Solvent-assisted reactive chromatography for ketalization reactions

30. **Project: A digital aid for language (Hindi) teaching and learning**
Faculty: Prof Malhar Kulkarni, Dept of Humanities and Social Sciences
Inventor: Prof Malhar Kulkarni, Prof Pushpak Bhattacharyya, Prof Preethi Jyothi and Prof Aniruddha Joshi
Domain: Education
Trademark applied for "Shabdamitra", "Sanskrit Shabdamitra", "Hindi Shabdamitra" (both word and logo) and "Marathi Shabdamitra"

31. **Project: Humidification dehumidification desalination system**
Faculty: Prof Shankar Krishnan, Dept of Mechanical Engineering
Domain: Water
Patent applied for Direct contact heat and mass transfer apparatus and desalination method

32. **Project: Development of multisensory technique for intervention of developmental dyslexia: An electrophysiological and behavioural approach**
Faculty: Prof Azizuddin Khan, Dept of Humanities & Social Sciences, and Prof. Abhishek Gupta, Dept of Mechanical Engineering
Domain: Healthcare
Patent applied for Development of Multisensory technique for intervention of developmental dyslexia

33. **Project: Development of a Telepathology framework**
Faculty: Prof Santosh Noronha, Ms Serena D'souza, Dept of Chemical Engineering, and Prof. Irishi N Namboothiri, Dept of Chemistry
Domain: Healthcare
Patent applied for Use of benzopyrone and its derivatives for the estimation of pyridine alkaloids

34. **Project: Development of a Telepathology framework**
Faculty: Prof Santosh Noronha, Ms Serena D'souza and Ms Neha N. Kuvelkar, Dept of Chemical Engineering and Dr. Usha Kini from St. John's Medical College, Bengaluru
Domain: Healthcare
Patent applied for Diagnosis of gut motility disorders

A patent granted

We at TCTD, IIT Bombay are happy to update that the patent application of the funded project Dark colored cool roof coatings has been granted and recorded in the Register of Patents, in mid-October 2019. The patent certificate has also been handed over to the Institute. This project has been led by Prof. Anand S Khanna along with Dr Narayanan Rajagopalan and Dr Vikram Singh from the Dept of Metallurgical Engineering & Materials Science. For Tata Centre, this has been the very first innovation that has been granted patent status and will now move closer to the communities, in the end to end innovation cycle.

Immersive learning at TCTD, IIT Bombay

External students at a Need Assessment workshop at TCTD, IIT Bombay

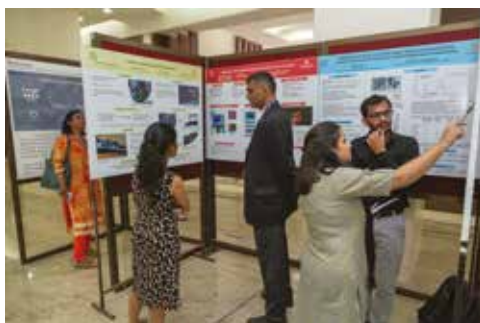Interacting with the Tata Fellows

TCTD Staff Retreat

A Tata Fellow interacting with international student visitors

Bidding farewell to the Tata Fellows

Building a prototype

Demonstrating TCTD projects at a local symposium

Brainstorming during an I-NCUBATE program

Discovering fabrication in the Product Realisation Lab

The Professor-in-charge interacting with TEQIP participants

I-NCUBATE and IDEAS program

Prof Parag Bhargava at a science workshop in JRD Tata School, Akola

A Tata Fellow presenting to visitors about a TCTD project

The Tata Fellows' special presentation at TCTD Symposium 2019

Workshops at JRD Tata School, Akola

A workshop on Waste Management

A panel discussion at TCTD Symposium 2019

Project teams explaining the prototype and the vision

Listening to the panelists at a Waste Management workshop

Ms Almitra Patel, at TCTD Symposium 2019

Monash University students visiting the Centre

Brainstorming on grand challenges in Waste Management

At the posters exhibition, TCTD Symposium 2019

Approved new project proposals

1. Project Title: Early warning solutions for low cost economies
PI: Prof Santosh Noronha
Dept. of Chemical Engineering

Disaster Management/Housing

-
2. Project Title: Sustainable housing solutions for flood-prone areas: Case study- Kuttanad region, Kerala
PI: Prof N C Narayanan
Co-PI: Vitasta Raina (External)
CTARA

Housing/Disaster Management

-
3. Project Title: Development of solar powered on-farm micro cold storage system
PI: Prof Amit Arora
CTARA
Co-PI: Prof Milind Rane
Dept of Mechanical Engineering

Food & Agriculture

-
4. Project Title: Development of a minimally intrusive passive assistive device (MIHELP) for giving mobility assistance to elderly people
PI: Prof Anirban Guha
Dept of Mechanical Engineering
Prof Neeta Kanekar
Dept of Biosciences and Bioengineering

Healthcare

-
5. Project Title: Smart warehouse
PI: Prof Santosh Noronha
Dept of Chemical Engineering

Food & Agriculture

News & Updates

Revised structure for ProSeminar
The ProSeminar courses MNG 629 and 630 and CL 724 have been restructured to ensure that there is scope for both perspective & skill building approach. The courses will enable the MTech and PhD Tata Fellows and non-Tata Fellows taking the course up as electives to get a 'working' perspective on development issues at the Bottom-of-the-Pyramid across various domains, unpack the assumptions they bring to the field of development as well as learn different problem-solving approaches and research designs (both qualitative and quantitative) for need identification and need validation, understand broad frameworks used in social organisations, apply the conceptual knowledge learnt in the Pro-Seminar on real-time projects and formulate a scholarly reporting style and learn effective communication skills in project presentations. Sessions will be in the form of class lectures, activities, videos and so on. The module of MNG 629 is scheduled to start with the academic session, this January.

CEP workshop on End-to-End Innovation in February

The first workshop for the year on End-to-End Innovation is scheduled in early February. After successful workshops in 2019, this program will again look at interest from faculty members of engineering colleges across the country. This course is working out to be a perfect combination of theory and fabrication elements, and thus sets the tone for an innovation ecosystem across disciplines.

Monash students' workshop at TCTD, IIT Bombay

TCTD conducted a half-day session on Need Assessment as part of the Seminar on Sustainability and Innovation for the Global Immersion Guarantee program, for undergraduate students from Monash University. Scheduled in November 2019, the aim was to introduce students to the defining of a need in order to develop a problem statement, drawing on some of the case studies and examples that the TCTD has supported, over and above discussing issues around sustainability of developed innovations.

A similar workshop is scheduled for another batch of undergraduate students from the same academic institution, in early January.

New website for TCTD

TCTD, IIT Bombay, now has a new website, updating itself with its changed brand identity. The features are improved and structured, to give a comprehensive overview of the Centre's activities. To access the new website, you can log onto **www.tatacentre.iitb.ac.in**
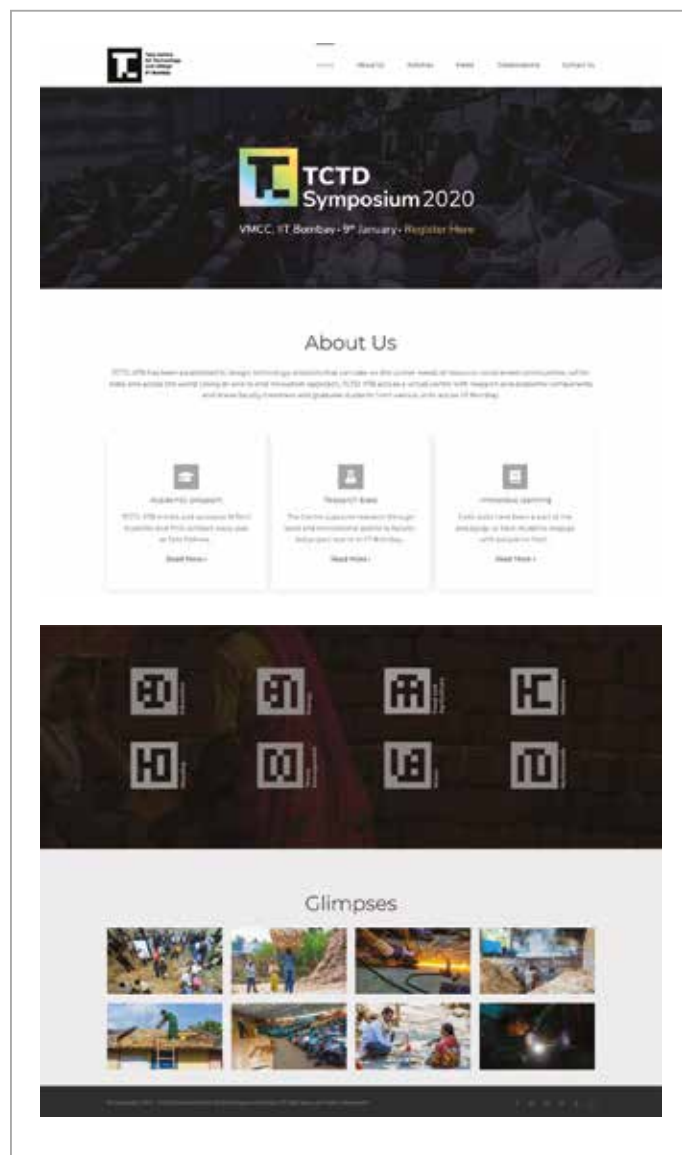
TCTD
Symposium 2020

9th January 2020
VMCC Auditorium, IIT Bombay

Agenda	Take Ideas to Scale

TIME   EVENT

08:30 am   Registrations

09:00 am   Welcome address

09:30 am   Defining an ecosystem to step up innovations
A talk by **Hemant Luthra**

10:15 am   How challenging is scaling up?
A conversation with **Deepak Satwalekar**

11:20 am   Garnering resources to scale up
A panel discussion with **Saurabh Nigam, Priya Naik, Pallavi Tak, Mangesh Wange**

01:30 pm   Posters & prototypes presentation

03:45 pm   Moving Ideas to Market – Talking of successful and failed models
A panel discussion with **Shraddha Joshi, Sharad Bansal, Urja Shah, K Thyagrajan**