



# INDIAN NATIONAL ACADEMY OF ENGINEERING

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## INAE Monthly E-News Letter Vol. VII, Issue 3, March 1, 2016

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### From the Editor's Desk

#### Two Observations

Observation 1: The ability to discover the ability of others is not easy. Often assessment results are effective indicator of a person's achievements and future outcomes. The assessment system usually tries to find out if the assessee knows or doesn't know. It tells us if one has 'arrived', but it doesn't tell us whether the persons who haven't arrived are on their way. This has prompted the development of technology-based assessment tools with the support of experts in diverse areas such as cognitive and developmental psychology, educational technology, neuroscience, and education policy. The design of the tools takes into account the three legs of assessment: cognition (how students develop and represent knowledge), observation (tasks or situations that allow one to observe students' performance), and interpretation (method for making sense of the data). We recognise that it is time to make the move to change the assessment approach in the education system. We also understand the need to move cautiously as there are logistic and funding challenges.

Observation 2: I often wonder how many of us would have done PhD if it was not a requirement for a position or a promotion we were aspiring for, particularly in the scientific and academic fields. Many say, 'surplus schooling' often is quite unproductive. In some countries the 'disposable academics' are considered 'the ugly underbelly of academia', because many of them can't be suitably employed. In our country it is necessary to recognise that more than the number, the quality of PhDs produced is important. It is well known that unlimited production dilutes the quality of PhDs by pulling less able individuals into the system. Maybe some kind of 'academic production control' is necessary. On the other hand, among the reasons assigned for not doing PhD in India are too much time required, too many pre-PhD courses to clear, low market value, and uninspiring supervisors. Some supervisors, however, are too 'inspiring'; they don't hesitate to supervise more than a dozen PhD students at a time. Developing independence is a crucial step to become an investigator. In other words, many recommend some non-academic training for PhDs. They believe courses in marketing, communication and leadership are useful for a scientist alongside academic acumen of critical thinking and analysis. An issue that needs consideration is how to 'trample the boundary' among scientific disciplines, because of the emerging trans-disciplinary nature of science and technology.



**Purnendu Ghosh**  
Chief Editor of Publications

### ACADEMY ACTIVITIES

#### Academy Announcements

##### Recent Dispatches from INAE Secretariat

- The Nomination Forms have been sent to the INAE Fellowship seeking nominations for election of Fellows and Foreign Fellows. The last date for receipt of nominations for Fellowship is March 31, 2016 and for Foreign Fellowship is May 31, 2016.
- Nominations have been invited for INAE Young Engineer Award 2016 and Innovative Student Projects Award 2016.

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- Nominations have been invited for INAE Young Engineer Award 2016 and Innovative Student Projects Award 2016.
- Nominations have been invited from the Fellowship for Life Time Contribution Award in Engineering; Prof Jai Krishna and Prof SN Mitra Memorial Awards and Outstanding Teachers Award. The last date for receipt of nominations is May 15, 2016.

The nominations for the above are requested from the Fellowship. In case the above forms have not been received, the same may be downloaded from INAE website [www.inae.in](http://www.inae.in) and sent to the INAE Secretariat within the stipulated dates.

#### **Creation of Data for INAE Expert Pool**

- INAE expert Pool has been created with the aim of identifying domain experts in various disciplines of engineering. The creation of this pool was discussed in the recent meetings with DST and Technology Information, Forecasting and Assessment Council (TIFAC). During the meetings, it has been decided that the domain experts from the Expert pool would be identified and selected for initial peer review by a group of experts for screening and assessment of the project proposals received by DST and TIFAC, from time to time. In addition, the Fellows would also be identified from the Expert Pool to form part of the Project Monitoring Committees (PMC), for projects sanctioned under the aegis of DST and TIFAC. Similar efforts are ongoing for further utilization of the INAE Fellows as domain experts in ongoing programmes of national importance. A letter from Dr BN Suresh, President, INAE had been forwarded sometime back to all Fellows and Young Associates to upload their particulars on the link for the INAE Expert Pool. The INAE Fellows and Young Associates who have not uploaded their particulars are requested to submit their profile details online at the link <http://inae.in/expert-search/index.php/inae-members-form>.

#### **INAE Chennai Local Chapter**

INAE Local Chapter at Chennai has been activated under the Chairmanship of Prof Bhaskar Ramamurthi, Director, Indian Institute of Technology Madras. Prof. BS Murty, Head, Department of Metallurgical & Materials Engineering, IIT Madras is the Honorary Secretary of the INAE Chennai Local Chapter. INAE Chennai Local Chapter along with INSA Chennai Chapter and IIT Madras organized a talk on “Linking Agriculture with Nutrition and Health” by Prof MS Swaminathan, Founder Chairmen and Chief Mentor, UNESCO Chair in Ecotechnology, MS Swaminathan Research Foundation on Feb 10, 2016 at IIT Madras, Chennai. All INAE Fellows in and around Chennai were invited to attend the talk.

#### **Book titled “Mind of an Engineer”**

The book – The Mind of an Engineer – is an initiative of INAE. It is a reflection of the experiences of some of the Fellows of the INAE in the field of science, technology and engineering. The book is about the reminiscences, eureka moments, inspirations, challenges and opportunities in the journey the professionals took toward self-realization and the goals they achieved. The book contains 58 articles on diverse topics that truly reflect the way the meaningful mind of an engineer works. The e-version of book titled “Mind of an Engineer” published by M/s Springer which contains articles written by INAE Fellows on their personal experiences and career paths leading to their success as

eminent engineers of the country; was released by the Chief Guest, Mr Sajjan Jindal during the Annual Convention of Academy at Pune on 10th December 2015. A complimentary copy of this book has been recently sent to all the Fellows of INAE.

**Report on “Development of Scientific Recycling in India and the Role of Research and Development”**

The report on “Development of Scientific Recycling in India and the Role of Research and Development” based on a study sponsored by the office of the Principal Scientific Advisor to the Government of India has been brought out recently. The issue of environmentally friendly disposal of end of life vehicles has assumed center stage consequent to the deteriorating air quality in our cities and judicial pronouncements limiting the age of vehicles. These issues have been duly addressed in the report which deals with R&D required on disposal of rubber and plastics and reduction of recycling residues, which are very important in the long run for India. The Principal Investigator of this study was Captain NS Mohan Ram, FNAE who presently chairs the recycling group of the Society of Indian Automobile Manufacturers (SIAM). The co-investigators of the study were Dr. Basudam Adhikari of IIT Kharagpur and Mr. Sugumar, Deputy Director and Head of the Central Institute of Plastics Engineering & Technology (CIPET) Chennai. The report has resulted in pertinent, actionable, recommendations on automotive recycling in general and also generated specific recommendations on the methodologies for disposal of rubber, plastics and auto shredder residues.

**Meeting with Niti aAayog**

A delegation of INAE led by Dr. BN Suresh, President, INAE met Dr. VK Saraswat, Member, Niti Aayog on June 10, 2015. Dr. Saraswat welcomed the suggestions from INAE and reiterated that Niti Aayog would like to work with INAE in the fields identified at national level. Some of the immediate areas of concern discussed are **Solar Energy; Manufacturing in Electronics Sector; Machine Tool Manufacturing and Manufacturing of Magnets**. A meeting with Dr VK Saraswat and selected experts from INAE is being held on March 4, 2016 to take this forward.

**Academia Industry Interaction**

***AICTE-INAE Distinguished Visiting Professorship Scheme***

Industry-academia interactions have become essential with the world over technological changes in recent times which can impart relevant knowledge to the students in the engineering institutions that would be sustainable in the changing conditions. While industries could gain by using the academia’s knowledge base to improve the industry’s cost, quality and global competitive dimensions; thereby reducing dependence on foreign know-how and expenditure on internal R&D, academics benefit by seeing their knowledge and expertise being fruitfully utilized practically and also by strengthening of curricula of educational programs being offered at engineering colleges/institutions. INAE together with All India Council for Technical Education (AICTE) launched “AICTE-INAE Distinguished Visiting Professorship Scheme” in 1999. Under this scheme, Industry experts are encouraged to give a few lectures in engineering institutions. This scheme has become popular among industry experts as well as engineering colleges.

Brief details pertaining to recent visits of industry experts under this scheme are given below.

<p>Dr. Manish Roy Scientist 'F', Defence Metallurgical Research Laboratory, Kanchanbagh,</p>	<p>Indian Institute of Engineering Science and Technology, Shibpur  Jan 11-12, 2016</p>	<p>Delivered lectures on “Heat Treatment of Steel for Tribological Applications” and “Tribocorrosion of Ti alloys in Physiological Solution”. According to the feedback from the college, the scheme is excellent as it gives an opportunity for the visiting industry expert to share his expertise with academic experts and also helps academicians to work on problems with practical</p>
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		and industrial relevance. The scheme also benefits post graduate and doctoral students through interactions with the industry expert and gives them exposure to industrial problems. It also helps to fine tune existing curriculum and introduce new courses of industrial relevance.
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### **International Conferences/Seminars being organized by IITs/other Institutions**

To view a list of International Conferences/Seminars being held in the month of March 2016 [click here](#).

### **News of Fellows**

1	Prof Debabrata Das, Department of Biotechnology and Professor-in-Charge, PK Sinha Centre for Bioenergy, Indian Institute of Technology Kharagpur has been selected for the for the International Association for Hydrogen Energy (IAHE) Fellowship for the year 2016; for his contributions to research and development in hydrogen energy, including biological hydrogen production. The Fellowship Certificate will be presented at the World Hydrogen Energy Conference (WHEC) 2016 to be held on June 13, 2016 at Zaragoza, Spain. Prof Das has also authored two books viz. "Biohydrogen Production: Fundamentals and Technology Advances" published by CRC Press and "Algal Biorefinery: An Integrated Approach" published by Springer.
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2nd International Conference on Sustainable Energy and Built Environment on March 10-12, 2016 at Vellore

<http://www.conferencealerts.com/show-event?id=162486>

International Conference on Innovative Trends in Mechanical Engineering on March 10-12, 2016 at Pune

<http://www.conferencealerts.com/show-event?id=164559>

Second IEEE International Conference on Engineering and Technology (ICETECH'16) on March 17-18, 2016 at Coimbatore

<http://www.conferencealerts.com/show-event?id=161574>

International Conference on Innovative Research in Civil, Computer Science, Information Technology, Mechanical, Electrical and Electronics Engineering (CIME-2016) on March 19-20, 2016 at New Delhi

<http://www.conferencealerts.com/show-event?id=164384>

International Conference on Recent Advances in Communication, Electronics and Electrical Engineering on March 25-26, 2016 at Greater NOIDA

<http://www.conferencealerts.com/show-event?id=163560>

## ENGINEERING EDUCATION AND SUSTAINABLE DEVELOPMENT



R Natarajan

Engineering Education has in the recent past undergone a major transformation across the world in highlighting *Outcomes-based Education* and is driven by corresponding Accreditation imperatives. The National Board of Accreditation Graduate Attribute # 7 on *Environment and Sustainability* prescribes the need to “understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development”.

While the importance of *Sustainability* is gaining in importance, there is no generally accepted definition of the term. Those who support the concept disagree in its precise meaning; while those who do not support it, agree that it has no meaning at all! There is also no widely recognized way to measure it.

*The Imperatives of Sustainable Development:* There is no alternative to Sustainable Development; it is already too late; we need to stop current trends; we need to do things differently, and to do different things. Over millennia, we have moved from survival economy and lifestyles to consumption economy and lifestyles. We need to move from consumption economy and lifestyles to conservation and preservation economy and lifestyles.

There are many dimensions of Sustainable Development: Each alphabet opens up opportunities and possibilities. For example, with the letter *E* we have Energy, Education, Environment, Efficiency, Ecology, Emissions, Economy, Employment, Equity, Engineering, Earth, Ethics, etc. With the letter *R*, we have Reduce, Re-use, Recycle, Renewable Energy, Resources – Exploitation, Conservation, etc.

*Concepts of Sustainability and Sustainable Development:* The pioneering definition of Sustainable Development is from *The Brundtland Report*, 1987: Sustainable Development meets the needs of the present generation without compromising the ability of future generations to meet their own needs.

Other definitions include: Living within ‘the carrying capacity’ of the Environment; Realization that the biosphere is both for us and for our descendants. A very popular expression is: “We have not inherited the Earth from our parents; we have only borrowed it from our children”. Sustainable Development is an inter-generational concept, seeking equity over time, and minimization of disparities between generations.

Since the present standard of living is low in most emerging economies, people aspire for a higher standard. Sustainable Development cautions that there are limits to such growth: Due to: finite stock of resources (both energy & materials); pollution of the environment; exploding populations; escalating aspirations; and conflicting interests.

Human Survival and Development depend on two crucial factors:

- Population control; and
- Successful Management of the world's natural resources.

"No development plans will be expected to bear fruit unless efforts are made simultaneously to contain population", concluded M S Swaminathan Committee recently.

#### SOME LAWS GOVERNING SUSTAINABLE DEVELOPMENT

Summary of the *Three Laws of Thermodynamics*:

All energy conversion processes are governed by the Laws of Thermodynamics. The following popular presentation of the three Laws brings out the hopelessness of the energy situation for mankind:

- ❖ First Law :You can't win ; you can only break even.
- ❖ Second Law :You can break even only at the absolute zero (Carnot efficiency is 100% at  $T_2 = 0$ )
- ❖ Third Law :You cannot reach the absolute zero.
- ❖ Conclusion :You can neither win nor break even !

*The Fundamental Law of Energy Use:*

"Unless the ratio of benefit to cost, measured in units of energy, is greater than 1:1, the potential resource will fail to become an actual resource." This Law defines energy resources, and provides the standard that all potential energy resources and energy technologies must meet. For example, food, fossil fuels, fissile fuels, etc are economic sources of energy only if they can be obtained at an energy / work cost that does not exceed the energy or work benefit obtained from them.

Thus, the following have little meaning in terms of energy resources:

- estimates of crude oil in the ground
- calculation of earth's total energy content
- solar insolation intercepted by the earth.



The moment that more energy is required to find, extract, process, transport and use a barrel of oil, than can be obtained from it, or in exchange for it, there will be no more potential reserves of petroleum. *Technological* feasibility neither equals nor forecasts *economic* feasibility.

#### *Some Environmental Principles*

In addition to the general principles of Sustainable Development, the Engineering Council identifies four key *Principles of Environmental Protection, impinging* upon Engineers' concerns:

- *The Prevention Principle* :is based on the universal concept of Prevention being better than Cure. This Principle accords priority to anticipating and preventing pollution and environmental harm.
- *The Precautionary Principle* : This requires that "where there are significant risks to the Environment, precautionary action should be taken to limit the use of potentially dangerous materials, or the spread of potentially dangerous pollutants, even where scientific knowledge is not conclusive, if the balance of likely costs and benefits justifies it".
- *The Polluter-Pays Principle*: This Principle requires the producer of any environmental damage to meet the financial costs of that damage. In law, an "avoidance cost" approach is employed, which requires the State to set standards, and the Polluter to meet compliance costs.
- *The Principle of Integration*: This concerns the need for integration of environmental consideration into all areas of decision-making, so that measures taken to improve environmental quality in one area are not undermined by unforeseen side-effects, or contradicted by action taken in another area.

#### TWO CONCLUSIONS OF WORLD ENERGY CONFERENCE (1989)

These two conclusions are as valid today as they were then.

1. *"Fossil fuels will continue to meet most of the world's growing energy demand"*.

The implications of this conclusion are: World energy demand is bound to increase monotonically due both to increase in population and more energy-intensive lifestyles. Most of this energy demand will be met by fossil fuels. This conclusion underscores the inevitability of our dependence on fossil fuels, and the need for us to use them rationally.

2. *"The economical rational use of our energy resources is essential for protecting the environment"*.

This establishes the nexus between Energy and Environment. Modern living depends on the use of energy resources, and all energy use is accompanied by environmental degradation. Higher efficiency of energy use has the twin benefits of slower resource depletion and reduced pollution.

## THE FOUR LAWS OF ECOLOGY

In order to survive on the earth, human beings require the stable, continuing existence of an appropriate environment, which encompasses a thin skin of air, water and soil. Barry Commoner has enunciated four Laws of Ecology that highlight the scope of this science of planetary housekeeping:

I Law :Everything is connected to everything else :The ecosystem consists of multiple interconnected parts, which interact with each other. The feedback characteristics of ecosystems result in amplification and intensification of several processes.

II Law :Everything must go somewhere:In nature, there is no such thing as “waste”; nothing can be expected to “go away”.

III Law :Nature knows best :Modern technology aims to “improve on nature”. This law holds, however, that any major man-made change in a natural system is likely to be detrimental to that system.

IV Law :There is no such thing as a free lunch :In ecology, as in economics, this law is intended to warn that every gain is won at some cost. In a way, this law embodies the previous three laws. Because the global system is a connected whole, anything extracted from it by human effort must be paid for; payment of the price cannot be avoided, it can only be delayed.

## UN DECADE OF EDUCATION FOR SUSTAINABLE DEVELOPMENT (2005-2014)

The overall goal of the UN Decade of Education for Sustainable Development (DESD) is to integrate the principles, values and practices of sustainable development into all aspects of education and learning. This educational effort is expected to encourage changes in behaviour that will create a more sustainable future in terms of environmental integrity, economic viability and a just society for present and future generations.

Implementing the mission involves: promoting and improving quality education; reorienting educational programmes; building public understanding and awareness; and providing practical training.

Kofi Annan, the former Secretary General of the United Nations has said: *"Our biggest challenge in this new century is to take an idea that seems abstract– sustainable development –and turn it into a reality for all the world's people."*

Several distinctive Generic Sustainability Competences have been identified:

- Competence to think in a forward-looking manner, to deal with uncertainty, and with predictions, expectations and plans for the future.
- Competence to work in an interdisciplinary manner.
- Competence to see interconnections, interdependencies and relationships.

- Competence to achieve open-minded perception, trans-cultural understanding and cooperation.
- Participatory competence.
- Planning and implementation competence.
- Ability to feel empathy, sympathy and solidarity.
- Competence to motivate oneself and others.
- Competence to reflect in a distanced manner on individual and cultural concepts.

#### GRAND CHALLENGES IDENTIFIED BY INAE

Corresponding to the 14 Grand Challenges proposed by the National Academy of Engineering (US), our Indian National Academy of Engineering has identified ten Important technology domains and milestones, which have implications for Engineering Education for Sustainable Development:

1. Energy Harvesting and Energy Security
2. Sustainable Healthcare
3. River Science and Water Resources
4. Sustainable, Green and Smart Cities
5. Manufacturing Engineering
6. Nano science and Nanotechnology
7. Computer and Information Science
8. Agro-Bio-Nano Technology
9. Outreach and Mass Education Program
10. Advanced Materials

## Customer Focus in Business – My Career and My Learning



VR Kanetkar

“Customer is God. Customer is ultimate. We must work for Customer satisfaction, Customer delight, and Customer retention.” We all hear this continuously in almost all the organizations as well as outside when we are in public. Probably in every presentation, every seminar, and every communication, we hear this. The Father of Nation talked about the customer more than sixty years back when globalization, IT, competitive life, modernization etc. were not the buzzwords.

I still remember the way we worked when I started my career as an R&D engineer in 1978. In those days, every application had to be studied and fully analyzed at the customer’s premises. One can say that the design was actually conceptualized at his premises. The finer aspects were worked out after returning to the factory. The customer knew practically every engineer involved and one could expect a call directly at his residence for immediate solutions. The engineers had the design on their tips and could guide the customer; many a times on phone itself. Every system design was checked thoroughly before releasing to manufacturing and the engineers had to receive good amount of firing for every mistake they committed (for their own good of course). When we returned back from site, the general manager grilled us for all the settings, modifications, testing, performance trials, etc. All the modifications done had to be explained, agreed, and ratified in a subsequent meeting with the concerned engineers (from manufacturing, quality, commissioning, system design, order execution, and marketing) and permanent changes had to be released accordingly.

The words like ISO certification, TQM, and so on did not exist those days. But the concept of customer satisfaction did exist, even though we did not talk about it in every seminar. There was a definite focus on quality as a whole. The records, however, were always up to date because of the systems in operation and quality was realized through every possible way; including design, system checks, manufacturing processes laid down, operator’s dependability, in house testing, and proper procedure for erection / commissioning. I think more than these factors what contributed to the reliability of the equipment were factors like sincerity, integrity, dedication, honesty while performing a task, and fully owning the individual processes and responsibilities.

Every engineer learnt almost all aspects of the engineering on job through sheer hard work and because of threat of proper firing (which was also taken in a spirit). The fundamentals had to be in place without which one could not work independently. There was also a great degree of trust, as well as frank and free atmosphere, where one could tell the general manager also that you are INCORRECT (one can guess the superlatives used also). However, the onus was then on the concerned engineer to prove that the manager was incorrect. Yes, there were problems related to promotions, increments, and appreciation. Despite this I suppose, the system bound everybody neatly because it invited ingenuity, owning the failures, lot of learning and zeal to learn, respect for seniors for their experience and knowledge, respect for them while learning and inheriting, freedom of expression while giving

suggestions and making improvements. The system was such that practically everything had to be learnt hard way with absolutely no shortcuts possible. Further, all good qualities like dedication, sincerity, honesty, integrity, hard work, patience, and perseverance had no boundaries and hence needed to be stretched to whatever higher extent one can decide to stretch it. In fact the system invited it. You had no option but to rise through ranks. One can only imagine the substantial efforts required for anybody to raise above all these levels, also and equally exerted by others, to differentiate him to get into any one of the upper slots. The best aspect of the system in place was that the engineer could never forget his fundamentals and had to acquire a broad vision to look at any operational / new technical system from top / apex, before he could get inside up to the required point of interest for analyzing the issue. Directly or indirectly, service to the customer remained always on top priority and attended to with equal sincerity from all the angles.

We all talked about the end customer then also. We talk about the end customer today also. Then what is the difference between yesterday's and today's conditions?

The experience and comparison show that several good things happened but the approaches changed. Let us have a look at what good changes came through, which could have helped all the good practices, processes, quality of our services to the end customer, and also our efficiency to serve him.

The most important changes (restricted to my field Electrical Engineering) relate to computers coming in a big way with Internet / Intranet and PC's ruling the information technology, communication becoming relatively much faster with different gazettes available, lot of technological changes coming through materials, digital controls with fast processors and DSP's, simulation platforms, power devices, drive systems, and virtually the electronics and power electronics dominating every aspect of Electrical Engineering.

The other changes (in general) include presentation methods, documentation in soft form, ease of access to substantial information, automation in processes, accuracies in every aspect of technology submission and utilization. It also made us understand optimized operations, international demands and competition, and work with highest degree of efficiency while cutting all unwanted corners.

But all is not well on the personal side. This includes some kind of cut and paste attitude, more stress on the sophistication of presentation than the real contents, two minute maggi noodle attitude, lethargic attitude to address the real problem, spending more time on who should solve and answer the technical issue rather than employing one's mind on it, half hearted attitudes, reduction in one's analytical capabilities, attitude to throw the problem in somebody else's court and still justify that this is not my problem, and so on. The overall impact continued based on simplified understanding of the famous Ohm's law, i.e. more current will flow in less resistive / impedance path. Thus the efficiency (with which we deserved an opportunity to react and retain our customers with the help of these improved tools and basic good qualities available at our disposal), instead of increasing dramatically, in fact went down and suffered owing to these negative attributes that got into the system over a period of time.

We expected that the modern technology would satisfy the customers. However, what is forgotten is that complete personal dedication is important even today in satisfying the customers.

The liberalization brought dollars to our doors allowing easy horizontal movements across the world and many young / experienced people who lost their valuable learning and core engineering ability while changing to the software jobs and thereby the real focus of their basic education. It created a big

void in normal operations of engineering companies since the technical expertise was lost to software companies.

On the other hand, I also could see significant change in the personal paradigm. We seem to be more worried about how to remain in good books of management rather than remaining in good books of our customers who can trust us and see us as dependable and friend in need. Our internal threat seems to make us more uncomfortable rather than the external threat from the customer. This is in total contrast with what we hear in our internal talks and discussions. Somewhere and somehow, we seem to be doing exactly the opposite to what we agree and what we are supposed to do. As a result, finally we all suffer; the company suffers in turn, and worst is that the customer suffers. This means we seem to be drifting away from the true satisfaction of the customer and his retention. I hope we all honestly agree to this situation.

I now come to another important and relevant question. Does it mean we all work under some kind of a constant fear? Probably yes. What is this fear? Losing a job? Losing credibility? Losing promotions or worrying about demotions? The analysis tells me that all these factors count as a fear. Further, we tend to get more conscious about our image, within and outside the company. This is in nutshell.

But why should we be so much worried? Why not learn to call spade a spade at all the times? I think the answer lies in we becoming bold but not arrogant, honest but not shy, answerable but not offensive, firm and assertive but not impolite, understanding but not over sentimental, analysts but not diplomatic, realistic and confident but not overconfident, ambitious to reach the top but not by stepping on other's shoes.

Few days back, I happened to read an interview of the great Socialist Shri Baba Amte. The future belongs to whom was the question asked to him. He calmly replied that it belongs to "common man with uncommon determination". I think it summarizes the issue. The future belongs to all of us as a common man. Yes, we need a very high degree of determination to do justice for our customers and in a broad sense to the relative future which involves the customer and us together.

Something which I now can add and I am sure this will help us to retain close and valuable relationship with the customer.

I learnt lot of things from my Ph.D. which I joined after acquiring around 11 years experience in industry. To put it more importantly and humbly, it made me learn that I really don't know many things. This in itself was a great realization and discovery. It made me feel so small but not guilty. It made me improve upon my analytical skills and made me understand that the efforts required to deliver even a small contribution can be extremely large. It made me develop never give up kind of attitude.

I have walked 57 km seven times from Baroda to get Bhagwan ShriKrishna's Darshan at Dakore. Thanks to my colleagues who inspired me to do it. The Dakore walking down and the Ph.D. experience have taught me and made me realize something very special that I have to stretch and keep stretching the boundaries of all good qualities like determination, honesty, integrity, patience, perseverance, hard work, and hardcore engineering (which is must for all of us as the practicing engineers) to achieve even a small and good contribution. All the fears will have to be driven out of our minds to cultivate and nurture these qualities.

With due respect to all those who helped me, taught me, and have contributed to my life, I humbly state here that development experience of over fifty products / systems to meet all challenges of Indian

customers and environment that I gained, stands for me as an example of stretching the boundaries of all good qualities as mentioned above. Over a period of time the technologies that we could produce / continue to produce in India (in my stay with all the organizations) included those for all core sector and other industries, railways and Metro's, electricity boards and many other customers. List is not important. What is important to be noted is that we had a faith in ourselves that we can develop technologies parallel to those available abroad and at a much cheaper cost and embed in it the reliability required to work with weak grids in India and more importantly match it with the Indian customer's expectations.

The Indian customer needs 20/500 formula to be applied and realized rather than 100/100 formula. What does it mean? It means if a product or a system is available at Rs 100 with 100% reliability specified for it, one need to deliver the same product or system in India at a cost of Rs 20 and with 500% reliability (as good as maintenance free). This is the biggest challenge in India and if one delivers against it, I am sure the products and systems can easily find their acceptance abroad. I am glad that at least I and the people who worked with me tried it and have been successful in many cases. In fact in some cases the customer gave us the order at a higher price than quoted (possibly unheard in Indian commercial history), since he properly understood the difference between the two formulae.

What is possible often lies just on the other side of our self-created boundary of impossible. What is needed is just a little bit of overstretching.

I submit my sincere thanks to all those people for the opportunity they gave me in conceptualizing the products / systems and bringing them in reality. The learning was very / extremely hard way as it involved full appreciation of the customer's applications vis-à-vis the real delivery. The people from the lowest ranks teach us a lot. We need to have open and egoless mind to learn it from them and absorb it for future understanding. Learning is a penance and a never ending process.

The customer teaches you lot many things inclusive of technical and nontechnical issues involved. Meeting therefore the customer requirements as a whole is a challenge to be taken by its spirit. The word "concept", if taken in a broad sense, reflects not only conceptualizing the so-called product or system, but also conceptualizing the customer's overall needs as a total solution. Moment this chord is struck, half the battle is already won.

Retaining the customer is reflecting sincerity in addressing and meeting all that is conceptualized. This also, hence, has a broad sense. It is hence a commitment, which stretches much beyond the product one offers to the customer. He looks forward to continued support not only for the product he has from you, but also for associated system, its appreciation, and many a times solutions to issues which may not be directly relating to the supplied product. In one line it can be summarized as, he relates himself to you for long-term association. This is a marriage for long term retention of the customer, which has "trust" as the major binding factor.

I give an example here to clarify it. We had an opportunity to exhibit the whole process from "Concept to Retention" in case of Tata Motors. This is a customer where the order for the 1800 kVAR Dynamic Reactive Power Compensator (DRPC or Statcon) for the Indica Spot Welding was almost lost when we entered the Tata premises. Tata's were technically convinced about the real need of Statcon for the application and that it cannot be met by the solution they were provided by some other party. The proto was developed specifically and demonstrated to Tata's. The Statcon was sold and the rest is history. Today my earlier organization has the appreciation from Tata Motors who have approved Statcon as a well-addressed and proven product for dynamic reactive power compensation for spot welding

application in automobile industry. For the expansion, Tata Motors wanted us to write the core specifications for the exact compensation process for the spot welding application, which subsequently found its way in the new tender specifications. This is the respect paid by a customer to my earlier organization. Over a period of time, number of technical needs have been addressed for Tata Motors and solutions have been suggested. The interaction has continued binding both Tata Motors and my earlier organization in a healthy and trusted relationship. In my opinion, it stands as an example for "Concept to Customer Satisfaction and Retention" perhaps as an example for any organization.

I can never forget the teachings and blessings of all those seniors with whom I had an opportunity to work and learn from and I honestly acknowledge the same today with all my humility.

Finally I come to my real learning and what I can share truly with all. When I look back, the years convince me that the success of any company lies in how honestly we develop and pursue the basic qualities (determination, honesty, integrity, patience, perseverance, hard work, and hardcore engineering) and how effectively we can use all the technology based tools available to us to improve everything that is related to the customer. That will decide / answer how close we are in achieving Customer Satisfaction, Delight, and Retention. After all, these are real rewards for every company and also to all of us.

What is my honest realization then?

Treat every customer as if your world revolves around him. In fact it does!

Please note: I have written this article without any prejudice to anybody, with due respect to all the people and also with all my sincerity and humility. Having already completed over 37 years of my professional life, and also having completed 60 years, I thought I have an occasion to share my experience and learning with all, specifically in relation to "Customer Focus". I hence humbly request all to take the article by its spirit and appreciate my respect for the organizations I worked with (M/s Larsen and Toubro Limited, M/s ABB Limited, and M/s Autometers Alliance Limited) and also the organization I am currently working with (M/s Shreem Electric Limited).



### 1. High-Tech Temporary Building Unveiled In Amsterdam



Temporary buildings and pavilions offer many benefits. They are typically lightweight and relatively easy to erect. They offer space when and where it is needed. But they can also allow for cutting-edge technology and designs to be tested. Such is the case with a temporary convention center that has been installed for use by the Presidency of the Council of the European Union during its time in the Netherlands: The facade of the complex's entrance contains elements that are created from fully reusable, 3-D-printed bioplastic sections. The 8,000 m<sup>2</sup> complex is located behind the walls of the Marineterrein, an area that is now being transformed into a public city district. The center includes six temporary, high-tech buildings connected by covered walkways. These buildings include conference rooms, lounges, a theatre, interpreting booths, and meeting rooms. The main entrance to the complex is striking: portions of the white facade appear to be pulled upward, sail-like, by invisible strings, creating alcoves with fluted overhangs. These alcoves hold a series of 3-D-printed benches and walls, created to open the building visually and physically to the public. The facade contains elements that are created from fully reusable, 3-D-printed bioplastic sections. A pulsing light highlights the alcoves situated beneath the portions of the facade that have been lifted. The screen consists of eight separate steel frames. A PVC-coated polyester tensile fabric is fitted to these frames to form the white cladding elements. The structure of the screen rests on base plates on the soil, fixed with anchoring rods, similar to circus tents. The facade frame is bolted to the building frame and all gaps between the two frames enclosed to lessen the wind loads on the interior frame. The 3-D-printed benches and wall elements were also bolted to the facade frame. The sail elements have been carefully detailed to appear clean and sharp with no connections or tensioning devices in sight. Along the alcoves the fabric is folded around the edge and clamped to the steel frame. Along the side and top edges the fabric folds around the steel frame and is tensioned to the back of the frame using springs. The alcoves hold a series of benches and walls—also created by 3-D printing—that open the building visually and physically to the public. Underneath these sails, the alcoves are a striking "EU blue," as the architects refer to the colour. Within the alcove, the 3-D-printed pattern elements increase in size from small to large, and visually appear to transition from round to square. A pulsing light highlights the alcoves at night. The benches were printed locally using a 3-D printer that uses fused deposition modeling technology and is capable of creating elements that measure up to 2 m by 2 m by 3.5 m. Because the bioplastic used in this printer is melted and built up layer by layer with a computer-controlled printer head, the final layers are clearly visible in the end project. The seating surfaces of the benches are filled with a layer of lightweight concrete for durability. The 3-D printed elements use a linseed oil-based bioplastic. This material is fully recyclable, and can be removed, shredded, and reused for future 3-D printing projects. Energy efficiency was of great importance for the complex and rooftop solar panels were installed to provide a portion of the required daily energy to operate the facility.

Source <http://www.asce.org/magazine/20160209-high-tech-temporary-building-unveiled-in-amsterdam/>

### 2. Chip Could Bring Deep Learning to Mobile Devices



*MIT researchers have designed a new chip to implement neural networks. It is 10 times as efficient as a mobile GPU, so it could enable mobile devices to run powerful artificial-intelligence algorithms locally, rather than uploading data to the Internet for processing.*

In recent years, some of the most exciting advances in artificial intelligence have come courtesy of convolutional neural networks, large virtual networks of simple information-processing units, which are loosely modeled on the anatomy of the human brain. Neural networks are typically implemented using graphics processing units (GPUs), special-purpose graphics chips found in all computing devices with screens. A mobile GPU, of the type found in a cell phone, might have almost 200 cores, or processing units, making it well suited to simulating a network of distributed processors. MIT researchers have created a new chip designed specifically to implement neural networks. It is 10 times as efficient as a mobile GPU, so it could enable mobile devices to run powerful artificial-intelligence algorithms locally, rather than uploading data to the Internet for processing. Neural nets in the past decade, however, are being researched under the name "deep learning." "Deep learning is useful for many applications, such as object recognition, speech, face detection," says researchers at MIT who developed the new chip. The new chip, which the researchers dubbed "Eyeriss," could also help usher in the "Internet of things" -- the idea that vehicles, appliances, civil-engineering structures, manufacturing equipment, and even livestock would have sensors that report information directly to networked servers, aiding with maintenance and task coordination. With powerful artificial-intelligence algorithms on board, networked devices could make important decisions locally, entrusting only their conclusions, rather than raw personal data, to the Internet. And, of course, onboard neural networks would be useful to battery-powered autonomous robots. A neural network is typically organized into layers, and each layer contains a large number of processing nodes. Data come in and are divided up among the nodes in the bottom layer. Each node manipulates the data it receives and passes the results on to nodes in the next layer, which manipulate the data they receive and pass on the results, and so on. The output of the final layer yields the solution to some computational problem. In a convolutional neural net, many nodes in each layer process the same data in different ways. The networks can thus swell to enormous proportions. Although they outperform more conventional algorithms on many visual-processing tasks, they require much greater computational resources. The particular manipulations performed by each node in a neural net are the result of a training process, in which the network tries to find correlations between raw data and labels applied to it by human annotators. With a chip like the one developed by the MIT researchers, a trained network could simply be exported to a mobile device. The way to lower the chip's power consumption and increase its efficiency is to make each processing unit as simple as possible; at the same time the chip has to be flexible enough to implement different types of networks tailored to different tasks. The key to Eyeriss's efficiency is to minimize the frequency with which cores need to exchange data with distant memory banks, an operation that consumes a good deal of time and energy. Whereas many of the cores in a GPU share a single, large memory bank, each of the Eyeriss cores has its own memory. Moreover, the chip has a circuit that compresses data before sending it to individual cores. Each core is also able to communicate directly with its immediate neighbours, so that if they need to share data, they don't have to route it through main memory. This is essential in a convolutional neural network, in which so many nodes are processing the same data. The final key to the chip's efficiency is special-purpose circuitry that allocates tasks across cores. The MIT researchers used Eyeriss to implement a neural network that performs an image-recognition task, the first time that a state-of-the-art neural network has been demonstrated on a custom chip.

## Mechanical Engineering

### 3. Mass-Produced Underwater Vehicles



*The AUV weighs less than 700 kilograms, making it a truly lightweight vehicle.*

Autonomous underwater vehicles are essential for tasks such as exploring the seabed in search of oil or minerals. Fraunhofer researchers have designed the first robust, lightweight and powerful vehicle intended for series production. There has never been so much human activity in the depths of the oceans. Several thousand meters below the surface, oil companies are prospecting for new deposits and deep-sea mining companies are looking for valuable mineral resources. Then there are the thousands of kilometers of pipelines and submarine cables that need regular maintenance. Not to mention the marine scientists who would like to be able to use robust devices to survey large areas of the ocean floor. All these applications mean there is a growing demand for underwater exploration vehicles. To meet this demand, researchers at the Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB in Ilmenau and Karlsruhe have designed a powerful autonomous underwater vehicle (AUV) capable of being manufactured in large numbers. Companies have been using AUVs for many years in deep-sea exploration missions. These untethered vehicles glide independently through the water collecting observation data, and make their own way back to the research vessel. Up to now, these have primarily been custom-built and very expensive. They have complicated structures, which makes them relatively difficult to handle by the crew on board the research vessel; for instance, accessing the batteries in order to replace them. It takes one hour to read the many terabytes of observation data out of the AUV's onboard processor. What's more, many of these vehicles are so heavy that only specially trained operators can place them in the water using the ship's winch. The IOSB's AUV overcomes all of these problems. The vehicle called DEDAVE (Deep Diving AUV for Exploration) bears a certain resemblance to the space shuttle. The research team has fitted it out with technologies not normally found in AUVs to date. To avoid the typical mess of cables, which was often a source of faults, they installed a CAN bus system like those found in every modern car. It consists of a slim cable to which all control devices and electric motors can be connected. The advantage of having so few cables and connectors is that faults are avoided. New modules, sensors or test devices can also be connected quickly and easily to the standardized CAN bus. Batteries and data storage devices are held in place by a tough but simple latch mechanism, allowing them to be removed with a minimum of effort. There is no longer any need to download data from the processor. One of the strengths of the lightweight, 3.5-meter-long underwater vehicle is that it takes up very little space. Aboard a ship, AUVs are stored in standard shipping containers, which usually offer only enough room for one vehicle. "We, on the other hand, can fit four AUVs into the same container," says the lead researcher. "The advantage of having four vehicles available is that larger than usual areas of ocean can be surveyed in far less time." Despite their small size, the AUVs still provide plenty of additional carrying space. The payload bay measures approximately one meter in length, which is sufficient for installing several different sensors for capturing ocean floor survey data. The underwater vehicle is powered by eight batteries, each weighing 15 kilograms. A fast-release latch mechanism enables them to be removed and replaced with little effort. A fully charged battery holds enough power for up to 20 hours' travel. The software for the sophisticated battery management system was specially developed by researchers at the Fraunhofer Institute for Silicon Technology ISIT in Itzehoe. In collaboration with the GEOMAR Helmholtz Center for Ocean Research, Kiel, and a Spanish research center, DEDAVE will go through deep sea testing off the coast of Gran Canaria in the coming weeks. DEDAVE is the world's first autonomous underwater vehicle to be developed from the outset with a view to series production. It will be manufactured by a company to be specifically created for this purpose as a spin-off from the IOSB in the first half of 2016.

### 4. Researchers Turn Paper Waste into Ultralight Super Material that Improves Oil Spill Cleaning, Heat Insulation

World's first cellulose aerogel made of paper waste is biodegradable, non-toxic, flexible and ultra-strong, report researchers. A research team from the National University of Singapore's (NUS) Faculty of Engineering has achieved a world's first by successfully converting paper waste into green cellulose aerogels that are non-toxic, ultralight, flexible, extremely strong and water repellent. This novel material is ideal for applications such as oil spill cleaning, heat insulation as well as packaging, and it can potentially be used as coating materials for drug delivery and as smart materials for various biomedical applications. This pioneering work was achieved by a team led by Assistant Professor Duong Hai Minh from the Department of Mechanical Engineering. "Aerogels, which are among the lightest solid materials known to man, are one of the finest insulation materials available. Traditional aerogels are mainly made of silica, which is not environmentally-friendly. In contrast, cellulose is low cost and makes up 75 to 85 per cent of recycled paper. Our team developed a simple, cost-effective and fast method of converting paper waste into aerogels. In addition to low thermal conductivity, these novel aerogels have several unique features, one of which is super high oil absorption capacity -- it is up to four times higher than commercial sorbents available in the market. We are very excited about the potential applications of this new material," said Asst Prof Duong. The novel cellulose aerogels developed by the NUS team boast super high oil absorption capacity. Coated with Trimethoxy-methylsilane (MTMS), the aerogels are water repellent and are capable of absorbing oil (excluding water) up to 90 times their dry weight, making them up to four times more effective than commercial oil sorbents. Furthermore, they can be squeezed to recover over 99 per cent of the crude oil absorbed. Elaborating on the potential application of the cellulose aerogels, Asst Prof Duong said, Oil spills are serious disasters that threaten marine ecosystems. Sorption has been considered one of the most effective ways to clean oil spills. Polypropylene (PP)-based absorbents are widely used for oil absorption but they are non-biodegradable, and their absorption capabilities are both low and slow. The novel cellulose aerogels therefore serve as an attractive alternative to current methods of oil spill cleaning. Another important application of the novel cellulose aerogels is to serve as insulation materials for buildings. As a heat insulation material, the novel cellulose aerogels offer a few added advantages. Their water repellent property allows them to be adaptable to both dry and rainy weather and their structure remains stable for about six months in tropical climate. Being extremely strong, they increase building strength. In addition, these aerogels are lightweight and slim, resulting in slimmer walls, thus increasing building space. The novel cellulose aerogels developed by the NUS team could also signal a change in the packing industry. Plastic-based packing materials such as the bubble wrap could be replaced with biodegradable aerogel-based foam or advanced cellulose aerogel nanosheets, which are environmentally-friendly. With high surface area and high porosity, the biodegradable aerogels could also be used as coating materials in drug delivery or as smart materials. The NUS team has also discovered a way of expanding the weight capacity of the cellulose aerogels. This is done by infusing the fibres of the cellulose aerogels with a solution of metallic nanoparticles. The cellulose aerogels are then hammered flat to remove most of the air, resulting in a magnetic thin film that has a weight capacity of over 28 tonnes per square centimetre. MTMS-uncoated cellulose aerogels are hydrophilic, thus they can also absorb and retain huge volumes of polar fluids such as water and alcohol. In addition, compressed cellulose aerogels can be used to plug life-threatening wounds such as a gunshot or stabbing lesion by injecting them into the wound cavity.

Source <http://www.sciencedaily.com/releases/2016/02/160203090934.htm>

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### 5. Researchers Develop Hack-Proof RFID Chips

Researchers at MIT and Texas Instruments have developed a new type of radio frequency identification (RFID) chip that is virtually impossible to hack. If such chips were widely adopted, it could mean that an identity thief couldn't steal your credit card number or key card information by sitting next to you at a café, and high-tech burglars couldn't swipe expensive goods from a warehouse and replace them with dummy tags. Texas Instruments has built several prototypes of the new chip, to the researchers' specifications, and in experiments the chips have behaved as expected. According to Chiraag Juvekar, a graduate student in electrical engineering at MIT, the chip is designed to prevent so-called side-channel attacks. Side-channel attacks analyze patterns of memory access or fluctuations in power usage when a device is performing a cryptographic operation, in order to extract its cryptographic key. "The idea in a side-channel attack is that a given execution of the cryptographic algorithm only leaks a slight amount of information," Juvekar says. "So you need to execute the cryptographic algorithm with the same secret many, many times to get enough leakage to extract a complete secret." One way to thwart side-channel attacks is to regularly change secret keys. In that case, the RFID chip would run a random-number generator that would spit out a new secret key after each transaction. A central server would run the same generator, and every time an RFID scanner queried the tag, it would relay the results to the server, to see if the current key was valid. Such a system would still, however, be vulnerable to a "power glitch" attack, in which the RFID chip's power would be repeatedly cut right before it changed its secret key. An attacker could then run the same side-channel attack thousands of times, with the same key. Power-glitch attacks have been used to circumvent limits on the number of incorrect password entries in password-protected devices, but RFID tags are particularly vulnerable to them, since they're charged by tag readers and have no onboard power supplies. Two design innovations allow the MIT researchers' chip to thwart power-glitch attacks: One is an on-chip power supply whose connection to the chip circuitry would be virtually impossible to cut, and the other is a set of "nonvolatile" memory cells that can store whatever data the chip is working on when it begins to lose power. For both of these features, the researchers use a special type of material known as ferroelectric crystals. As a crystal, a ferroelectric material consists of molecules arranged into a regular three-dimensional lattice. In every cell of the lattice, positive and negative charges naturally separate, producing electrical polarization. The application of an electric field, however, can align the cells' polarization in either of two directions, which can represent the two possible values of a bit of information. When the electric field is removed, the cells maintain their polarization. Texas Instruments and other chip manufacturers have been using ferroelectric materials to produce nonvolatile memory, or computer memory that retains data when it's powered off. A ferroelectric crystal can also be thought of as a capacitor, an electrical component that separates charges and is characterized by the voltage between its negative and positive poles. Texas Instruments' manufacturing process can produce ferroelectric cells with either of two voltages: 1.5 volts or 3.3 volts. The researchers' new chip uses a bank of 3.3-volt capacitors as an on-chip energy source. But it also features 571 1.5-volt cells that are discretely integrated into the chip's circuitry. When the chip's power source -- the external scanner -- is removed, the chip taps the 3.3-volt capacitors and completes as many operations as it can, then stores the data it's working on in the 1.5-volt cells. When power returns, before doing anything else the chip recharges the 3.3-volt capacitors, so that if it's interrupted again, it will have enough power to store data. Then it resumes its previous computation. If that computation was an update of the secret key, it will complete the update before responding to a query from the scanner. Power-glitch attacks won't work. Because the chip has to charge capacitors and complete computations every time it powers on, it's somewhat slower than conventional RFID chips. But in tests, the researchers found that they could get readouts from their chips at a rate of 30 per second, which should be more than fast enough for most RFID applications.

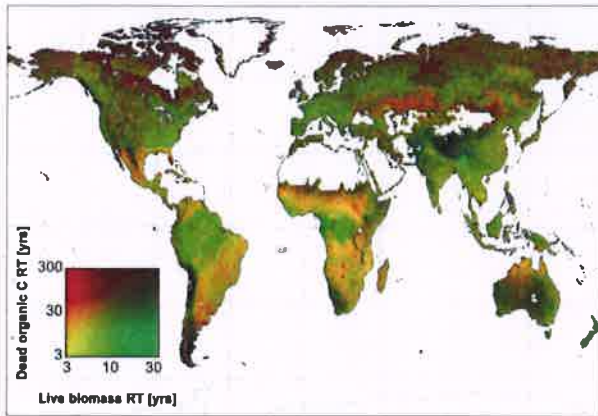
### 6. New Thin Film Transistor May Lead to Flexible Devices

An engineering research team at the University of Alberta has invented a new transistor that could revolutionize thin-film electronic devices. Their findings could open the door to the development of flexible electronic devices with applications as wide-ranging as display technology to medical imaging and renewable energy production. The team was exploring new uses for thin film transistors (TFT), which are most commonly found in low-power, low-frequency devices like the display screen you're reading from now. Efforts by researchers and the consumer electronics industry to improve the performance of the transistors have been slowed by the challenges of developing new materials or slowly improving existing ones for use in traditional thin film transistor architecture, known technically as the metal oxide semiconductor field effect transistor (MOSFET). But the U of A electrical engineering team did a run-around on the problem. Instead of developing new materials, the researchers improved performance by designing a new transistor architecture that takes advantage of a bipolar action. In other words, instead of using one type of charge carrier, as most thin film transistors do, it uses electrons and the absence of electrons (referred to as "holes") to contribute to electrical output. Their first breakthrough was forming an 'inversion' hole layer in a 'wide-bandgap' semiconductor, which has been a great challenge in the solid-state electronics field. Once this was achieved, "we were able to construct a unique combination of semiconductor and insulating layers that allowed us to inject "holes" at the MOS interface," said Gem Shoute, a PhD student in the Department of Electrical and Computer Engineering. Adding holes at the interface increased the chances of an electron "tunneling" across a dielectric barrier. Through this phenomenon, a type of quantum tunnelling, "we were finally able to achieve a transistor that behaves like a bipolar transistor." "It's actually the best performing [TFT] device of its kind--ever," said researchers. "This kind of device is normally limited by the non-crystalline nature of the material that they are made of". The dimension of the device itself can be scaled with ease in order to improve performance and keep up with the need of miniaturization, an advantage that modern TFTs lack. The transistor has power-handling capabilities at least 10 times greater than commercially produced thin film transistors. The researchers were determined to try new approaches and break new ground. The team knew it could produce a high-power thin film transistor--it was just a matter of finding out how. Their goal was to make a thin film transistor with the highest power handling and switching speed possible. "The high quality sub 30 nanometre layers of materials produced by the researchers enabled them to successfully try these difficult concepts. In the end, the team took advantage of the very phenomena other researchers considered roadblocks. "Usually tunnelling current is considered a bad thing in MOSFETs and it contributes to unnecessary loss of power, which manifests as heat," explained researchers. "What we've done is build a transistor that considers tunnelling current a benefit." The next step is to put the transistor to work "in a fully flexible medium and apply these devices to areas like biomedical imaging, or renewable energy."

Source <http://www.sciencedaily.com/releases/2016/02/160209162412.htm>

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### 7. New Satellite-Based Maps to Aid in Climate Forecasts



New, detailed maps of the world's natural landscapes created using NASA satellite data could help scientists better predict the impacts of future climate change. The maps of forests, grasslands and other productive ecosystems provide the most complete picture yet of how carbon from the atmosphere is reused and recycled by Earth's natural ecosystems. Scientists at the University of Edinburgh, Scotland, United Kingdom; NASA's Jet Propulsion Laboratory, Pasadena, California; and Wageningen University, Netherlands, used a computer model to analyze a decade of satellite and field study data from 2001 to 2010. The existing global maps of vegetation and fire activity they studied were produced from data from NASA's Terra, Aqua and ICESat spacecraft. The researchers then constructed maps that show where -- and for how long -- carbon is stored in plants, trees and soils. The maps reveal how the biological properties of leaves, roots and wood in different natural habitats affect their ability to store carbon across the globe, and show that some ecosystems retain carbon longer than others. For example, large swaths of the dry tropics store carbon for a relatively short time due to frequent fires, while in warm, wet climates, carbon is stored longer in vegetation than in soils. Although it is well known that Earth's natural ecosystems absorb and process large amounts of carbon dioxide, much less is known about where the carbon is stored or how long it remains there. Improved understanding about how carbon is stored will allow researchers to more accurately predict the impacts of climate change. Study first author Anthony Bloom, a JPL postdoctoral scientist, said: "Our findings are a major step toward using satellite imagery to decipher how carbon flows through Earth's natural ecosystems from satellite images. These results will help us understand how Earth's natural carbon balance will respond to human disturbances and climate change." Researchers also said, "Recent studies have highlighted the disagreement among Earth system models in the way they represent the current global carbon cycle. "Our results constitute a useful, modern benchmark to help improve these models and the robustness of global climate projections." To generate values for each of the 13,000 cells on each map, a supercomputer at the Edinburgh Compute and Data Facility ran the model approximately 1.6 trillion times. New data can be added to the maps as it becomes available. The impact of major events such as forest fires on the ability of ecosystems to store carbon can be determined within three months of their occurrence, the researchers say. NASA uses the vantage point of space to increase our understanding of our home planet, improve lives and safeguard our future. NASA develops new ways to observe and study Earth's interconnected natural systems with long-term data records. The agency freely shares this unique knowledge and works with institutions around the world to gain new insights into how our planet is changing.

### 8. New Material Lights Up When Detecting Explosives

Scientists have created a material which turns fluorescent if there are molecules from explosives in the vicinity. The discovery could improve, for example, airport security -- and also it gives us an insight into a rather chaotic micro-world where molecules and atoms constantly are responding to their surroundings. Unlike humans, dogs' noses are so sensitive that they can smell explosives in the vicinity. They can detect single molecules in the air, and thus they may be valuable helpers when it comes to detecting explosives. Inspired by such talents, science is devoting many resources on developing electronic or chemical "noses" which similarly can detect explosives molecules and thus warn that explosives may be hiding in the vicinity. Researchers from University of Southern Denmark now report the creation of a new material, consisting of a set of molecules which react when encountering explosives molecules in their vicinity. The set consists of the molecules TTF-C[4]P and TNDCF. TNDCF has the special talent that it becomes fluorescent when an explosives molecule is introduced to the set of molecules. "This new knowledge could lead to creating a small device based on this set of molecules. With such a device security staff in airports could e.g. test if there are explosives molecules on or near a bag," explains Steffen Bähring. Bähring is first author of a scientific paper on the subject. This is not the first time scientists report the development of chemical substances capable of detecting explosives. But previously many uncertainties have been involved, and therefore the methods have not been entirely reliable. One problem is that previous techniques have been based on a substance that became fluorescent when there were no explosives molecules in the vicinity and that the fluorescence disappeared if the substance came into contact with explosive molecules. "The problem was that several factors could make the fluorescence disappear; a number of salts for example had this effect. Thus these substances could give off a false alarm," explains Bähring. The new material only turns fluorescent when exposed to molecules from the explosive TNB and some specific salts, such as those based on chlorine or fluorine. "There can only be two reasons why it turns fluorescent, one of them being the presence of explosives. Thus this material is a highly reliable tool for detecting explosives," explains Bähring. His new material consists of molecules held together by weak bonds. Weakly bonded molecules form substances that can easily switch form -- just like water can be found in both liquid, solid or gaseous form -- and compared to strongly bonded molecules they are very easily influenced by their surroundings. Weakly bonded molecules constantly respond to their environment, e.g. changes in temperature. This makes them very difficult to control. It also makes them extra difficult to work with, and creating new molecular architectures based on them is no easy task. Because of this understanding, controlling weakly bonded molecules is a huge scientific challenge. "It is extremely hard to create a chain of different weakly bonded molecules. If a scientist one day succeeds in putting just ten different types of molecules together in this way, it would be a great achievement," says Bähring.

Source <http://www.sciencedaily.com/releases/2016/02/160204121952.htm>

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### 9. Helping Turn Waste Heat into Electricity



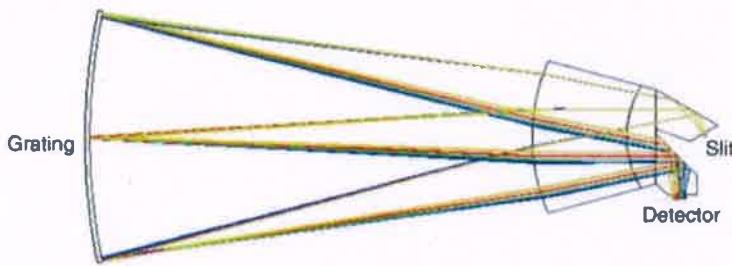
*Solar panels. Mastering the conversion of waste heat into electricity would have many applications; one would be to improve the overall efficiency of solar cells.*

At the atomic level, bismuth displays a number of quirky physical phenomena. A new study reveals a novel mechanism for controlling the energy transfer between electrons and the bismuth crystal lattice. Mastering this effect could, ultimately, help convert waste heat back into electricity, for example to improve the overall efficiency of solar cells. These findings have now been published recently by Piotr Chudzinski from Utrecht University, the Netherlands. The researcher investigates the collective motion of electrons in bismuth, which behaves in a fluid manner with waves propagating in it, a phenomenon referred to as a low energy plasmon. Electrons moving throughout the material constantly aim to preserve the same density. Bismuth exhibits two types of electrons--extremely light ones and heavier ones-- moving at different speeds. As a result, an area of less dense electron liquid is formed. In response, electrons move back to compensate at the lower density end. Yet, some of them move faster than others. And a more sparsely dense area appears in another part of the material. And so on and so forth... This study demonstrates that the low energy plasmons, when tuned to the same wavelength as the lattice vibrations of the bismuth crystal, or phonons, can very efficiently slow lattice motion. In essence, this plasmon-phonon coupling mechanism, once intensified under specific conditions, could be a new way of transferring energy between electrons and the underlying crystal lattice. One implication is that the plasmon-phonon coupling can help to explain a long-since observed, significant effect in bismuth: the so-called Nernst effect. This occurs when a sample is warmed on one side and subjected to a magnetic field, causing it to produce a significant electrical voltage in the perpendicular direction. Hence it turns heat into useful electricity. Within the new interpretation the Nernst effect scales up with temperature in a manner that is in line with experimental observations in bismuth, lending strong support to the theory.

Source <http://www.sciencedaily.com/releases/2016/02/160203110649.htm>

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## 10. Researchers Report on New Tool to Provide Even Better Landsat Images



*JPL researchers report in *Optical Engineering* on a new imaging spectrometer design to improve Landsat images. Fig: Spectrometer ray-trace in the spectral direction. The two reflecting prisms and planoconvex element are made of  $\text{CaF}_2$ . The grating aperture as shown is 14 cm in diameter.*

For more than 40 years, Landsat satellites have provided a wealth of data that has informed our understanding of Earth features, phenomena, and environments as diverse as coral reefs, urbanization, tropical deforestation, and glaciers. Now, scientists at the Jet Propulsion Lab (JPL) at the California Institute of Technology have developed a way to substantially improve images derived from Landsat systems. Pantazis Mouroulis and colleagues at JPL describe in a new article published in *Optical Engineering* the design of a high-throughput and high-uniformity pushbroom imaging spectrometer and telescope system that is capable providing Landsat swath and resolution with better than 10 nm per pixel spectral resolution over the full visible to short-wave infrared band. The Landsat 8 satellite carries a thermal infrared sensor and an operational land imager (OLI). The OLI replaced a thematic mapper found in the previous Landsat generations, which used a scan mirror to cover the required wide swath. OLI instead utilizes long detector arrays in a pushbroom fashion, the authors note in "Landsat swath imaging spectrometer design." While the removal of the scan mirror is an advance in terms of signal to noise, reliability, and potential simplicity of design, the OLI design still suffers from registration concerns between bands owing to the nonsimultaneity of data collection. An imaging spectrometer does not suffer that problem since it is capable of collecting all bands simultaneously. Even more important is the enhanced science potential that the full spectroscopic capability brings, the authors note. "However," they write, "it has been generally difficult to find optical spectrometer and system solutions that satisfy the swath, resolution, spectral range, and signal to noise ratio of the heritage systems. We present in this paper a pushbroom imaging spectrometer design that can achieve these objectives." The significance of the report is that it demonstrates new capabilities in what is technically possible with advances in a range of supporting technology domains.

Source <http://www.sciencedaily.com/releases/2016/02/160201141920.htm>

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## Engineering Innovation in India

### Aurobindo Pharma

Among the largest 'Vertically Integrated' pharmaceutical companies in India, Aurobindo has robust product portfolio spread over major product areas encompassing CVS, CNS, Anti-Retroviral, Antibiotics, Gastroenterologicals, Anti-Diabetics and Anti-Allergic with approved manufacturing facilities by USFDA, UKMHRA, WHO, MCC-SA, ANVISA-Brazil for both APIs & Formulations. Founded in 1986 by Mr. P.V. Ramaprasad Reddy, Mr. K. Nityananda Reddy and a small group of highly committed professionals, Aurobindo Pharma was born off a vision. The company commenced operations in 1988-89 with a single unit manufacturing Semi-Synthetic Penicillin (SSP) at Pondicherry. In addition to being the market leader in Semi-Synthetic Penicillins, it has a presence in key therapeutic segments such as neurosciences, cardiovascular, anti-retrovirals, anti-diabetics, gastroenterology and cephalosporins, among others. Through cost effective manufacturing capabilities, the company entered the high margin specialty generic formulations segment.

In less than a decade Aurobindo Pharma today has evolved into a knowledge driven company manufacturing active pharmaceutical ingredients and formulation products. It is R&D focused and has a multi-product portfolio with manufacturing facilities in several countries. Auro Peptides Ltd. is the subsidiary division of Aurobindo Pharma, that delivers innovative solutions from discovery to development and commercialization through cost-effective drug development and manufacturing.

Aurobindo Pharma Ltd. is a vertically integrated pharmaceutical company that delivers innovative solutions. From discovery to development to commercialization, their growth is aided by cost-effective drug development and substantial manufacturing. The formulation business is systematically organized with a divisional structure, and has a focused team for key international markets. Leveraging on its large manufacturing infrastructure for APIs and formulations, wide and diversified basket of products and confidence of its customers, it aims to achieve USD 2 billion revenues by 2015-16. Aurobindo's nine units for APIs/intermediates and seven units for formulations are designed to meet the requirements of both advanced as well as emerging market opportunities. A well integrated pharma company, Aurobindo Pharma features among the top 10 companies in India in terms of consolidated revenues.

Aurobindo exports to over 125 countries across the globe with more than 70% of its revenues derived out of international operations. Their customers include premium multi-national companies. With multiple facilities approved by leading regulatory agencies such as USFDA, EU GMP, UK MHRA, South Africa-MCC, Health Canada and Brazil ANVISA, Aurobindo makes use of in-house R&D for rapid filing of patents, Drug Master Files (DMFs), Abbreviated New Drug Applications (ANDAs) and formulation dossiers across the world. Aurobindo Pharma is among the largest filers of DMFs and ANDAs from India.

Source <http://www.aurobindo.com/>

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