

Infosys Prize 2011 Presentation Ceremony

Bangalore

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Applied and fundamental research is indeed the prime need of the nation

“Inventions and discoveries have emanated from creative minds that have been constantly working and imagining the outcome in the mind. With imagining and constant effort, all the forces of the universe work for that inspired mind, thereby leading to inventions and discoveries.”

Dear friends, I am delighted to be with the experts, academicians, business leaders and distinguished guests at the Infosys Prize 2011 Presentation Ceremony in Bangalore organized by Infosys Science Foundation. My congratulations to all the winners present here for their work and achievements in the fields of their specialization. I would like to congratulate the Infosys who have thought of highlighting the globally competitive high performance in five different disciplines.

I was keenly reading about the work of the awardees present today. Prof. Kalyanmoy Deb, is being awarded the Infosys Prize for Engineering and Computer Science for enriching work in various multi-criteria dimensions of problem solving and decision making. Prof. Deb's research indeed will make a difference for both fundamental and applied aspects of optimization and the expected applications usefulness for industries such as logistic and refineries. His software helps to

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arrive at right solution from millions of choices, for example, selecting the right type of process linking cost, quality, availability in short time in manufacturing product and system.

The Infosys Prize for Life Sciences has been given to Dr. Imran Siddiqui for his breakthrough contributions to basic understanding of clonal seed formation in plants, and I hope his work could contribute in progressing in second green revolution in the nation.

Friends, as you all know, we are celebrating the 125th birth anniversary of the famous Indian mathematician Srinivas Ramanujan this year. With this backdrop of remembering such a remarkable mathematician of the past century, I am happy to note the contributions of the Infosys Prize for Mathematics awardee Prof. Kanan Soundararajan whose contributions to zeta functions have led to some critical proofs of the Quantum Unique Ergodicity. I am also happy to understand his work ranging from prime numbers to character sums and zeta functions have become standard tools of research in the mathematics field.

I am also happy to read about the work of the Infosys Prize for Physical Sciences winner – Prof. Sriram Ramaswamy. He has used simple but powerful arguments based on symmetry and conservation principles to uncover the strange laws governing the collective behavior of active particles

including organisms ranging from bacteria to macroscopic levels across a wide range of parameters.

Prof. Raghuram Rajan, the winner of the Infosys Prize for Social Science (Economics), is a well known expert in his field. His work on how excessive incentives can have negative effects on the overall economic health is indeed a far-sighted observation and today when we discuss the empowerment of under privileged population of the world, this focus on empowering rather than subsidies shall be a focal point.

When I read about the Infosys Prize for Social Science (Political Science) winner, Prof. Pratap Bhanu Mehta, I am reminded of how he has given a creative leadership in constructing an institution of Center for Policy Research. His critical thinking and insights are indeed a valuable contribution to the political processes of the nation in increasing global world.

Friends, when I see all of you, experts from multiple fields, I was thinking what topic I should discuss, which can act as a crucible for bringing together such a multi-diverse expertize. Hence, the topic I have selected for today is: ***“Applied and fundamental research is indeed the prime need of the nation”.***

The main theme that occurred to me was that we should become global leaders in science with our experience. Whenever we achieve some significant milestone, we are used

to seeing a foot note, we are the among the first six nations. How do we come out of this syndrome? In recent times, I have been interacting with a number of ignited minds with their creative ideas and experiments. India has the benefit of 600 million youth. And what an opportunity awaits the country. How do we achieve this? It is essential the creative class room, creative syllabus and creative teachers has to commence from the primary school level and this spirit of research and importance has to be focused all the way through secondary education and university education consecutively.

Basic research leads to competitive and prosperous India

When I was studying the Global innovation report for the year 2011, I found that as per Global Innovation Index Switzerland is ranked 1; Sweden 2; Singapore-3; Hong Kong-4; and India 62. There is a relationship between innovation index and competitiveness. While India is 62 in innovation index, our ranking in global competitiveness index is 56 in 2010-11. If India has to graduate from the present ranking in competitiveness index of 56 and become equal to economically developed nations (within the top 10), we should note that India will have to depend on the technologies derived from Indian science and improve its innovativeness index to better than 5. The present growth has been achieved by the use of technologies essentially developed elsewhere based on scientific discoveries and patents generated before 10 to 15

years. Definitely, latest technologies resulting from latest scientific results are not available from developed countries to India at least for a decade. Hence, research is very vital, particularly, basic science which will result in the latest technology required for meeting Global Competitiveness by Indian organizations, institutions and industry.

Let us now give a national perspective towards realizing the economically developed and peaceful India by the year 2020 through the application of sciences. The challenges of research and development are in the areas of, water, agriculture, access to green energy, ICT transforming into knowledge system powerhouse, customized healthcare for promoting, enhanced longevity and disease free life, balancing the green gas budget. If our nation undertake a R&D missions on these areas, then India not only can address the challenges of our country but helps the whole humanity.

Water: Adequate Quantity of Quality Water for All

We need to cater for about 1.5 billion people by the year 2030 with a target of 25 Kilo-liters of water annually for each citizen. Also, we have to provide adequate water for producing more than 400 million tonnes of quality food grains every year by 2030. This has to be achieved through both, demand and supply side management and brining innovation in research for producing quality safe drinking water at less cost. Also it is essential to save the 300 BMC flood water which goes to sea

every year and divert it for the effective use of enriching the agriculture growth through irrigation by Interlinking of Rivers and establishing Smart Waterways. Science should also find recycling methods for domestic and industrial waste water and desalination of sea water using solar energy. Further, there is also a need to work out cost effective and feasible strategies which will reduce the demand for water in sanitation and irrigation.

Sustainable Agriculture

Friends, when the entire planet Earth is faced with the problem of climate change, there is a need for Farmers, Agricultural Planners, Educationists and researchers to intensify the quantum of organic farming in the country. Organic agriculture recognizes that crop rotation and intensive partnership with animal husbandry is important to maintain ecological balance. In this respect, organic farming becomes a sustainable development process. Farmers can realize better value from the agricultural residue and value addition by introducing System of Rice Intensification (SRI) method for increasing the productivity of the Rice and Sustainable Sugarcane Initiative (SSI) method of increasing the productivity of Sugarcane, Precision farming for vegetable, fruits, horticulture and medicinal plants and various other food grains as followed in Tamilnadu. Also we need to continuously innovate to excel in agriculture, agro food processing sector for the complete life cycle from Seed to

market. There are many research and development and manufacturing tasks are ahead in farm based mechanization sector and agro –food processing sector.

While at National Institute of Rural Development, Mr. Yadav, a farmer in Andhra Pradesh with his experience in organic farming says, “**timely sowing, optimum plant population, balanced nutrition, proper water management, early weed control and pest control can lead to record production of mango and coconut with the application of organic manure**”.

The scientific community present should ask one question “How can we translate experience of people like Mr. Yadav and today we have seen the 6 researchers who got the awards into action across the county so that we get a scalable output?”

Access to Green Energy for All

India has 17% of the world’s population, but only about 1% of the world’s known oil and natural gas resources. Based on the progress visualized for the nation during the next two decades, the power generating capacity has to increase to over 950,000 MW by the year 2030 from the current 140,000 MW in India. This takes into consideration energy economies planned and the design and production of energy efficient equipments and systems. Energy independence has got to be achieved through three different sources namely renewable

energy (solar, wind and hydro power), electrical power from nuclear energy and bio-fuel for the transportation sector. Energy independence throws very important technological challenges to the world: The solar cell efficiency has to increase from the present 20% to 55% through intensified research on CNT (Carbon Nano Tube) based solar cells. As it is known, thorium is a non-fissile material. It has to be converted into a fissile material using Fast Breeder Technology. For the transportation sector, our aim should be to make the overall import crude oil to be zero, and this can be achieved through multi pronged strategies:

- (1) Work on alternative fuels like bio-diesel and ethanol which will completely replace fossil fuel utilization. It will also have systems to enhance Cetane and Octane number so that there is no need for changes in the engine design. Research on Emulsification technology using fossil fuel will help to save 25% of the fuel in Automobile and other forms of Energy Generation and also reduce the green house gas emissions.
- (2) Also necessary public policy level changes and ensure that all the systems and subsystems which consumes present fossil fuel has to be redesigned to suite the bio-fuel such as bio-diesel, ethanol and emulsified fuels. R&D has to be initiated to achieve this mission.

Space Solar Power Satellite

The sun, as you all know, radiates about 10 trillion times the energy which human consume across the world today. If we are able to extract even a small portion of this energy from the sun, it would be sufficient to secure the energy demands of our future. There are three major focus areas of research in the space based solar power plant. First component is the space based solar power plant. Second, is the earth based collection system. And the third important aspect is the medium of transmission from space to earth.

The aspect of safety and efficiency has to be paramount in the way energy is transmitted from space back to earth – either through microwave or any other technology like laser technology. Careful research of the impact and safety concerns would have to be conducted. When I am with such enlightened audience, I would like to share a new thought on transmission of solar power from space to earth, that may be safe and cost-effective. Science has history of making the impossible today, a reality of tomorrow. I venture now to suggest some ideas that may sound highly challenging and leave as food for thought for you to take up the challenge, for I am sure that if best brains, vouch to work together, all these impossible dreamer's ideas will become real and the world become the best place to live. Having established that the space is another destination for the man's quest for renewable energy, I have few ideas that may be or may not be out of the ordinary. While one could

approach the transmission of energy from space through micro waves and laser beams from space, I am thinking of attempting to transport “**nano energy packs**”, like nano batteries back and forth between space and earth. These nano energy packs may contain materials hitherto unknown but would store the energy through reversible chemical reaction or may be electrical reaction and when brought back to earth, can deliver energy per kg of payload touching several hundreds of watt hours. Another important factor in this sector is reducing the cost of access to space. Number of science and technological research missions are needed to be initiated to reduce the cost of access to space from \$20,000 per orbital kg to \$2000 per orbital kg. Can we do this? It has to come through a multi-pronged approach with international collaboration and investment

ICT transforming into a Knowledge system Powerhouse

The strides we have made in ICT are very significant. However the potential that is offered by the requirements of the billion plus population is also enormous, challenging and fulfilling. I am a proponent of “free bandwidth”. If that has to become reality, the mobile revolution has to be made sustainable by constantly increasing value added services in the infotainment and other sectors. The e-Governance has to percolate the country in a war footing to improve efficiency of governance, to service the citizens, to maintain transparency

and above all enable connectivity of the governed and governing. And again, all these can result in many job creators, as already ICT has demonstrated. We need to graduate towards knowledge power house from the IT software power house. In the knowledge economy of 2030, the objective of a society changes from fulfilling the basic needs of development to that of empowerment. The objective of knowledge society will change from physical transactions to large scale virtual transactions. The researchers have to see how to move towards this transformation without the pain of transition. I will now talk about the research tasks in the customized Healthcare in 2030, which will promote enhanced longevity and disease free life.

Customized Healthcare for promoting enhanced Longevity and Disease free Life

If we study the Human genome, it is reported that every human being has 70,000 genes and they are packaged in 23 chromosomes. If we ask ourselves, what percentage of genes influence the aging phenomena in human being, it is said that, only 10% genes (7000) influence aging. It is said that “each chromosome is just a giant super coiled, foot-long DNA molecule”. It can be copied fully excepting the very tip of each end. This stretch of terminal TDM is known as telomere. In our body, telomeres are continuously shortening at the rate of “31 letters” in a year. In an 80 years old person, telomere on

an average is about 62.5% as long as it was at birth. It is also said, telomere length is strongly inherited as is longevity. Natural selection has built our telomere of such a length that they can survive at most for 75 to 90 years wear, tear and repair. How the medical community and life scientists can work together to find a method by which we can delay the process of wear, tear and repair of telomere which can lead to further enhancing a disease free longevity of the individual. Based on the knowledge of the distribution of 7000 genes which determine aging, the medical researchers should advise appropriate proactive preventive healthcare as soon as the child is born.

This should be complemented with convergence of bio-nano-info technologies which can lead to the development of nano robots that may results revolution in healthcare system. Nano robots when they are injected into a patient should be able to diagnose and deliver the treatment exclusively in the affected area and then the nano-robot should get digested. Let me now talk about how by 2030, we need to mitigate the risks posed by the Green House Gas Emissions.

Balancing the Greenhouse Gas Budget

The earth has both natural sources and sink for the Greenhouse gases which are delicately balanced. Natural sources of Greenhouse gases are volcanic eruptions, decaying vegetation, releases from oceans and land due to natural

processes. These are balanced by natural sinks of Greenhouse Gases like ocean absorption, plants and soil.

As in 2010, the Carbon dioxide emission worldwide stood at roughly 34 billion tons or 34 Gigatons annually. Out of this, around half is absorbed in natural sinks of oceans and soil. This means, around 17 Gigatons of additional CO₂ is released into the atmosphere.

The scientific community has the responsibility to have an overview of the complete problem taking into account all the GHG producing system and the GHG absorbing systems. This should lead to decisions on energy independence using green sources, plantation and afforestation and botanical research to reduce the methane emission and increase the CO₂ absorption per unit area by alternation of the pore sizes of the leaf.

So far I have discussed the challenges ahead in many diverse sectors of the economy. Since Infosys Science Foundation is rightly taken up to celebrate the success of the achievers in many areas, it is time now to speed up the research and development tasks with the public private partnership model. What is the mechanism to implement this missions?

World Knowledge Platform

Dear friends, With the Indian experiences of successful international cooperative ventures from concept to realization

and marketing such as Brahmos and Pan African e-Network, India is in the mission of establishing the “World Knowledge Platform. The convergence of Bio, Nano and IT is expected to touch every area of concern to the humanity. The “World Knowledge Platform” will take up the missions, in many R&D challenges such as Water, Energy, Healthcare, Agriculture, ICT, Automotive and Transportation, Habitat, Disaster Prediction, Aerospace and Capacity Building, which are of utmost urgency to all of us to make our world a safe, sustainable, peaceful and prosperous place to live.

Like Infosys, many IT and other industry houses has to join together with the Government departments and academia and formulate a World Knowledge Platform for Research mission with a joint investment of \$1 billion to start in a PPP mode. This \$1 Billion research laboratory will start attracting the researchers from many parts of the world including the best scientific minds from India. That mission will focus on Science, Research and Development, Transforming into technology resulting into Products and systems so that the research of the results will enrich the business growth of our nation while finding the integrated solution for the challenges. That will enrich the universities with projects and necessary funding for the R&D Missions and will work as a feedback mechanism between industry and academia. For that what is necessary is the creative leadership in all the sectors.

Conclusion: Qualities of Leadership

Friends, I have seen three dreams which have taken shape as vision, mission and realization. Space Program of ISRO (Indian Space Research Organization), AGNI program of DRDO (Defense Research and Development Organization) and PURA (Providing Urban Amenities in Rural Areas) becoming the National Mission. Of course these three programmes succeeded in the midst of many challenges and problems. I have worked in all these three areas. I would like to convey to you, what I have learnt on leadership from these three programmes.

- a. Leader must have a vision.
- b. Leader must have a passion to accomplish the mission.
- c. Leader must be able to travel into an unexplored path.
- d. Leader must know how to manage a success and failure.
- e. Leader must have courage to take decision.
- f. Leader should have Nobility in management.
- g. Every action of the leader should be transparent.
- h. Leader should work with integrity and succeed with integrity.

I have been discussing these essential traits of creative leaders with people of eminence in different areas and students from India and abroad. Apart from this what is needed is the spirit among the youth that “I can do it, we can do it and the nation can do it.” Our educational institutions have to concentrate on developing the leadership traits and the confidence to perform among every youth of the nation. This quality of leadership will certainly empower the underprivileged people of the world and lead to inclusive development.

Every year, Infosys Science Foundation is awarding six Infosys prizes for various research areas. The nation (Government, industries, research laboratories and the universities) has to facilitate such researchers to participate in our university research programme and enrich our young research minds.

With these words, today’s Infosys Science Foundation function, I have witnessed the celebrating the research areas, celebrating researchers and celebration of the best in the areas, and celebrating the best, so that the research culture and research intensity will go on multiplying. My greetings and best wishes to all of you.

May God Bless you.