

Address and Interaction with the Students & Faculty of  
**Birla Institute of Technology and Science**  
**Pilani, Rajasthan**  
30 March 2007

**Convergence of Technologies**

*“Technology is a non-linear tool  
which can effect fundamental changes  
in economic competitiveness”*

I am delighted to address and interact with the students and the faculty of Birla Institute of Technology and Science (BITS). I greet the Vice-Chancellor, Faculty members, Students, Parents and other distinguished guests. I take this opportunity to congratulate all the Faculty members, Students and staff of this Institute and all those who have contributed in promoting good educational standards in this institute, during the last four decades and transformed BITS, Pilani as a world class institution. BITS Pilani with its linkages with premier educational institutions and industries has the right ambience for the creation of Global Human Resource Cadre. While I am with you today, I recall my visit to Dubai Campus of BITS, Pilani at Dubai Knowledge Village on 20th October 2003. I had a beautiful experience of addressing and interacting with the Students and Faculty members. Since I am in the midst of prospective scientists and technologists, I

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would like to share with you few thoughts on the topic “convergence of technologies”.

### **Can computer challenge the Brain?**

I understand that most of the computers of the future and accessories will be micro sized, wearable and will have wireless communication with each other. Moderately priced PCs capable of performing about a billion calculations per second today will be able to perform about a trillion calculations per second within next 10 years. It is predicted that by 2019, the computational ability of an ordinary PC would exceed the capability of human brain. By 2029, the capability of a normal PC would be around 1000 times that of the human brain. (Reference: The age of spiritual Machines by Ray Kurzweil)

My view is, definitely the creativity of the human mind, will always be superior to the most powerful computers in the horizon. Promoting Creativity has to be the mission of Institutions like BITS Pilani.

### **India in transformation**

India is well on its way to become a knowledge power, there are all round growth in all sectors of the economy namely the agriculture, manufacturing and services. Today we have an opportunity to take the leadership in the knowledge

revolution. Knowledge Revolution is indeed the foundation for leading India into a Developed Nation. For this, the time is ripe because of the ascending trajectory of the economy, availability of great institutions for capacity building of the human resource, abundant bio-diversity, and other natural resources and above all, our 540 million youth who are determined to make the nation prosperous, happy and a safe place to live well before 2020. With this background India must take the lead in mobilizing and integrating national and international knowledge resources.

### **Convergence of Technologies**

The information technology and communication technology have already converged leading to Information and Communication Technology (ICT). Information Technology combined with bio-technology has led to bio-informatics. Now, Nano-technology is knocking at our doors. It is the field of the future that will replace microelectronics and many fields with tremendous application potential in the areas of medicine, electronics and material science. When Nano technology and ICT meet, integrated silicon electronics, photonics are born and it can be said that material convergence will happen. With material convergence and biotechnology linked, a new science called Intelligent Bioscience will be born which would lead to a disease free, happy and more intelligent human habitat with longevity and high human capabilities. Convergence of bio-

nano-info technologies can lead to the development of nano robots. Nano robots when they are injected into a patient, my expert friends say, it will diagnose and deliver the treatment exclusively in the affected area and then the nano-robot gets digested as it is a DNA based product. Let me share with you some of the nanotechnology products that have emanated from the Indian labs and academic institutions.

### **Products progress in Nano Science & Technology in India – some examples**

#### **a. *Water: Nano tube filter – water purification***

The scientists from Banaras Hindu University have devised a simple method to produce carbon nanotube filters that efficiently remove micro-to nano-scale contaminants from water and heavy hydrocarbons from petroleum. Made entirely of carbon nanotubes, the filters are easily manufactured using a novel method for controlling the cylindrical geometry of the structure. The filters are hollow carbon cylinders several centimeters long and one or two centimeters wide with walls just one-third to one-half a millimeter thick. They are produced by spraying benzene into a tube-shaped quartz mold and heating the mold to 900°C. The nanotube composition makes the filters strong, reusable, and heat resistant, and they can be cleaned easily for reuse.

The carbon nanotube filters offer a level of precision suitable for different applications. They can remove 25-nanometer-sized polio viruses from water, as well as larger pathogens, such as E. coli and Staphylococcus aureus bacteria. The researchers believe this could make the filters adaptable to micro fluidics applications that separate chemicals in drug discovery.

**b. *Power: Gas flow induced generation of voltage from solids***

Prof AK Sood, Professor of Physics at IISc and his student Shankar Ghosh has studied, experimented and found that the liquid flow in carbon nano tubes can generate electric current. One of the most exciting applications to emerge from the discovery is the possibility of a heart pacemaker – like device with nanotubes, which will sit in the human body and generate power from blood. Instead of batteries, the device will generate power by itself to regulate defective heart rhythm. The IISc has transferred the exclusive rights of the technology to an American start-up Trident Metrologies. They will develop the prototypes and commercialize the gas flow sensors.

**c. *Drug delivery system***

A research group headed by Professor A. N. Maitra of the University of Delhi's Chemistry Department has developed 11

patentable technologies for improved drug delivery systems using nanoparticles. Four of these processes have been granted U.S. patents. One of the important achievements at the initial stage of drug delivery research was development of a reverse micelles based process for the synthesis of hydrogel and 'smart' hydrogel nanoparticles for encapsulating water-soluble drugs. This method enabled one to synthesize hydrogel nanoparticles of size less than 100nm diameter. This technology has been sold to Dabur Research Foundation.

Another technology has been transferred to industry deals with nanoparticle drug delivery for eye diseases. Traditionally, steroids have been used extensively in the treatment of ocular inflammatory disease and allergies. However, prolonged use of steroids has many side effects. The Delhi University group's process uses nanoparticles to encapsulate non-steroidal drugs. This process aims to improve the bioavailability of the drug on the surface of the cornea. The technology has been transferred to Chandigarh-based Panacea Biotech Ltd.

d. **Microwave CNTs Production unit**

DMSRDE, Kanpur is synthesizing non-aligned, quasi-aligned and aligned CNT with a batch size of 50 grams using a fast synthesis process. It has a maximum operating temperature 1200<sup>o</sup> C. The CNTs will have applications in EM

absorbers, composites, gas sensors, flow monitors, field emission devices.

**e. *Healthcare: Typhoid Detection Kit***

Typhoid Detection Kit has been developed by DRDE, Gwalior using the nano sensor developed by IISc, Bangalore. Typhoid fever caused by *Salmonella typhi* is a major health problem and an important challenge to health authorities of third world countries due to unsatisfactory water supply, poor sanitary conditions, malnutrition, emergence of antibiotic resistant strains etc. According to an estimate the worldwide incidence to typhoid fever is 16 million cases annually and death rate is 6 lakhs individual per year worldwide. In India, the morbidity due to typhoid varies from 102 to 2219/100,000 population in different parts of the countries. In some areas typhoid fever is responsible for 2-5% of all deaths.

In India for routine diagnosis for typhoid disease Widal test is performed with single serum sample which does not provide the correct diagnosis of infection. Therefore a Latex agglutination based test has been developed at DRDE, Gwalior using recombinant DNA technology and immunological technique for rapid diagnosis of typhoid infection. The test detects “S” typhi antigen directly in patient’s serum within 1-3 minutes which is very important for initiating early treatment and saving human life. The collaborative work between

DRDO and Indian Institute of Science, Bangalore has resulted in increasing the sensitivity of the test by 30 times by applying a small electric charge (1.5 V).

### **Partnership in mission mode**

Now, I would like to discuss the experience the nation has gained by bringing together the core competence of two nations resulting in a state-of-the-art world class system having a global market and connectivity mission with 53 African nations.

**An International Joint Venture – BRAHMOS:** In order to achieve global competitiveness, the product must be world class with high quality, cost effective and must be available in time within the shelf life of the product. I would like to share a unique experience of design, development, production and marketing of a missile system - BRAHMOS, an Indo-Russian joint venture. What we have achieved through this venture is the development and realization of a world-class product using the synergy of technological competence and consortium of industries of partner countries. The BRAHMOS missile is the fastest operational cruise missile existing in the world today and can be launched from any type of platform - land, sea, and air and precisely reach the targets either on land or at sea with high lethal effect. The missile has undergone twelve

successive successful flight trials and has been inducted by the Indian Navy. In addition, the product being internationally competitive, it is able to service a large market with availability in time and state of the art performance at reduced cost per unit. With minimum incremental investment the product has been developed and led to production and induction, at a relatively short time frame, well ahead of prescribed schedule. This has enabled early entry of the product into the world market well before any competitor could emerge. This proves that if the core competencies of nations are synergized, best of knowledge products can emanate well ahead of time.

### **Pan African e-Network**

During the year 2003-04, I visited African countries such as Sudan, Tanzania, Zanzibar and South Africa. I addressed the Pan African Parliament on 16 September 2004, at Johannesburg, South Africa which was attended by Heads of 53 member countries of the African Union. Based on my study of connectivity needs of African countries in communication, healthcare and education, I proposed the concept of Pan African e-Network using seamless and integrated satellite, fiber optics and wireless network connecting all the 53 African countries.

Twelve universities (7 from India and 5 from Africa), seventeen super specialty hospitals (12 from India and five from Africa), fifty three tele-medicine centers and fifty three tele-education centres in Africa will be connected through the Pan-African e-Network project. The pilot project on tele-education and tele-medicine in Ethiopia has already been commissioned. One of our Indian Universities has taken up the MBA Course for 34 Ethiopian students of Addis Ababa and Harmaya Universities. As regards, tele-medicine, the specialists from CARE Hospital, Hyderabad are providing one-hour live tele-consultation to doctors in Black Lion Hospital, Addis Ababa in Cardiology and Radiology since November 2006. The Pan African e-Network will primarily provide Tele-Education, Tele-Medicine, Internet, videoconferencing and VOIP services. It also supports e-Governance, e-Commerce, infotainment, resource mapping and meteorological services. Each remote location will be able to access the Internet through the network by linking the HUB to Internet backbone. Using this network the Heads of the State in all the 53 countries will be connected for instant communication. The network is designed to have 169 terminals and a central hub to deliver tele-education and tele-medicine services. The proposed network will utilize state-of-the-art technology and can be integrated with the latest broadband technologies like Wi-Fi and Wi-Max. The network is scalable to support different applications catering to increased number of users. I am

happy to inform you that 22 countries will be connected by the first half of 2007 and the rest will be operationalized by early 2008.

### **World Knowledge Platform**

From these international partnership experiences, we have evolved what is called a World Knowledge Platform, which will be the launch pad for many innovations that are waiting to be unearthed only by the combined power of all the scientists and technologists drawn from many institutions both in India and abroad.

**Missions of World Knowledge Platform:** The convergence of Bio, Nano and ICT is expected to touch every area of concern to the humanity. The “World Knowledge platform” will take up the missions, in some of the areas given below, which are of utmost urgency to all of us to make our world a safe, sustainable and peaceful and prosperous place to live:

1. Energy: exploration, storage, production and conversion
2. Water: treatment and desalination
3. Healthcare: Diagnosis, drug delivery system
4. Food: preservation, storage and distribution

5. Knowledge products :Hardware, Software and Networking Products
6. Automobile: Hardware and embedded software integration

In addition to the areas mentioned above, areas such as electronics, ICT and Automobile Sector may also be focused especially in the areas of design, development leading to productionization for meeting the market demands of many nations. The core competence of India is software and the core competencies of the other partner nations could be hardware and software. This can lead to design, development and marketing of world class systems that is equally dominated by the software intelligence and hardware innovation. The world knowledge platform will also evolve a virtual design centre with the participation of collaborating institutions. Students and faculty members of BITS Pilani can definitely participate in such a collaborative programme.

### **Virtual University**

BITS Pilani with its experience having campuses in multiple locations in India and abroad should now create a virtual university through networking. You have to only position the infrastructure and the modalities in place so that you can become the operational virtual university in the country combining 45 years of accumulated academic and

research strength. This virtual university will enable students to attend courses of their choice without geographical constraints. The day when all our educational institutions begin to offer this flexibility and assure constant and consistent high quality among students spread across the length and breadth of the country, we can definitely get transformed into a knowledge society.

### **Attracting students to Virtual Universities**

While it is unarguable that the Virtual Universities provide us with technologies of the future and the most economic way of scaling high quality education in the country, they are no substitute to the campus based education. The challenge to the Virtual Universities is to provide the best of breed of both the worlds. In this process, we could plan an optimum mix of direct contact hours between the students and the teachers and also amongst the students themselves. These interactions should also be used as a platform to excite the students to take to learning in the new paradigm.

In the world of Virtual Universities the equitable access to all its participants is the primary goal. Unlike in the real world, the equitable access is always the democratic average, in the Virtual Universities the equitable access always means the equitable access to the best resources – be it the teachers,

be it the library, be it the laboratory, available across the network. In effect, the network brings the best of its participants to every one of its participants.

## **Conclusion**

Recently, I was reading the two volumes of the book titled 'The Big and the Small' from the Microcosm to the Macrocosm written by Dr. G. Venkataraman. In this latest book, author establishes fascinating link between particle physics and cosmology in two volumes. Since I am in the midst of students, faculty members and researchers of BITS, Pilani, I thought of sharing with you an incident narrated in the book about Sir CV Raman. Raman was in the first batch of Bharat Ratna Award winners. The award ceremony was to take place in the last week of January, soon after the Republic Day celebrations of 1954. The then President Dr. Rajendra Prasad wrote to Raman inviting him to be the personal guest in the Rashtrapati Bhavan, when Raman came to Delhi for the award ceremony. He wrote a polite letter, regretting his inability to go. Raman had a noble reason for his inability to attend the investiture ceremony. He explained to the President that he was guiding a Ph.D. student and that thesis was positively due by the last day of January. The student was valiantly trying to wrap it all up and Raman felt, he had to be by the side of the research student, see that the thesis was finished, sign the

thesis as the guide and then have it submitted. Here was a scientist who gave up the pomp of a glittering ceremony associated with the highest honour, because he felt that his duty required him to be by the side of the student. It is this character that truly builds science.

I am sure that the Faculty members of BITS Pilani will embed this quality among the Students graduating from this Institute. My best wishes to all the members of BITS Pilani community.

May God bless you.