6th Convocation
19th January 2010

Address of the Chief Guest

I deem it a great privilege to be invited for giving the 6th Convocation address of the Dhirubhai Ambani Institute of Information and Communication Technology. I am indeed extremely impressed by the progress made by DA-IICT in the short period of only nine years. I congratulate the management, faculty and students who have brought it a very fine reputation.

Please permit me to dream about the future of DA-IICT. I dream that in years to come, say by the end of this decade, DA-IICT can and should become a world class institution, not only in the area of ICT but also in the fields of science, engineering and social sciences. Beyond any doubt, India is currently on a great forward march. Our future progress would depend critically on the growth of world class universities in India. India should seize this moment in its history. As an example, the faculty and students of the Stanford University, my alma mater, created not only the Silicon Valley that led to revolution in the field of information sciences and communication technology, but also in the fields of electronics, microwaves, semi-conductors, high energy physics, medical sciences to name only some of the areas. Although a private university, Stanford had freedom to continue to excel by seeking funds fom alumni, industries and also the national science funding agencies, based on projects submitted and results achieved. India badly needs a few world class universities in order to bridge the gap between the fields of science, engineering and social sciences. Universities produce leaders of tomorrow by giving an all round education, while giving specialization in specific areas.

India became a Republic on January 26, 1950. During the last 60 years, great progress has taken place in India, though much more needs to be done. As one of the many examples, during 1 951 -52, very few bicycles were made in India and ~ 280,000 were imported. On the other hand, more than 2 million bicycles, nearly one million motor-bikes, nearly 330,000 automobiles were

manufactured in India during 2008-2009. Further, today, India is poised to become a world leader in the field of automobile manufacturing. The growth of Indian industry was quite slow during the license raj till 1991. Nevertheless, many enterprising industrialists learnt to deal with the bureaucrats and politicians, a prime example being that of the late Dhirubhai Ambani. In 1991, India had to send ~ 700 tons of its precious gold to banks in UK, so that letters of credit issued by the government agencies and Indian industries could be honoured!

The economic liberalization of India in 1991, spurred the growth of Indian industries. India's progress has continued to accelerate, resulting in the glorious decade of 2000-2009. Our foreign exchange reserves are ~ USD 287 billion today, contributed in a good part by the software industry, BPOs, textiles, diamond polishing and leather industry, etc, areas that depend on the relatively low cost labour in India compared to that in the world. That advantage may not last for long. We need to enhance the skills of our population, comparing to those in the developed nations.

In August 1943, Dr. Homi Bhabha, a young man of only 34 years, wrote a letter to Mr. J.R.D. Tata, followed by a letter in March, 1944 to Sir Dorabji Tata Trust for setting up a "school of physics comparable with the best anywhere" that led to the establishment of the Tata Institute of Fundamental Research in 1945. His letter to the Dorabji Trust, written 18 months before the explosion of the atomic bomb at Hiroshima and Nagasaki, that were developed in a top secret Manhattan project in USA, was prophetic: "Moreover, when nuclear energy has been successfully applied for power generation, say in a couple of decades from now, India will not have to look abroad for its experts but will find them ready at hand.

During 1940s and 1950s, Dr. Bhabha encouraged Dr. Vikram Sarabhai to carry out cosmic ray and upper atmospheric research. Soon after the launch of the pioneering Sputnik satellite by USSR in 1957, Bhabha supported the efforts of Dr. Vikram Sarabhai for starting space research and technology. Of many great success stories of the last 60 years, I may cite only a few, such as the Atomic Energy programme initiated by Dr. Bhabha, Space science and technological endeavors by Dr. Sarabhai, Green revolution by Dr. Swaminathan, white (milk) revolution by Dr. Kurien, amongst many other examples. I am optimistic that

we would have many more success stories in the next decade. ICT will play an important role in these areas.

In a conference on Communications held at the Indian Institute of science in December 1999, in association with five IITs, I gave a talk, as the Chief Guest, titled "India's Grey Gold, a rare opportunity for India". I summarized in 1999 "can India become a world power through tele-networking and extensive software export- a challenge to educational institutes and industry". I concluded that "we should be able to aim at software export of about Rs. 100,000 Crores ($25 billion) in the 10th year from today. The question is can we do it? This is a rare opportunity for India to become a world power by using its brain wealth, i.e. its grey matter or what I have coined as INDIA'S GREY GOLD". As a radio astronomer, I was quite familiar with the theory and practice of Fourier Transform, digital techniques and complex image processing. Also, I had built two of the world's largest radio telescopes of a completely novel design fully indigenously in India by 1996. Hence I could see the potential of India's Grey Gold. However, I underestimated the growth of the software industry during 2000-2009. According to the NASSCOM report of February 2009, India's exports due to IT services were US $ 26.9 billion, BPO services US $ 12.8 and Engineering Services and Software Products US $ 7.3 billion, a total of US $ 47 billion. I had not reckoned the growth of the BPO services, which is an important sector. As highlighted by Professor Parsuraman in his talk in the NIS Spartas knowledge series (an initiative of the ADA group), firms can get marketing excellence through superior services and productivity. I consider that computers, automation and software products play an important role in the growth of companies, supplementing the enterprise and vision of their management and workers.

Globally Software and Services touched US $ 967 billion in February 2009. India has still a long way to go. Unfortunately, India has not been able to develop original software products except in a relatively small way. That is a great challenge for this decade. Can it be done? I believe it is possible. In my view, it requires convergence of science, education and industry. DA-IICT could take a lead in this direction, by appropriate course work, increase in R&D efforts and continuing education of its graduates in their later career. Also DA-IICT may organize workshops of a week or two, inviting experts from India and abroad and participations by selected software engineers from across India, who could

come on deputation or leave from their companies. I am not an expert in the field but I believe that DA-IICT could do it, as it is supported by one of India's very successful enterprises. The success of Chandrayaan mission, at a cost of only Rs. 300 Crores, clearly demonstrates that we can become leaders in R&D efforts in many fields, including the development of software products in the next decade. I see the signs of it here and there.

Another great success story of India is the growth of mobile communication. With only a few millions in late 90s, there are more than 480 million subscribers today and growing by
~ 1 5 million every month. Reliance WiMax has been in service in Pune for ~ 2years. Soon WiMax and 3G would be introduced in many cities in India. It would provide mobile broadband capability and may require engineering; research in areas such as pico-cells and femto-cells. Mobiles have changed as to how one communicates with friends and families; and how business is done not only by shopkeepers and companies but also by farmers, electricians, plumbers and carpenters. I understand that Reliance Communication has established integrated digital network covering over 20,000 towns and 500,000 villages. There is tremendous potential for using the communication network for imparting education to millions. As an example, optical fibre network is widespread in India, connecting almost every village. However, our engineers and technocrats have not managed to produce a low cost electronics unit for broadband communication, so that every student, particularly in our small town and villages, can access vast amount of knowledge, available on the net at a low affordable cost. Wireline and wireless communication and affordable LCD projectors can supplement primary education across India and wake up India's sleeping 'Giant'.

We have failed miserably towards design and manufacturing of electronics products. Over the last 1 5 years, I have interacted with several bright B.E. or B. Tech students from some of the reputed engineering colleges in Pune, guiding their 4^{th} year project. I find that the practical skill of students is rather poor in the field of electronics as their coursework and exams concentrate on theory. As a result, we continue to import electronics designs and products of more than Rs, 100,000 Crores every year, including the simple key used for opening or closing the car doors, to electronics used in TVs, computers, communication

towers, and defense equipment. In spite of having a tax exemption of 1 50 percent, the Indian industries spend very little on research and development.

MNCs do R&D in India and get equipment manufactured in China that gets imported to India as well!

I suggest that centralized facilities could be set up in the field of electronics in several major towns in India with advanced test equipment and electronic components, so that selected students from various engineering colleges could learn on their own by building various electronics circuits and products through their 4-year of under-graduate degree under minimum guidance by staff, who may also do consultancy and research. Various international firms plan to make India a manufacturing hub in electronics by 2020 but that would require availability of adequate manpower in India.

There are indeed many challenges for developing software solutions for education, agriculture, health and security not only for computer networks but also against acts by terrorists. The challenge taken by Shri Nandan Nilekani for Unique Identification Number (UID) to every citizen is likely to transform India, so that vast majority of India's population would be able to access information and services without bribing corrupt politicians and officials, as one of the examples.

Computers and software solutions are a vital tool for modern research. It would not have been possible to decode the human genome without the help of computers. Now we need to develop innovative low cost solutions for genetic mapping of every individual so as to identify any genetic defects that may lead to serious sickness later. I recently heard a talk by Professor Balaram, Director, of the Indian Institute of Science, who described identification of every molecule of the venom of snakes and certain rodents, using a standard gas-chromatograph and computers in his laboratory, in some cases by his B.Sc. students during a
summer project. Computers will help in discoveries of new drugs,

Another example is that of the Giant Metrewave Radio Telescope built by us at TIFR fully indigenously 80 km north of Pune. The GMRT consists of 30

antennas, each of 45m diameter located in an array of 25 km in extent. It records trillions of bytes of data every day. Many innovative algorithms have been developed for analyzing the data. At the end of the day, images of radio galaxies and quasars are made, as if made by a perfect parabolic dish of 25 km diameter that becomes possible by using ingenious software solutions! Operating in five bands in the frequency range of ~ 130 MHz to 1430 MHz, GMRT is the largest radio telescope in the world. It is being used by hundreds of radio astronomers from India and 22 other countries, including those from Cambridge, Oxford and Stanford. A sophisticated correlator system using FPGAs and cluster computing is under development in order to enhance the capability of the GMRT by a large factor, a very challenging project. The international SKA project, of which India is also a partner will be 50 times more powerful than any existing radio telescope in the world; its performance would depend critically on innovative software control and processing solutions, for which India can make a major contribution. Considering the mathematic ability of a large fraction of our students, India can and should become a leader in the field of scientific software.

One does not have to be a genius to participate in modern research. In January 1948, when I was a B.Sc. student, Professor C. V. Raman attended the Science Congress held at the Allahabad University. In a lecture he looked at each of the students and remarked that making a discovery is 99% perspiration and 1 % inspiration. I said to myself that I live in a hot country and perspiration is not my problem.
Fortunately, I had good teachers who inspired me. Although I have specialized in the fields of physics and astronomy, I have learnt basics of electronics and other engineering subjects, enabling me to participate in world class experimental projects. I may stress that it is important for B. E. and B. Tech. students not to forget basics of the science subjects, such as physics, chemistry and mathematics as they continue to specialize in the field of ICT.

In the Diamond jubilee year of our Republic, we are now standing at a cross road. There is great deal of prosperity in our cities, yet there are more than 27% of our population below the poverty level, not adequate food, no education to their children and no electricity. Our higher education is in a mess. As I said earlier, ICT can play an important role towards mass education. Further, we need to develop new products, There is serious shortage of faculty

even in our distinguished IITs. In the past there was a long gap between a scientific discovery and its technological innovation. Today, there is a gap of only few years. Nano-science is one of many examples. As I said earlier, we need to integrate education in the fields of science, engineering, literature and social sciences. Only then we would be able to educate adequate numbers of students to tackle myriad of problems facing the nation and the world, concerning environmental degradation, new sources of energy, food shortage, shelter, optimum utilization of water resources, bio-terrorism, etc. Ten years of canvassing by the late Professor V. G. Bhide and me led to the establishment of five Indian Institute of Science, Education and Research for a 5 year education after 10+2 education (IISER) under MHRD and one NISER under the Dept. of Atomic Energy. We need to have a better tie up between IITs, IISERs, R&D institutions and industry, so that students can see the vast potential and opportunities existing in India.

To summarize, economic liberalization in 1991 has unleashed enterprising skills of our population, placing India in the forefront of the nations in the globe. Graduates from IITs, IIMs and other institutions have amply demonstrated India's intellectual capability. Challenges and opportunities for new ventures and initiatives in the coming decades are enormous. Today money is not in short supply in India. Further, India has largest number of young persons below the age of 25 years in the world.I congratulate all the graduating students and my felicitations to those getting prizes. Your parents would have a great sense of pride today. I admire the faculty members for giving you quality education. There are many great opportunities in the world today. I am sure that you will be very successful in whatever you choose to do. World belongs to those who dream and act.

Prof. Govind Swarup
FRS, Former Director of NCRA,
TIFR, Pune.