

CHAPTER ONE

**WHY IITs ARE IMPORTANT
TO THE NATION?**

*“The best higher education is a model
and a source of pressure for creating
a modern civil society. This is an ideal
not often realized but is nevertheless a standard
against which to measure national systems”*

WORLD BANK TASK FORCE REPORT:

*“Higher Education in Developing Countries:
Peril and Promise 2000”*

CHAPTER ONE

WHY IITs ARE IMPORTANT TO THE NATION?

The resurgence of India as a nation competitively endowed in science, technology and higher technical education can be traced to the vibrant currents of 1947 when, to India's great fortune, Jawaharlal Nehru took charge as the country's first Prime Minister. Among his several pioneering initiatives designed to accelerate India's development through education and research in scientific and technology disciplines, several specific projects have stood out with extraordinary success and have achieved global reach and stature. Among them is his visionary venture to set up a group of institutions called the Indian Institutes of Technology. From Kharagpur in 1950 to Roorkee in 2001, there are now seven potentially world-class institutions in the family. Their consistent performance assiduously kept up in the last fifty years has attracted not only nation-wide acclaim for them but provided them international commendation, which they so richly deserve. What are those features associated with the IITs that have contributed to their *brand* as institutes of excellence?

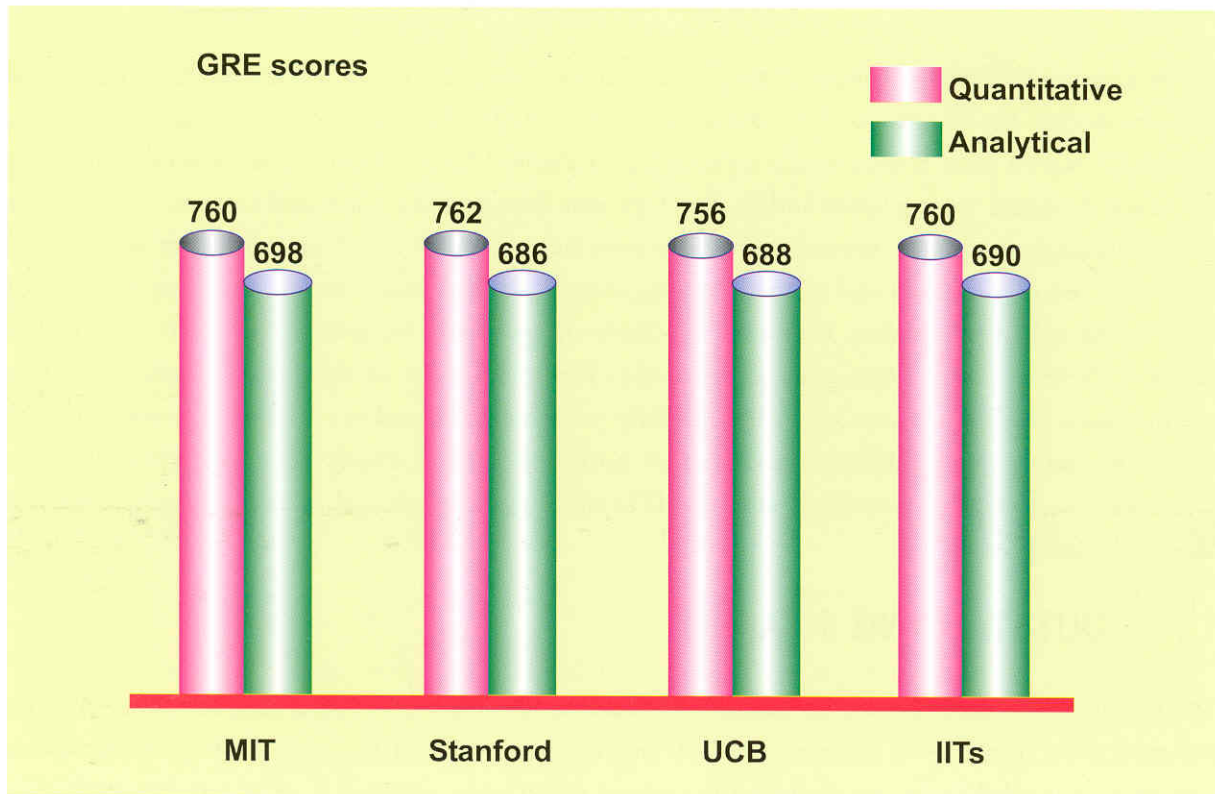
1.1 OUTSTANDING INTAKE

The nation-wide examination that the IITs conduct to select the most deserving for admission has proved to be a significantly effective filter. At one time the ICS and, later on, the IAS examinations conducted for *graduates in any discipline* throughout the country enjoyed a great reputation. Such a reputation was based on transparency and rigour of the selection process. No wonder those that withstood the pressure and succeeded in the selection, from among the several thousand that attempted, shone as visionary builders of our institutions. They stood apart as exemplary guardians of the nation's stability and committed their indefatigable energy and contribution to India's economic and social development. It may not be an exaggeration to state that the JEE, *held for the 12th grade students*, in recent times has perhaps eclipsed these and a myriad other competitive examinations in its ability to pick the most outstanding from a very large gene pool. In nurturing the IIT system with the ablest in this way, the JEE is singularly responsible for accomplishing the brand image to India. The IITs have thus emerged as a cradle for India's future leaders.

1.2 WORLD CLASS PERFORMANCE OF THE B.Tech. GRADUATES

The International competitiveness of the IIT undergraduates is reflected in their performance at the Graduate Record Examination (GRE) of the USA, an examination for graduates from all over the world. A comparison of the performance levels at the GRE between the IIT B.Tech.s and those of the three of the best institutions in the world is shown in Figure 1.1. In no other sphere have any of our Universities and Institutes of higher education come anywhere near MIT, Stanford University and University of California at Berkeley, USA, – Institutions which rank among the world's top ten Universities. (A global consultancy firm, Mckinsey, has reported that they have more IIT graduates in their

worldwide work force than those from any other University in the world). It is this kind of topnotch performance of IIT graduates that, *inter alia*, has infused self-esteem and self-reliance in the Indian mind.



Source: IIT Delhi Alumni Report 2004

Figure 1.1: IIT undergraduates are comparable to the best

India today boasts of over 1200 engineering colleges with an intake that has presently risen to about 4,00,000. An impressive figure of around 3,00,000 students graduate from these colleges every year (incidentally, this is 4 times the number of engineering graduates in the USA). In this sizeable population of colleges and engineering graduates, the small number of seven IITs and their 2300 graduates each year stand out in their accomplishments. The IITs have, therefore, been justifiably hailed as islands of excellence in India's engineering education. Apart from the outstanding intake, the following IIT characteristics place them apart from the rest of the hundreds of engineering colleges:

- Nearly all of IIT faculty members have Ph.D.s. Their research interests impact their teaching, govern their consultancy methods and enable their continuing education.
- In the engineering field, the IITs together account for over 60% of the Ph.D.s from India.
- The faculty members at IITs enjoy full academic autonomy and are able to update their curricula to keep pace with the modern developments.
- The continuous assessment of students, with particular emphasis on tutorials, leads to continuous learning.

- Student evaluation of teaching is an established norm among the IITs.
- Much academic activity occurs in their libraries, around their laboratories and computing facilities, which are made available to students till late hours in the evening.
- Students have the opportunity to interact with post-graduate and Ph.D. research scholars.
- Their campus-centred ambience has magically contributed to personality building at an impressionable age.

1.3 EXEMPLARY ALUMNI AND FACULTY

The alumni of IIT today number more than 1,35,000 and constitute an asset of inestimable worth. Alumni data in Table 1.1 brings out two less-known features:

- Over 70% alumni are working in India
- It is notable that 28% (IIT Kanpur) to 62% (IIT Kharagpur) of IIT Faculty are IIT alumni

Table 1.1 Approximate number of IIT alumni in India and abroad*

	IITB	IITM	IITD	IITK	IITKGP
Total number graduated till 2003	~27,000	~26,111	~25,485	~20,000	~34,649
Alumni abroad	~7,000	~7,000	~6,500	~5,400	~6,000
Alumni in India	~20,000	~19,111	~18,985	~14,600	~28,000
IIT Faculty with at least one degree from any of the IITs	~170 (44%)	~190 (60%)	~270 (61%)	~90 (28%)	~275 (62%)

*The total turnout of graduates from the IITs, as of March 2003, is about 1,33,245.

** % figure in the brackets reflects % of total faculty.

In the present day technology-intensive times, the performance of IIT alumni has had a definitive impact on the national and international professional scene. An illustrative list of celebrated achievers among the alumni demonstrates their impressive spread across industry, academia and entrepreneurship in India and abroad, as well as in Government establishments in India (please see Table 1.2 at the end of this chapter). One should not lose sight of the fact that quite a few of these achievers and others, who are professionally engaged in India, are post-graduates from the IITs.

Nothing succeeds like success. This adage comes true in the manner in which the alumni of the IITs, whose success is so phenomenal, are now returning to their *alma mater* with gratitude. The PAN-AMERICAN IIT Alumni Association has grown into a colossal body catalyzing a comprehensive approach to maintaining the alumni link. The Association has formed an authentic conduit for the flow of funds and other kinds of support; it has provided a much needed platform for the alumni to come together to discuss and determine how best to advance and propel the IITs into a league of the world's best universities. It is with these aims that thousands of the old IIT students already gathered twice in a common forum in the distant California, in the US. The tangible outfall of this passionate wave to give, which has no parallel in India's educational

institutions, is reflected in the impressive corpus funds, physical assets and invaluable contacts now made available to the IITs. **This alumni gesture of gifting with gratitude is yet another special IIT asset.**

Just as the IIT alumni have done the nation proud, so also the IIT faculty. Many of the former faculty members are in the lead roles today as Vice-Chancellors of leading Universities, heads of eminent institutions and valued advisers to Government and, above all, honoured as famed academics.

1.4 DEMONSTRATED POTENTIAL

Our endeavour from now on should be to address the question as to whether the IITs have realized their full potential. Suffice it to say at this stage that, if we have to pick a dozen technical institutions in the country which have the highest potential to become the dominant players in a knowledge intensive society, the seven IITs will easily figure among them.

Why do we say that the IITs have the potential? It is because, whether in original research or in product design or product development, IITs have often clearly demonstrated their high level of competence. We mention here a few examples:

- (a) Institute of Scientific Information, Philadelphia, USA, has put out a list of most cited authors during 1981-1999. Of these, 8 are from India, out of whom 3 are from the IITs. These are Soumitro Banerjee (in Engineering) and Sadhan Kumar De (Material Science) of IIT Kharagpur and K.L. Chopra (Material Science) from IIT Delhi. The fourth is V.K. Gupta (Ecology and Environment) from the then Roorkee University, now IIT Roorkee.
- (b) The work from IIT Kanpur gave the first deterministic polynomial-time algorithm for the primality testing problem, i.e. given a number, test if it is prime, a major breakthrough in the area of computational number theory.
- (c) IIT Delhi, in conjunction with the Central Electronics Ltd. (CEL) and Solid State Physics Laboratory (SPL), developed the dual mode reciprocal (both to receive and transmit operations) phase shifter at X Band, also at C Band, with integrated antenna elements and driver. With respect to these microwave ferrite phase shifter modules, as they were denied to our country, all of their elements had to be designed, developed and produced in hundreds by the IIT Delhi-SPL-CEL team. Without the collaborative pooling of the three institutional resources in which IIT Delhi had a lead role, a major technological achievement of making the phased array radar, capable of acquiring a target with total flexibility in terms of multibeam electronic scanning, would not have been possible in the country.
- (d) The CorDECT Wireless in Local Loop (WLL) telecommunication system has been designed, developed and commercially deployed by the TeNet group of IIT Madras. The TeNet Group consisted of faculty members of the Departments of Electrical Engineering and Computer Science and Engineering. They co-opted nine IITM alumni who formed the company Midas Communications. TeNet, together with Midas Communications, constituted a powerful consortium to work for a common goal.

(Midas Communications won this year's CSIR Technology Award). This is a remarkable demonstration of how the costs of even the so-called high technology products, when they are indigenously researched, developed and produced, can be drastically cut and consequently their deeper penetration can be facilitated. It is no surprise, therefore, that the WLL telecommunication system is reaching out to the less endowed villages in the country. Further, unprecedented export possibilities could be realized.

- (e) The modern rice-mills that were set up in Andhra Pradesh and the rest of India were based upon the design of international manufacturers. But it was IIT Kharagpur, which brought about the required design changes and contributed to testing, and propagated the modern rice mills. IIT Kharagpur has also significantly contributed to the design and development of paddy-husk-fired fixed bed and fluidized bed combustors and allied equipment that form an integral part of the rice milling plant. It is noteworthy that IIT Kharagpur is the only Institution offering educational and research programmes in Agricultural and Food Engineering at the undergraduate and post-graduate levels.
- (f) IIT Bombay has made a mark in the important role they played in the development of technologies for India's prestigious Light Combat Aircraft (LCA), *Tejas (Brilliance)*. Their wide-ranging contributions included the development of aeroservoelasticity analysis software (not available commercially anywhere in the world) and computational fluid dynamics (CFD) packages, besides their work on controls for LCA and the maintenance-training simulator.
- (g) Indigenous development of earthquake engineering goes to the credit of IIT Roorkee. Beginning with the development of experimental tools to study the dynamic behaviour of various types of structures, IIT Roorkee's work was basic to the reconstruction programmes following the Latur earthquake in Maharashtra and in Gujarat in the aftermath of the Bhuj earthquake.
- (h) The newest IIT at Guwahati has taken a pioneering initiative in starting a Bachelor's course in Design. Their design of bamboo products for use in local institutions, such as hospitals and schools, in the north-eastern region holds considerable promise.

1.5 THE NEW FRONTIER

Times have changed and "*we stand today on the edge of a new frontier*". The world has transited from industrial revolution and from industrial economy to knowledge revolution and toward knowledge economy. In this changed scenario, global economies are getting integrated. R&D is crossing national borders. India, with its large pool of technical graduates, is confronting new challenges. They are indeed of a kind that suits India's genius. There is, therefore, a new opportunity for India to seize upon. The nature of products of immeasurable economic worth will henceforth be knowledge-based, requiring minimal capital unlike the conventionally manufactured industrial products that guzzle huge capital. Here is where the IITs must have their prominent presence.

How can one define knowledge economy? A good definition could be that knowledge economy is characterized by the highest number of the best-trained, productive individuals. In other words, **highly educated, research-oriented human capital of the creative class would be the bedrock of the knowledge economy.** It has been forecast that, before the middle of the century, BRICs (Brazil, Russia, India and China) could become a much larger force in the world economy and India could be the third largest economy. Indian companies in the pharma, software and automotive sectors have shown their strength in knowledge-based commercial operations and some of them have been recognized as potential world leaders.

New technologies in the field of bio-technology and pharmaceuticals, advanced materials and nano-technology, information and communication technology are likely to be the key drivers of growth in the near future. All of this should make it clear that the next phase of development of India and the growth of the Indian economy will primarily be technology driven. There are real opportunities for India to be in the forefront of the new technology-based development and application in diverse areas.

In the emerging scenario, the IITs have a glorious opportunity to play their role in the cutting-edge fields of science and technology. For this to become a reality, IITs have to rank *paripassu* with the best in the world. The IIT brand has, therefore, to be moved up the value ladder from the undergraduate to the post-graduate and Ph.D. rungs and even beyond post-doctoral level to more mature heights of research.

1.6 IITs ARE A RESOURCE TO ENHANCE INDIA'S SCIENTIFIC IMPACT

There are two recent publications, which have attracted much attention here in our country, and elsewhere in the world. These are: (1) A feature article by David A. King in *Nature* (vol.430, July 2004) in which nations have been ranked in accordance with their research publications and the related citation analysis and (2) A publication by the Shanghai Institute of Education of a list of the top 500 world Universities (<http://ed.sjtu.edu.cn/ranking.htm>).

In the list published in the *Nature's* article, among the 31 countries assessed, which accounted for 98% of the world's highly cited research papers, India's rank is 23. The parameter chosen by David King for this ranking is not to be trivialized as he has shown a striking correlation between the citation intensity of publications and wealth intensity of these 31 countries.

In the Shanghai rankings of 500 Universities, based upon 5 parameters described in their publication, only 3 Indian academic institutions figure. While IISc appears in the band 251-300, two IITs, namely IIT Delhi and IIT Kharagpur, weigh in at 451-500. (There are more recent rankings in which IITs figure at significantly higher places).

When IITs gear up to compete among the world's top institutions, even as their vision statements aver their intention to be world-class, IITs are bound to move up in their own rank and thereby India's ranking among the world's top research-intensive countries will rise. IITs can and should be in such an orbit and advance further. A whole range of accomplishments,

a sample of which has been listed in 1.4 (a) to (h), will flow from such calibre and commitment across the IIT network for the benefit of our technological progress and in the service of our societal needs. And herein lies the answer to the question: Why IITs are important to the nation?

Our task, then, is to envision how best to empower these IITs, with their remarkable capability in generating world-class undergraduates, so that they can shine as the top-most institutions for outstanding researchers. What additional resources are needed to take them up the hill of creative knowledge without jeopardizing in any way their performance in undergraduate education? The report will analyse the status of IIT research and the various elements of their present resources and suggest ways and means by which the IITs can be further endowed to enable them to advance their research and extension activities.

While the following chapters will consider these issues, it should be clear that the importance of the IITs to India is only further accentuated by their potential to become world leaders in a knowledge-rich regime. How then is their potential to be harnessed? While the Committee will suggest along the lines indicated above, **the key to release and channel this potential, in the ultimate analysis, lies with the faculty, staff and students that compose the IITs.**

Table 1.2: An Illustrative list of prominent IIT alumni

INDIA - GOVERNMENT AND R&D
Dr. Kiran Bedi, Former Joint Commissioner, Delhi Police (IIT Delhi)
Dr. A.K. Balyan, Director, ONGC (IIT Delhi)
Mr. Vijay Mahajan, BASIX India (IIT Delhi)
Mr. Pradeep Kumar, Ambassador of India in Cambodia (IIT Delhi)
Dr. Mahesh Sharma, Chairman, KVIC (IIT Delhi)
Vice Admiral A.S. Krishnan, Indian Navy (IIT Delhi)
Dr. D. Banerjee, Chief Controller R&D, DRDO (IIT Madras)
Dr. G. Sundararajan, Director, ARCI, Hyderabad (IIT Madras)
Dr.C.G.K. Nair, Former Chairman, HAL, Bangalore (IIT Madras)
Mr. M. Natrajan, Scientific Adviser to Raksha Mantri (IIT Madras)
Mr. B.S. Sudhir Chandra, Member Railway Board (IIT Madras)
Mr. N.R. Dave, Under Sheriff, Madras (IIT Madras)
Mr. P. Damodaran, Secretary, Govt. of Tamil Nadu (IIT Madras)
Mr. R. Ganesan, Secretary to Government of India, Dept. of Posts (IIT Madras)
Mr. M.S. Srinivasan, Joint Secretary, Ministry of Commerce & Industry, Govt. of India (IIT Madras)
Dr. S. Banerjee, Director, BARC, Mumbai (IIT Kharagpur)
Dr. K. Sekhar, Director, DRDE, Gwalior (IIT Kharagpur)
Mr. V.P. Sandlas, Chief Controller R&D (Electronics), DRDO (IIT Kharagpur)
Dr. S. Sivaram, Director, NCL, Pune (IIT Kanpur)
Dr. H.S. Maiti, Director, CGCRI, Kolkata (IIT Kanpur)
Dr. S.P. Mehrotra, Director, NML, Jamshedpur (IIT Kanpur)
Dr. K. Vijayraghavan, Director, NBC, Bangalore (IIT Kanpur)
Dr.K. Balasubramanian, Director NFTDC, Hyderabad (IIT Kanpur)
Dr. Ashoke Sen, FRS, Mehta Institute, Allahabad (IIT Kanpur)
Mr. Sudhir Vyas, IFS, Ambassador (IIT Kanpur)
Mr. T. Ravi Mathur, Joint Secretary, MHRD (IIT Kanpur)
Mr. Rahul Asthana, formerly BEST, now DAE (IIT Kanpur)
Dr. Kota Harinarayana, Ex. Director, ADA, VC, Hyderabad Central University (IIT Bombay)
Dr. R.K. Bhandari, Ex-Director, Natural Disaster Mitigation Centre, Chennai (IIT Bombay)
Mr. P.L. Bongirwar, Former CEO, MSRDC, Mumbai (IIT Bombay)
Dr. S. Agnihotri, Secretary Women & Child Dept., Govt. of Orissa (IIT Bombay)
Mr. Pradeep Bajjal, Chairperson, TRAI, (IIT Roorkee)
Mr. R.K. Singh, Chairman, Railway Board, Ministry of Railways (IIT Roorkee)
Mr. P.C. Parekh, Secretary, Govt. of India, Ministry of Coal & Mines (IIT Roorkee)

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Professor Prem Vrat, Director, IIT Roorkee (IIT Delhi, IIT Kharagpur)	Professor A.J. Paulraj, Dept. of Electrical Engineering, Stanford University, USA (IIT Delhi)
Professor Trilochan Sastry, IIM, Bangalore (IIT Delhi)	Professor Madhu Sudan, Computer Science, MIT, USA (IIT Delhi)
Professor Devang Khakkar, Ch. E, IIT Bombay (IIT Delhi)	Professor G.P. Agarwal, Institute of Optics, University of Rochester, USA (IIT Delhi)
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Mr. S. Srinivasan, Chairman & MD, SRA Systems Ltd., (IIT Madras)	Mr. Gururaj Deshpande, Chairman, Sycamore Networks, USA, (IIT Madras)
Mr. P. Mallick, MD, Wartsila India Ltd., (IIT Madras)	Dr. R. Ramaswami, VP Xros/Nortal Networks, USA (IIT Madras)
Mr. K.V. Rangaswamy, Executive VP, L&T, (IIT Madras)	Dr.C. Mohan, IBM Fellow, IBM, USA (IIT Madras)
Dr. R. Mahadevan, Director, India Pistons (IIT Madras)	Mr. A. Subu, Director, Almex, USA (IIT Madras)
Mr. B. S. Kamath, Chairman & MD, Laser Soft Infosystems, (IIT Madras)	Mr. Arun Sarin, CEO Vodafone, USA (IIT Kharagpur)
Dr. V. Sumantran, Executive Director, Tata Motors (IIT Madras)	Mr. Rononjoy Dutta, Former President, United Airlines, USA (IIT Kharagpur)
Mr. R. Gopalkrishnan, Executive Director, Tata Sons (IIT Kharagpur)	Mr. Vinod Gupta, Chairman and CEO, Info USA Inc., USA (IIT Kharagpur)
Mr. B.K. Syngal, CMD, VSNL (IIT Kharagpur)	Mr. Rakesh Gangawal, Former President, US Airways (IIT Kanpur)
Dr. S.K. Kaura, CMD, Samtel Colour (IIT Kanpur)	Mr. Sanjay Mittal, CTO, Selectica, USA (IIT Kanpur)
Mr. Som Mittal, CEO, Digital Global Soft (IIT Kanpur)	Dr. Arindam Bose, President, Pfizer, USA (IIT Kanpur)
Mr. Suresh Pandey, MD, Bokaro Steel (IIT Kanpur)	Dr. Rakesh Agarwal, President, Air Products, USA (IIT Kanpur)
Dr. B.N. Singh, Former CEO, RINL and now Jindal (IIT Kanpur)	Dr. Rajendra Singh, CEO, Telecom Ventures, USA (IIT Kanpur)
Mr. Devasis Chowdhury, CMD, Midhani (IIT Kanpur)	Mr. Muktesh Pant, Reebok (IIT Kanpur)
Dr. Pawan Kumar Goenka, COO, Mahindra & Mahindra Ltd. (IIT Kanpur)	Mr. Victor Menezes, Vice President, Citigroup, USA (IIT Bombay)
Mr. Parag R. Rele, Managing Director, Aplab (IIT Bombay)	Mr. Ravi Tilak, Director, Almex, USA (IIT Bombay)
Mr. Ravi Venkatesan, Chairman, Cummins India (IIT Bombay)	Mr. Rajiv L. Gupta, Chairman and CEO, Rohm & Haas, USA (IIT Bombay)
Dr. S. Rama Iyer, Managing Director, Kvaerner Powergas India Ltd. (IIT Bombay)	Mr. S.S. Kakade, President & CEO, US Aeromotive Inc., USA (IIT Bombay)
Mr. Deepak Satwalekar, Managing Director, HDFC Standard Life Insurance Ltd. (IIT Bombay)	Dr. Arun Netravali, President, Lucent Technologies, USA (IIT Bombay)
Mr. R.M. Pandia, MD Herdilia Chemicals Ltd. (IIT Bombay)	Mr. V. Kasturirangan, Chairman & CEO, Unilever, Phillipines (IIT Bombay)
Dr. Badri Prasad, Joint MD, Furnace Fabricia (I) Ltd. (IIT Bombay)	Dr R. Ayer, Chairman & CEO, Hartford Financial Services Group Inc., USA (IIT Bombay)
Mr. S.N. Mathur, Chairman, IBP-Balmer Lawrie Group of Companies (IIT Bombay)	Dr. - Ing, B. Balasubramanian, Sr. VP, Daimler Chrysler AG, Germany (IIT Bombay)
Mr. Atul Vijaykar, Intel Asia (IIT Bombay)	Mr. A. Manudhane, Advisor & Former Managing Partner, Goldman Sachs, USA (IIT Bombay)
Mr. A. Godbole, CEO, L&T Information Technology Ltd. (IIT Bombay)	Mr. Jitendra Goel, California(CA), USA (IIT Roorkee)
Mr. J.K. Tandon, MD and CEO, Jindal Vijaynagar Steel Ltd. (IIT Bombay)	Dr. Ajay Kumar, Director (AAAC) NASA Langley Research Centre, Virginia (VA), USA (IIT Roorkee)
Sri Subodh Bhargava, Chairman, Wartsila India Ltd. & Former Chairman & CEO, EICHER Group (IIT Roorkee)	Dr. Jai Hakhu, Vice President, Intel Corporation (Santa Clara), California, USA (IIT Roorkee)
Mr. S.K. Gupta, CMD, VSNL (IIT Roorkee)	
Mr. S.G. Awasthi, Ex-CMD Daewoo Motors Ltd. (IIT Roorkee)	