

National Knowledge Commission

Report to the Nation

2006 - 2009



सत्यमेव जयते

Government of India

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Foreword

The National Knowledge Commission (NKC) is pleased to submit its final Report to the Nation. It is essentially a compilation of our various reports from 2006 to 2009. The Commission was set up by the Prime Minister Dr. Manmohan Singh to prepare a blueprint to tap into the enormous reservoir of our knowledge base so that our people can confidently face the challenges of the 21st century. We were conscious that this was a daunting task, which required not only resources and time, but also a bold vision and a long-term focus on speedy implementation.

At the heart of NKC's mandate are five key areas related to ACCESS, CONCEPTS, CREATION, APPLICATIONS and SERVICES. We have addressed the question of how to build a knowledge society from these perspectives, with particular focus on access to knowledge. Under these five focus areas we have covered various subjects related to Right to Education, Language, Translation, Libraries, National Knowledge Network, Portals, Health Information Network, School Education, Vocational Education and Training, Higher Education, More Students in Maths and Science, Professional Education, More Quality Ph.Ds, Open and Distance Education, Open Education Resources, Intellectual Property Rights, Legal Framework for Public Funded Research, National Science and Social Science Foundation, Innovation, Entrepreneurship, Traditional Health systems, Agriculture, Enhancing Quality of Life and E-governance.

In most of these areas we organised Working Groups consisting of domain experts from the government, academia, industry, civil society, media and others to make the entire process democratic, transparent and participative. The Working Groups were requested to have various consultations and prepare a white paper for discussion and debate at the Commission. Based on this methodology, a final set of recommendations was agreed upon by the majority of the members of the Commission. As a result, we believe that these recommendations reflect and incorporate the concerns

and aspirations of domain experts and other concerned stakeholders.

In the last three years NKC has submitted around 300 recommendations on 27 subjects in the form of letters to the Prime Minister. These have been widely disseminated in our Reports to the Nation, seminars, conferences, discussions and covered by national and regional media. These recommendations are also accessible through the NKC website in 10 languages. As part of our outreach program we have organised various conferences and workshops in collaboration with universities, colleges, schools, CII, FICCI, AIMA, and others. We have also been reaching out to various State Governments to discuss recommendations and associated implementation at the state level. The response from most of the states has been very good.

The UPA's commitment to NKC's Vision is reflected in the 11th Five Year Plan adopted by the National Development Council. The Plan places high priority on education as a central instrument for achieving rapid and inclusive growth with specific emphasis on expansion, excellence, and equity. This is reflected in the proposed allocation of Rs. 3 trillion, a four-fold increase over the Tenth Plan. The share of Education in the total Plan will accordingly increase from 7.7 to 20 per cent, representing a credible progress towards the target of 6 per cent of GDP. The vision of the Prime Minister and support of our leadership from across the political spectrum is indeed laudable. This is a landmark initiative in the history of government planning. We believe that the education agenda outlined in the 11th Plan is a critical step towards realising the objective of an equitable society. It is also fundamental to our continuing growth, employment generation, infrastructure development and other developmental priorities.

While releasing the first NKC Report to the Nation in January 12 2007, the PM emphasised that the Commission "must be involved in ensuring the implementation of their innovative ideas". The focus of

our work has been on ensuring that while the Central Government designs appropriate strategies supported by financial allocations to implement our recommendations, we engage simultaneously with diverse stakeholders to build a groundswell of favourable opinion and assist preparation of implementation strategies at the grassroots. Continuing dialogue with a wide and diverse set of stakeholders has been a critical part of our process, both in the formulation of the recommendations and in the subsequent dissemination.

Regarding implementation, we find that there is indeed a great deal of enthusiasm and emphasis on education as a means of achieving personal growth and development. The growing aspirations of children and parents across the cross-section of society are reflected in an increasing demand for education, which has far exceeded the supply. There is still resistance at various levels in the government to new ideas, experimentation, process re-engineering, external interventions, transparency and accountability, due to rigid organisational structures with territorial mindsets. As a result, the real challenge lies in organisational innovation with new regulatory frameworks, new delivery systems and new processes. In their absence, increasing resources could well result in more of the same things being replicated. Our country is too large, too complex and too diverse for 'one size fits all' solutions. Decentralisation and community participation at the local level would be the key to devising effective programs for implementation.

We hope that our recommendations find enthusiasm and support at various levels at State and Central Government for speedy implementation. We believe that implementation is the key in going forward to address the three fundamental challenges related to demography, disparity and development. Knowledge, education, and innovations are critical to provide opportunities for the poor and underprivileged to reduce disparities in our

society. These are equally important to expedite the process of development and to improve productivity, efficiency, and reduce cost. To get the real demographic dividends we need to empower and educate the 550 million young below the age of 25 through proper education to build future growth and prosperity. The destiny of India is in their hands.

While making the recommendations we have been guided by how knowledge will impact the lives of ordinary people of India. We are conscious that knowledge is about farmers having access to accurate information about water, land, weather and fertilisers; students having access to quality education and jobs; scientists having access to laboratories; industry having access to skilled work force; and people feeling empowered with good governance in a vibrant democracy.

Finally, I want to thank all the members and our young associates for their exceptional hard work, dedication and ongoing support. I would also like to thank the members of various Working Groups and workshops, the Planning Commission, the Prime Minister's Office, and various other individuals and organisations in the government and industry for their contribution and support.

As we have said in the past, the recommendations of the National Knowledge Commission are really a call to action. It is time to act and implement these recommendations now.

Sam Pitroda
Chairman
National Knowledge Commission

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Overview

Introduction

Knowledge has been recognised as the key driving force in the 21st century and India's ability to emerge as a globally competitive player will substantially depend on its knowledge resources. To foster generational change, a systemic transformation is required that seeks to address the concerns of the entire knowledge spectrum. This massive endeavour involves creating a roadmap for reform of the knowledge sector that focuses on enhancing access to knowledge, fundamentally improving education systems and their delivery, re-shaping the research, development and innovation structures, and harnessing knowledge applications for generating better services. Such a knowledge revolution that seeks to build capacity and generate quality will enable our country to empower its human capital – including the 550 million below the age of 25. Our unique demographic dividend offers a tremendous opportunity as well as a daunting challenge which requires creative strategies for a new knowledge oriented paradigm.

Keeping this scenario in mind, the National Knowledge Commission (NKC) was constituted in June 2005 by the Prime Minister Dr. Manmohan Singh, under the Chairmanship of Mr. Sam Pitroda, to prepare a blueprint for reform of our knowledge related institutions and infrastructure which would enable India to meet the challenges of the future. The Terms of Reference of NKC are:

- Build excellence in the educational system to meet the knowledge challenges of the 21st century and increase India's competitive advantage in fields of knowledge.
- Promote creation of knowledge in Science & Technology laboratories.

- Improve the management of institutions engaged in Intellectual Property Rights.
- Promote knowledge applications in Agriculture and Industry.
- Promote the use of knowledge capabilities in making government an effective, transparent and accountable service provider to the citizen and promote widespread sharing of knowledge to maximise public benefit.

To take its mandate forward the Commission focused on five key aspects of knowledge: enhancing access to knowledge, reinvigorating institutions where knowledge concepts are imparted, creating a world class environment for creation of knowledge, promoting applications of knowledge for sustained and inclusive growth and using knowledge applications in efficient delivery of public services. Specific focus areas were identified to realise each of these objectives. NKC carried out wide stakeholder consultations, in particular engaging non-government organisations and experts in the form of Working Groups, while formulating recommendations.

In three years NKC has submitted recommendations on 27 focus areas in the form of letters to the Prime Minister. These have been widely disseminated in three compilations: 'Report to the Nation 2006', 'Report to the Nation 2007' as well as 'Towards a Knowledge Society' which is a compilation of the education recommendations. The recommendations, also accessible through the NKC website, have been widely debated. NKC has also reached out to State Governments for developing knowledge initiatives at the state level.

Terms of Reference and Organisation

The National Knowledge Commission (NKC) was constituted on 13th June 2005 as a high level advisory body to the Prime Minister of India. The vision for NKC was articulated by Dr. Manmohan Singh, Prime Minister of India, in the following words:

“The time has come to create a second wave of institution building, and of excellence in the fields of education, research and capability building.”

The Terms of Reference of NKC are:

- Build excellence in the educational system to meet the knowledge challenges of the 21st century and increase India’s competitive advantage in fields of knowledge.
- Promote creation of knowledge in Science & Technology laboratories.
- Improve the management of institutions engaged in Intellectual Property Rights.

- Promote knowledge applications in Agriculture and Industry.
- Promote the use of knowledge capabilities in making government an effective, transparent and accountable service provider to the citizen and promote widespread sharing of knowledge to maximise public benefit.

National Knowledge Commission had a designated time-frame of three years from 2nd October 2005 to 2nd October 2008, which was extended to 31st March 2009.

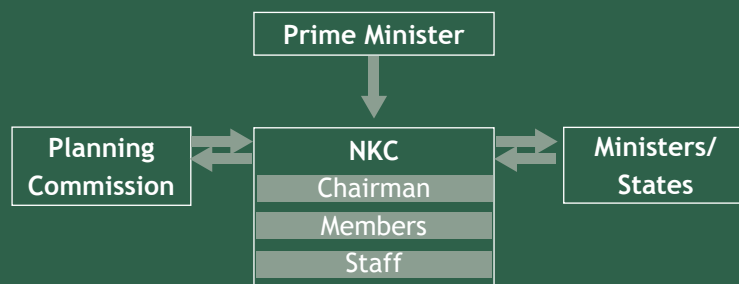
The final Report of NKC contains the full text of all the recommendations submitted by the Commission in the last three years. It also includes follow up on the recommendations, baseline figures on the key focus areas as well as details of NKC consultations.

Organisation

NKC consists of eight Members, including the Chairman. All Members perform their duties on a part-time basis and do not claim any remuneration.

The Members are assisted in their duties by a small Technical Support Staff. The Commission is also free to co-opt experts to assist in the management of its tasks.

The Planning Commission is the nodal agency for the NKC for planning and budgeting purposes as well as for handling Parliament submissions or responses.



Members

Mr. Sam Pitroda (Chairman)

Mr. Pitroda has spent four decades in the world of telecommunications, having pioneered its use as a means to expedite the process of development and nation building, and in bridging the global communications divide. His professional career has been divided between the three continents of North America, Asia and Europe, and he has received international acclaim for using telecommunications as a tool for national development.

As Adviser to Prime Minister Rajiv Gandhi, Mr. Pitroda helped to build India's telecommunications and information technology infrastructure. He was the founding Chairman of the Telecom Commission in India and headed the National Technology Missions on Drinking Water, Literacy, Immunisation, Oilseeds and Dairy. In these roles, he made a notable contribution to India's developmental planning and policy approaches. Mr. Pitroda has owned and run several companies in the United States and Europe; as an inventor he owns more than 75 patents worldwide. He is also a recipient of the Padma Bhushan.

Dr. Ashok Ganguly

Dr. Ganguly is the Chairman of Firstsource Ltd. and ABP Pvt. Ltd., and a Director on the Central Board of the Reserve Bank of India, since November 2000. He heads his own consulting company, Technology Network India Pvt. Ltd. He also currently serves as a non-executive director of Mahindra & Mahindra, Wipro Ltd. Tata AIG Life Insurance Co Ltd. and ICICI Knowledge Park.

He is a member of the Prime Minister's Council on Trade and Industry as well as the Investment Commission. Dr. Ganguly's professional career spanned 35 years with Unilever Plc/N.V. He was the Chairman of Hindustan Lever Ltd. from 1980 to 1990 and a member of the Unilever Board from 1990 to 1997, with responsibility for worldwide research and technology.

He was a member of the Science Advisory Council to the Prime Minister of India (1985-89) and the UK Advisory Board of Research Councils (1991-94). A recipient of the Padma Vibhushan and an Honorary Professor at the Chinese Academy of Science, Dr. Ganguly has authored three books – *Industry and Liberalisation*, *Strategic Manufacturing for Competitive Advantage* and *Business Driven R&D - Managing Knowledge to Create Wealth*.

Dr. P. Balaram

Professor P. Balaram is a Professor of Molecular Biophysics and currently the Director of the Indian Institute of Science, Bangalore. Prior to this, he was Lecturer (1973-77), Assistant Professor (1977-82), Associate Professor (1982-85), Chairman, Molecular Biophysics Unit (1995-2000) and Chairman, Division of Biological Sciences (2002-05) at the Institute. His main research interests are in bio-organic chemistry and molecular biophysics. He is the author of over 370 research papers. He received his M.Sc from IIT Kanpur (1969) and Ph.D in Chemistry from Carnegie-Mellon, Pittsburgh, USA (1972).

Professor Balaram is a Fellow of the Indian Academy of Sciences, Indian National Science Academy and the Third World Academy of Sciences, Trieste, Italy. Professor Balaram has received many awards and honours in recognition of his work, including the Shanti Swarup Bhatnagar Prize, CSIR (1986), Alumni Award for Excellence in Research, IISc (1991), TWAS Award in Chemistry (1994), G.D. Birla Award for Scientific Research (1994) and the Padma Shri awarded by the Government of India (2002).

Professor Balaram currently serves on many committees of the Government of India, and is a Member, Science Advisory Committee to the Union Cabinet, Board of Research in Nuclear Science of DAE, Advisory Board of CSIR and Scientific Advisory Council to the Prime Minister. He has been the Editor of "Current Science" for over ten years.

Dr. Jayati Ghosh

Dr. Ghosh is a Professor of Economics and Chairperson of the Centre for Economic Studies and Planning, School of Social Sciences, Jawaharlal Nehru University, and is an alumnus of Delhi University, Jawaharlal Nehru University and the University of Cambridge. Her research interests include globalisation, international trade and finance, employment patterns in developing countries, macroeconomic policy, and issues related to gender and development.

Her published works include *Crisis as a Conquest: Learning from East Asia*, *The Market that Failed: A Decade of Neoliberal Economic Reforms in India*, and *Work and Well-being in the Age of Finance* (co-authored with Prof. C.P. Chandrashekar). She was the principal author of the West Bengal Human Development Report 2004 which received the UNDP Award for excellence in analysis, and numerous academic papers. She is a regular columnist for leading journals and periodicals. Dr. Ghosh is involved in managing several public information websites, a founder of the Economic Research Foundation, and is the Executive Secretary of International Development Economics Associates (IDEAS), an international network of heterodox development economists. She chaired the Andhra Pradesh Commission on Farmers' Welfare in 2004, and continues to be closely involved in working with progressive organisations and social movements.

Dr. Deepak Nayyar

Dr. Nayyar is Professor of Economics at Jawaharlal Nehru University, New Delhi. Earlier, he has taught at the University of Oxford, the University of Sussex, and the Indian Institute of Management, Calcutta. Professor Nayyar was Vice Chancellor of the University of Delhi from 2000 to 2005. He also served as Chief Economic Adviser to the Government of India and Secretary in the Ministry of Finance.

He was educated at St. Stephen's College, University of Delhi. Thereafter, as a Rhodes Scholar, he went on to study at Balliol College, University of Oxford, where he obtained a B. Phil and a D. Phil in Economics. He has received the V.K.R.V. Rao Award for his contribution to research in Economics. He is an Honorary Fellow of Balliol College, Oxford.

He has published more than 50 papers in academic journals and is the author of 12 books, which

include *India's Exports and Export Policies*; *Migration, Remittances and Capital Flows*; *The Intelligent Person's Guide to Liberalization*; *Governing Globalization: Issues and Institutions*; *Stability with Growth: Macroeconomics, Liberalization and Development*; *Trade and Globalization*; and *Liberalization and Development*.

Professor Nayyar is Chairman of the Board of Governors of the UNU World Institute for Development Economics Research, Helsinki and is Vice President of the International Association of Universities, Paris. He has also served as a Member of the Board of Directors of the Social Science Research Council in the United States, and Chairman of the Advisory Council for the Department of International Development, Queen Elizabeth House, University of Oxford. He was a Member of the World Commission on the Social Dimension of Globalization.

Mr. Nandan Nilekani

One of the founders of Infosys Technologies Ltd. Mr. Nilekani is the Co-Chairman of the Board of Directors. He has formerly held the post of Managing Director, President and Chief Operating Officer at Infosys. Mr. Nilekani co-founded India's National Association of Software and Service Companies (NASSCOM). He is Vice-Chairman of The Conference Board, Inc., an international research and business membership organisation and Member of the London Business School's Asia-Pacific Regional Advisory Board. He has served as Chairman of the Government of India's IT Task Force for the power sector. He was a member of the insider trading subcommittee of the Securities and Exchange Board of India (SEBI), and of the Reserve Bank of India's Advisory Group on corporate governance. He is also a member of the review committee of the Jawaharlal Nehru National Urban Renewal Mission and serves on the Board of Reuters as a non-executive member.

His many honours include Fortune magazine's 'Asia's Businessmen of the Year 2003' award (along with Infosys Chairman Mr. N.R. Narayana Murthy), the Corporate Citizen of the Year Award at the Asia Business Leader Awards (2004) and Padma Bhushan (2006). In 2002 and 2003 he was named among the 'World's Most Respected Business Leaders' in a global survey by Financial Times and PricewaterhouseCoopers.

Mr. Nilekani became one of the youngest entrepreneurs to join 20 global leaders on the prestigious World

Economic Forum (WEF) Foundation Board in January 2006.

Dr. Sujatha Ramdorai

Dr. Sujatha Ramdorai is a Professor at the School of Mathematics, Tata Institute of Fundamental Research (TIFR). She has held visiting positions in several universities and research institutions around the world. Currently she is a visiting Professor at the Chennai Mathematical Institute.

Dr. Ramdorai is a recipient of the Shanti Swarup Bhatnagar Award and the ICTP Srinivasa Ramanujan Medal awarded by the Norwegian Academy of Science and Letters for her research in algebraic number theory. She has been involved with issues related to education and research, especially research in the pure sciences in India. She has authored several research papers in internationally reputed journals and has collaborated widely in her research work. She is the co-author (with Prof. J. Coates) of *Cyclotomic Fields and Zeta Values*.

Dr. Amitabh Mattoo

Professor Mattoo is a Doctorate in International Relations from the University of Oxford, United Kingdom. He is the former Vice Chancellor of the University of Jammu. He was also Professor of International Relations at Jawaharlal Nehru University and concurrently Director of the Core Group for the Study of National Security. Professor Mattoo is on the Governing Council of the Pugwash Conference on Science and World Affairs, on the Board of the India-Afghanistan Foundation and the President of the Jammu and Kashmir chapter of SPIC-MACAY.

Professor Mattoo has been on the Governing Council of the Nuclear Science Centre; a member of the Standing Committee of the Association of Indian Universities; and on the Executive Council of several Universities. He has been the recipient of several national and international awards and was, till recently, a member of India's National Security Council's Advisory Board. In 2008 he was conferred the Padma Shri by the Government of India.

Methodology

- Identification of key focus areas
- Identification of diverse stakeholders and understanding major issues
- Constitution of Working Groups and organising of workshops/seminars, extensive consultations with concerned experts and stakeholders
- Consultation with administrative Ministries & the Planning Commission
- Discussion in NKC to finalise recommendations in the form of letter to the PM from the Chairman
- Letter to PM containing key recommendations, first steps, financial implications etc. supported by the relevant explanatory documents by NKC
- Dissemination of recommendations to State Governments, civil society and other stakeholders
- Initiating the implementation of the recommendations under the aegis of the Prime Minister's Office
- Coordinating and following up implementation of proposals

Working Groups

Libraries, Language, Knowledge Applications in Agriculture, Health Information Network, Higher Education, Medical Education, Legal Education, Management Education, Engineering Education, Traditional Health Systems, More Students in Maths and Science, Open and Distance Education, Using Knowledge for Enhancing Quality of Life

Workshops/Seminars

Literacy, Translation, Networks, School Education, Muslim Education, Vocational Education, Open and Distance Education, Intellectual Property Rights, Science and Technology, Agriculture, Open Education Resources, Portals, Quality of Life, More Quality Ph.Ds

Surveys

Innovation, Health Information Network, Traditional Health Systems, Entrepreneurship, More Quality Ph.Ds

Methodology

The methodology followed by the National Knowledge Commission involves identification of focus areas in the first instance. This selection arises from wide consultation, within and outside the government. After the identification of focus areas, Working Groups of specialists and practitioners are constituted. Working Groups typically consist of five to ten experts, and meet periodically over three to four months in order to prepare a report. Working Group reports are one of the inputs used by the NKC during deliberations to frame its recommendations. In addition, workshops and seminars are held periodically along with informal consultations with concerned experts and stakeholders to get as broad-based a point of view as possible.

Following this, NKC Members discuss the issues raised during Consultations and in the Working Group Reports to finalise recommendations. After several rounds of deliberations, a letter is sent to the Prime Minister containing key recommendations. Widespread dissemination of NKC recommendations to State Governments, civil society and other stakeholders takes place after the recommendations have been received by the Prime Minister and the relevant ministries. The

implementation of the recommendations under the aegis of the Prime Minister's Office is then initiated, along with coordination and follow up with various implementing agencies. Key steps include:

- Identification of key focus areas
- Identification of diverse stakeholders and understanding major issues in the area
- Constitution of Working Groups and organising of workshops/seminars, extensive formal and informal consultations with concerned experts and stakeholders
- Consultation with administrative Ministries & the Planning Commission
- Discussion in NKC to finalise recommendations in the form of letter to the PM from the Chairman
- Letter to PM containing key recommendations, first steps, financial implications etc. supported by the relevant explanatory documents by NKC
- Dissemination of recommendations to State Governments, civil society and other stakeholders
- Initiating the implementation of the recommendations under the aegis of the Prime Minister's Office
- Coordinating and following up implementation of proposals.

NKC Snapshot

Recommendations submitted in 2006

- Libraries
- Translation
- Language
- National Knowledge Network
- Right to Education
- Vocational Education & Training
- Higher Education
- National Science and Social Science Foundation
- E-governance

Recommendations submitted in 2007

- Health Information Network
- Portals
- Open Educational Resources
- Legal Education
- Medical Education
- Management Education
- Open and Distance Education
- Intellectual Property Rights
- Innovation
- Traditional Health Systems
- Legal Framework for Public Funded Research

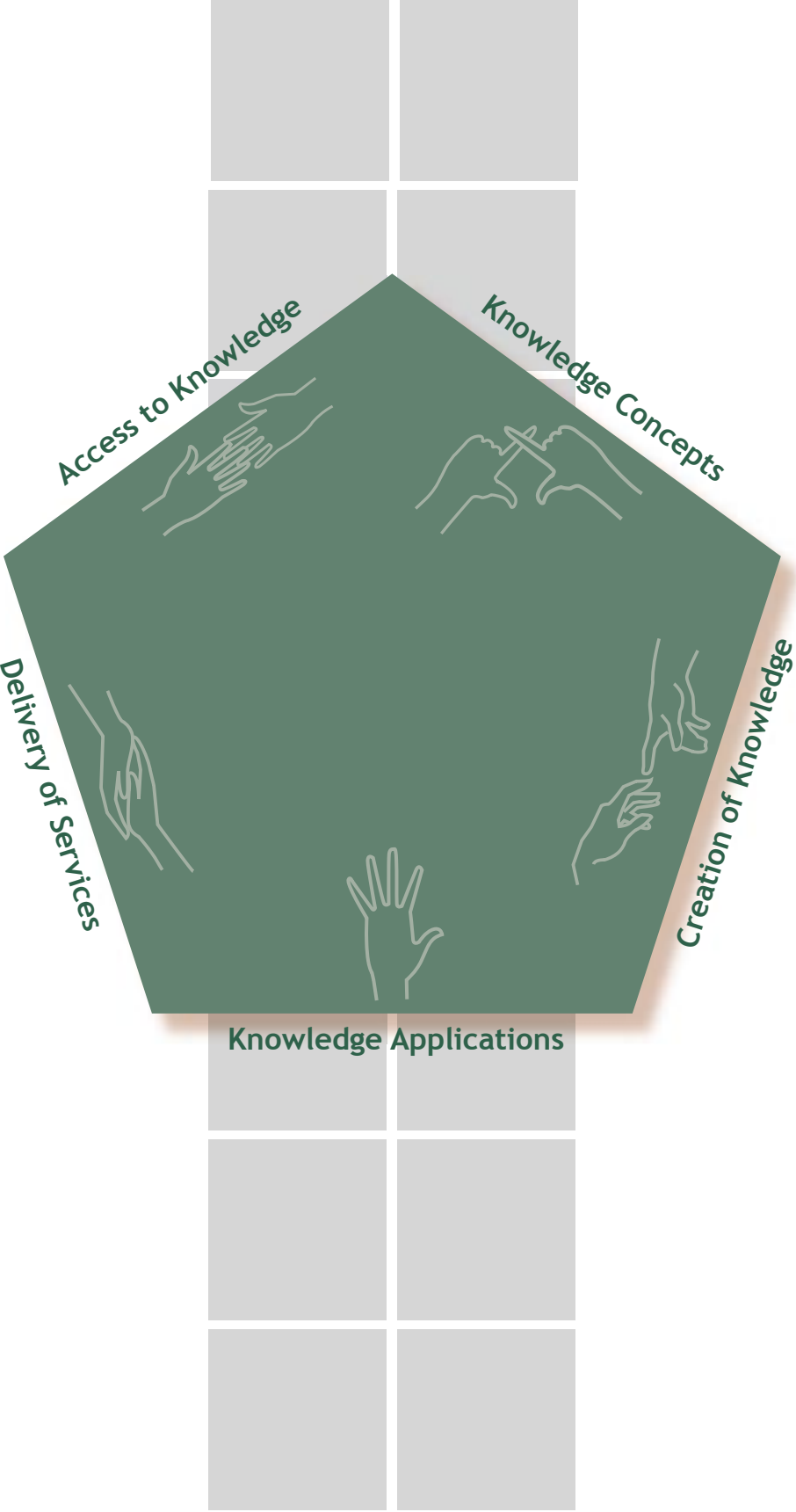
Recommendations submitted in 2008

- School Education
- Engineering Education
- More Talented Students in Maths and Science
- More Quality Ph.Ds
- Entrepreneurship

Recommendations submitted in 2009

- Knowledge Applications in Agriculture
- Knowledge Applications for Enhancing Quality of Life

Knowledge Pentagon



Summary of Recommendations

ACCESS

Providing access to knowledge is the most fundamental way of increasing the opportunities of individuals and groups. Therefore, it is essential to revitalise and expand the reach of knowledge in society. In this context NKC has submitted recommendations on areas such as Right to Education, libraries, language, translation, portals and knowledge networks.

- **Right to Education:** The 86th Constitutional amendment act made the Right to Education a Fundamental Right. However, to enhance universal access to quality education for Indian children, NKC recommends that there is a need for a central legislation affirming the Right to Education. This must entail a financial provision requiring the central government to provide the bulk of the additional funds needed for realising the Right to Education. The legislation should also lay down minimum standards of quality in school education and for it to be effective, the responsibility of the Government at different levels, must be recognised and made justiciable.
- **Language:** In the current scenario an understanding and command over the English language is a most important determinant of access to higher education, employment possibilities and social opportunities. NKC therefore recommends that the teaching of English as a language should be introduced, along with the first language (either mother tongue or the regional language) of the child, starting from Class I. Further, NKC has also focused on the need to reform the pedagogy of English language teaching and the use of all available media to supplement traditional teaching methods.
- **Translation:** In a multilingual country, translation should play a critical role in making knowledge available to different linguistic groups. NKC has recommended developing translation as an industry and setting up a National Translation Mission with

a focus on promoting translation activities across the country. The Mission would undertake a host of activities such as setting up a storehouse of information on all aspects of translation, providing quality training and education for translators, and creating and maintaining various tools for translation.

- **Libraries:** To revamp the Library and Information Services (LIS) sector NKC has recommended a comprehensive census of libraries, modernising management of libraries to ensure greater community participation, including models for public private partnerships in LIS development and leveraging ICT for various applications. For sustained attention to the sector, NKC has recommended the setting up of an independent National Commission on Libraries which would streamline all development initiatives in the sector.
- **National Knowledge Network:** The key to successful research today demands live consultations, data and resource sharing. Towards this end, NKC has recommended the establishment of a high-end National Knowledge Network connecting all our knowledge institutions in various fields and at various locations throughout the country, through an electronic digital broadband network with gigabit capacity.
- **Portals:** NKC has also proposed the creation of national web based portals on certain key sectors such as Water, Energy, Environment, Teachers, Biodiversity, Health, Agriculture, Employment, Citizens Rights etc. The portals would serve as a single window for information on the given sector for all stakeholders and would be managed by a consortium consisting of representatives from a wide range of stakeholders to ensure that they have a national character. NKC has facilitated the setting up of five portals: on Water, championed by Arghyam Trust; on Energy, championed by The Energy Research Institute (TERI); on Environment,

championed by the Centre for Science and Environment (CSE); on Teachers, championed by the Azim Premji Foundation; and on Biodiversity, championed by the Ashoka Trust for Research in Ecology and the Environment (ATREE).

- **Health Information Network:** The developments in information and communication technology have created new opportunities for enhancing the efficiency of health care delivery. NKC believes that the country needs to develop a web-based network, connecting all health care establishments, in both private and public sectors. When fully functional, all health care transactions will be recorded electronically and this data will be available in the health data vault to authorised users, when they need it and where they need it. For this purpose a common Electronic Health Record (EHR) based on open source solutions needs to be created and disseminated widely.

CONCEPTS

Knowledge concepts are organised and disseminated through the education system. Education is the key enabler for the development of an individual and for altering the socio-economic landscape of a country. Therefore, NKC's work has focused on revamping the education sector. NKC's concern with many aspects of the Indian education system covers school education, higher education, professional education, and vocational education.

- **School Education:** Making access to good school education a reality will require major expansion at the elementary and secondary levels and improvement in the quality of schools. NKC has therefore proposed generational changes in the school system which would encourage decentralisation, local autonomy in management of schools, and flexibility in disbursement of funds. To improve quality and generate accountability, NKC has also recommended improving school infrastructure and revamping school inspection with a greater role for local stakeholders and greater transparency in the system. Further, wherever feasible, Information and Communication Technology should be made more accessible to teachers, students and the administration. NKC has also emphasised the need for reforms in the curriculum and examination systems by moving away from rote learning to a critical understanding of concepts and finally improvement in faculty.

- **Vocational education and training (VET):** To improve vocational education and training (VET), NKC's recommendations focus on increasing the flexibility of VET within the mainstream education system. NKC has also emphasised the need to expand capacity through innovative delivery models, including robust public private partnerships. Given that only 7 per cent of the country's labour force is in the organised sector, enhancing training options available for the unorganised and informal sector will be critical for enhancing the productivity of the bulk of our working population. It is necessary to ensure a robust regulatory and accreditation framework, along with proper certification of vocational education and training. This will allow easier mobility into higher education streams, enhancing the value of such training.
- **Higher Education:** In higher education NKC recommendations have focused on the three key aspects of expansion, excellence and inclusion. NKC has recommended increasing GER in higher education to 15 and above by 2015. In addition to increased public spending, this would involve diversifying the sources of financing to encourage private participation, philanthropic contributions and industry linkages. To bring about this expansion, NKC has suggested the creation of 1500 universities by 2015, partly by restructuring the existing ones. In order to reduce the current barriers to entry, NKC has recommended setting up an Independent Regulatory Authority for Higher Education (IRAHE) which would be at an arm's length from all stakeholders and would accord degree granting power to universities. To ensure quality, NKC has called for reform of existing universities to ensure frequent curricula revisions, introduction of course credit system, enhancing reliance on internal assessment, encouraging research, and reforming governance of institutions. Further, there is an urgent need to restructure the system of affiliated undergraduate colleges which no longer provides a viable model for quality higher education. NKC has also suggested creating models for community colleges that provide credit and non-credit courses leading to two year associate degrees. These would include general education programs as well as employment oriented programs, creating the flexibility for students to pursue higher education later in life. NKC believes that all deserving students should have access to higher education, irrespective of their socio-economic background. While the

government heavily subsidises university education by keeping fees low, there is better value created for this subsidisation by ensuring well funded scholarships and affirmative action that takes into account the multi dimensionality of deprivation.

- **More Talented Students in Maths and Science:** To rejuvenate science education and research in the country NKC considers it crucial to attract more students in maths and science. To encourage this, NKC has recommended launching a massive science outreach program, upgrading available infrastructure, revitalising the teaching profession and revamping teacher training at all levels.
- **Professional Education:** The professional education streams are plagued by the problems similar to the higher education system. NKC has recommended that the present regime of regulation in all professional education streams including medical, legal, management and engineering education, be replaced by subgroups on different streams under the proposed independent regulator. This would have to be accompanied by independent multiple accreditation agencies that provide reliable ratings. Other measures for improving professional education include allowing greater autonomy to institutions, reforming the current examination system, developing contemporary curricula and encouraging research.
- **More Quality Ph.Ds:** To invigorate research and development in the country, NKC has recommended steps to improve the quality of Ph.Ds. It has suggested massive investment in education and research at all levels, together with renovation and reform of the university system, and the fostering of a global outlook in research. Further, steps have to be taken to rejuvenate the doctoral program across disciplines and develop vigorous industry-academia interaction. NKC has also recommended the setting up of a National Research Mission which will create the required research ecosystem in the country.
- **Open and Distance Education and Open Educational Resources:** Development of open and distance education and open educational resources is imperative to achieve the objectives of expansion, excellence and inclusion in higher education. More than one-fifth of the students enrolled in higher education are in the Open and Distance Education stream. NKC recommendations on

distance education focus on creating a national ICT infrastructure, improving regulatory structures, developing web based common open resources, establishing a credit bank and providing a national testing service. To supplement this, NKC also recommends that the production of quality content and leveraging global open educational resources, needs to be focused on in a comprehensive manner. We need to encourage open access for all material- research papers, books, periodicals etc.

CREATION

Producing new knowledge and protecting existing resources is critical for a nation to compete in the global knowledge economy. This makes it important to consider all activities that lead to the creation of knowledge directly or help in protecting the knowledge that is created. NKC has therefore examined issues such as innovation systems in the country, science and technology activities and the regime of Intellectual Property Rights.

- **Intellectual Property Rights:** For India to become a global knowledge leader, we would need to be at the forefront of creating knowledge. This requires a favourable eco-system that not only protects the ingenuity of the creator but also rewards knowledge creation through commercial applications. In order to facilitate the creation of knowledge NKC has recommended scaling up efforts to build a world class IPR infrastructure, including steps to modernise the patent offices and building global standards. IPR training in IP Offices as well as in educational institutions needs to be intensified, and IPR Cells need to be developed. In addition, NKC has recommended establishing new structures such as a separate IPR Tribunal, a national institution for cutting edge IPR policy and a Global Technology Acquisition Fund. NKC recommendations also highlight the need to protect traditional knowledge, create incentives for it and also explore mechanisms for identification of key IPR issues in new technology areas.
- **Legal Framework for Public Funded Research:** To revitalise research in universities and give an impetus to public funded research, there is a requirement for enacting a legislation that would give universities and research institutions ownership and patent rights over inventions arising out of government funded research. This will create an enabling environment

for commercialisation of such inventions through licensing arrangements where inventors would also be allowed to receive a share of the royalty.

- **National Science and Social Science Foundation:** A National Science and Social Science Foundation (NSSSF) has been recommended by NKC to look at all knowledge as one seamless entity. The objectives of the NSSSF would be to suggest policy initiatives to make India a leader in the creation and use of new knowledge in all areas of natural, physical, agricultural, health, and social sciences.
- **Innovation:** Innovation is a key driver of growth based on knowledge inputs. NKC conducted an extensive survey on the status of innovation in the country. NKC's Innovation Survey reveals that innovation is emerging as one of the key factors in India's economic growth, where both large firms and SMEs have increased innovation related revenues. The strategic prioritisation of innovation has also increased significantly since the start of economic liberalisation. Crucial firm level structures and processes play a key role in innovation, but skill shortage arising out of lack of emphasis on experimentation/problem solving in the curricula is a critical barrier. There is also need for more effective synergy between industry, government, the educational system, R&D environment and the consumer.
- **Entrepreneurship:** Entrepreneurship has been recognised as a key driver for wealth creation and employment generation. Given its importance, NKC undertook a study to explore factors that have promoted Entrepreneurship in India as well as others which could facilitate even greater growth of Entrepreneurship. Based on the study, several policy recommendations were suggested. These include creation of a supportive business environment through measures such as a single window system, composite application form etc. and setting up of new institutional mechanisms such as special commercial courts and Limited Liability Partnerships. NKC has also suggested facilitating information flows by creating one-stop shops, web based portals and information handbooks for entrepreneurs, and giving incentives for seed capital funding. Further, creation of entrepreneurship clubs and incubation centres, increase in industry-academia synergies, and introduction of entrepreneurship in school and college syllabus has been recommended.

APPLICATIONS

Knowledge can be productively applied to promote technological change, enhance quality of life and facilitate reliable and regular flow of information. This requires significant investment in goal-oriented research and development along with delivery models that can simplify processes within an industry. Initiatives in the areas of agriculture, labour and traditional knowledge can demonstrate that knowledge can be very effectively applied for the betterment of the community.

- **Traditional Health Systems:** India has an immensely rich and complex indigenous medical heritage. NKC has recommended that major efforts be undertaken to provide quality education in traditional medicine. Evidence-based approaches should also be introduced into the current educational framework, possibly through institutions of the standard of IISc, IIT and AIIMS, with commensurate financial outlays. NKC recommendations focus on the need for strengthening research through concerted higher investments and more rigorous methodologies, ensuring internationally acceptable standardisation and documentation of herbal medications, promoting clinical trials, along with adhering to a world-class certification process. Another aspect highlighted in the NKC recommendations is the need to create a suitable IPR framework for better protection of the sources of traditional medical knowledge, while at the same time ensuring that sufficient incentives are created for commercialisation of traditional medicines.
- **Agriculture:** NKC recognises that the challenges facing Indian agriculture can only be addressed through a comprehensive package of measure that includes an emphasis on enhanced knowledge generation and application. NKC has recommended concrete steps to modernise and stimulate agricultural research institutions, coordinate research and make research support more flexible. It has also recognised the need for improving the organisation of agricultural research, directing more research to neglected areas, providing more effective incentives for researchers and reforming the curricula in agricultural universities. Further, to improve the scope and efficiency of extension, NKC has stressed making knowledge applications in agriculture community-driven and farmer-led and shifting the focus to provide an integrated range of services. NKC has also recommended restructuring

the Agricultural Technology Management Agency (ATMA) to make it more decentralised, participatory and locally responsive, and enhancing the role of private players in agricultural extension delivery.

- **Enhancing Quality of Life:** NKC has focused on knowledge applications for enhancing the well being of common people, especially in rural areas. Towards this end, NKC has recommended the setting up of Panchayat Gyan Kendras (PGKs) throughout the country which would ensure efficient implementation of NREGA and would eventually develop into resource centres to demonstrate best practices, evolve local solutions and provide a platform for converging different social sector programs. NKC has also recommended conceptualising fresh perspectives in tool design to improve dignity of labour and ensure skillful engagement and enhanced productivity.

SERVICES

For the creation of a true knowledge society, the availability of efficient knowledge services for citizens is critical, especially for enhancing citizen-government interface. Technology provides us with an opportunity to ensure accountability, transparency and proficiency

in government services. E-governance is one of the ways in which citizens can be empowered to increase transparency of government functioning.

- **E-governance:** To enhance the efficacy of delivery of services by the government, NKC has reiterated that e-governance should be an opportunity not merely for computerisation of age old processes, but a step towards re-thinking our systems and processes to ensure greater efficiency and citizen orientation. NKC recommendations focus on re-engineering government processes to change the basic pattern of governance for simplicity, transparency, productivity and efficiency. They highlight the need for developing common standards and deploying a common platform/ infrastructure for e-governance. Further, 10 to 20 important services that make a critical difference to citizens may be selected, simplified and offered as web-based services, along with beginning all new national programs (like Bharat Nirman, Rural Employment Guarantee Scheme etc.) with well-engineered e-governance implementation and web interface. This will ensure speedy delivery, productivity and efficiency of services making them citizen centric and ensuring that the right people get the benefits.

Follow Up on NKC Recommendations

By focusing on the five aspects of the knowledge paradigm, NKC has created an extensive roadmap for the future. The Governments at the Centre and State are taking steps for the successful implementation of these policy suggestions. The Government's commitment to NKC's vision is reflected in the Eleventh Five Year Plan where NKC's inputs have been incorporated in formulating the broad contours of the Plan.

The Eleventh Five Year Plan (2007-2012) places high priority on education as a central instrument for achieving rapid and inclusive growth with specific emphasis on expansion, excellence and equity. This is evident from the proposed allocation of Rs 3 trillion, a four fold increase over the Tenth Plan. The share of education in the total Plan will accordingly increase from 7.7 per cent to 20 per cent.

Initiatives to improve school education in the Plan include reorienting Sarva Shiksha Abhiyan with a strong rights focus to make Right to Education a reality. Under the Scheme for Universal Access and Quality at the Secondary Stage, 6000 new high quality model schools are to be set up, with at least one school in each block. The first stream will consist of 2500 public funded schools [2000 in KVs (Kendriya Vidyalayas) and 500 in NVs (Navodaya Vidyalayas) template] to be launched in the Educationally Backward Blocks which have a significant SC, ST, OBC and Minority population. The second stream of about 2500 schools would be set up through Public Private Partnership in other Blocks with emphasis on geographical, demographic, gender and social equity. Modalities for the remaining 1000 schools have not yet been finalised.

To strengthen vocational education a new Skill Development Mission under the supervision of the Prime Minister, with an outlay of Rs. 31,200 crore, will aim at opening 1600 new industrial training institutes (ITIs) and polytechnics, 10,000 new vocational schools and 50,000 new Skill Development Centres. A Skill Development Corporation will also be created by the Government with the active participation of the private sector to give special training to young men and women, workers and technicians.

In Higher and Technical Education the focus of the Eleventh Plan is on expansion, inclusion and rapid

improvement in quality by enhancing public spending, encouraging private initiatives and initiating the long overdue major institutional and policy reforms. The Eleventh Plan aims at expansion with the establishment of 30 new universities. Further, 8 new IITs, 7 new IIMs, 20 new IIITs, 5 new Indian Institutes of Science, 2 Schools of Planning and Architecture, 10 NITs, 373 new degree colleges and 1000 new polytechnics will also be set up. In establishing these institutions the scope for Public Private Partnership will be explored. The Plan also recognises the need for the review of regulatory institutions such as the UGC, AICTE, MCI and BCI. Subsequently, a High Level Committee has been set up to suggest a specific reforms agenda in this context. For rejuvenation of research in Universities a National Science & Engineering Research Board is proposed. A provision of Rs. 5,000 crore has been made in the Eleventh Plan for an 'Education Mission through ICT' to leverage the potential of ICT to enhance the Gross Enrolment Ratio (GER) in Higher Education. The Plan also envisages the setting up of a National Knowledge Network (NKN) interconnecting all knowledge institutions in the country with gigabit capabilities, for sharing resources and research. To operationalise the first phase of the NKN, 1000 institutions would be linked up.

The Plan also makes a commitment to improve public libraries and create a National Translation Mission for promoting Translator education including specialised courses in translation technology. The Government has approved the setting up of a National Translation Mission with an outlay of Rs. 73.97 crore for the Plan period, under the aegis of the Central Institute of Indian Languages (CIIL), Mysore. The process for launching a National Mission on Libraries is also underway.

Emphasis has also been laid on strengthening traditional health systems such as AYUSH in the National health programs and improving IPR, with the ultimate aim of enhancing the outreach of AYUSH health care in an accessible, acceptable, affordable and qualitative manner.

Provisions for strengthening IPR in the Eleventh Plan include undertaking the second phase of modernisation of IP offices. This would specifically seek to address the needs of human resources development, training

and awareness and also infrastructure, besides regular updating of the IT facilities.

The Eleventh Plan also recognises the need for an appropriate legislative framework for incentivising the innovators and commercialisation of public funded R&D where the Government, the recipients of funds, the inventor as well as the public benefit from the protection and commercialisation of IP. A Bill on the subject is expected to be introduced in the Parliament.

Understanding the importance of innovation, the Plan emphasises the need for a National Innovation Policy

which encourages competition among enterprises, greater diffusion of knowledge and increased support to early stage technology development initiatives and grassroots level innovators.

NKC recommendations on e-Governance were broadly endorsed by the government and incorporated into the National e-Governance Plan (NeGP). As part of the Program Management Structure for the implementation of NeGP, the Cabinet approved the setting up of a Body under the Chairpersonship of the Prime Minister to provide leadership, prescribe deliverables and milestones and to monitor periodically the implementation of the NeGP.

Recommendations

Access to Knowledge

Right to Education

Language

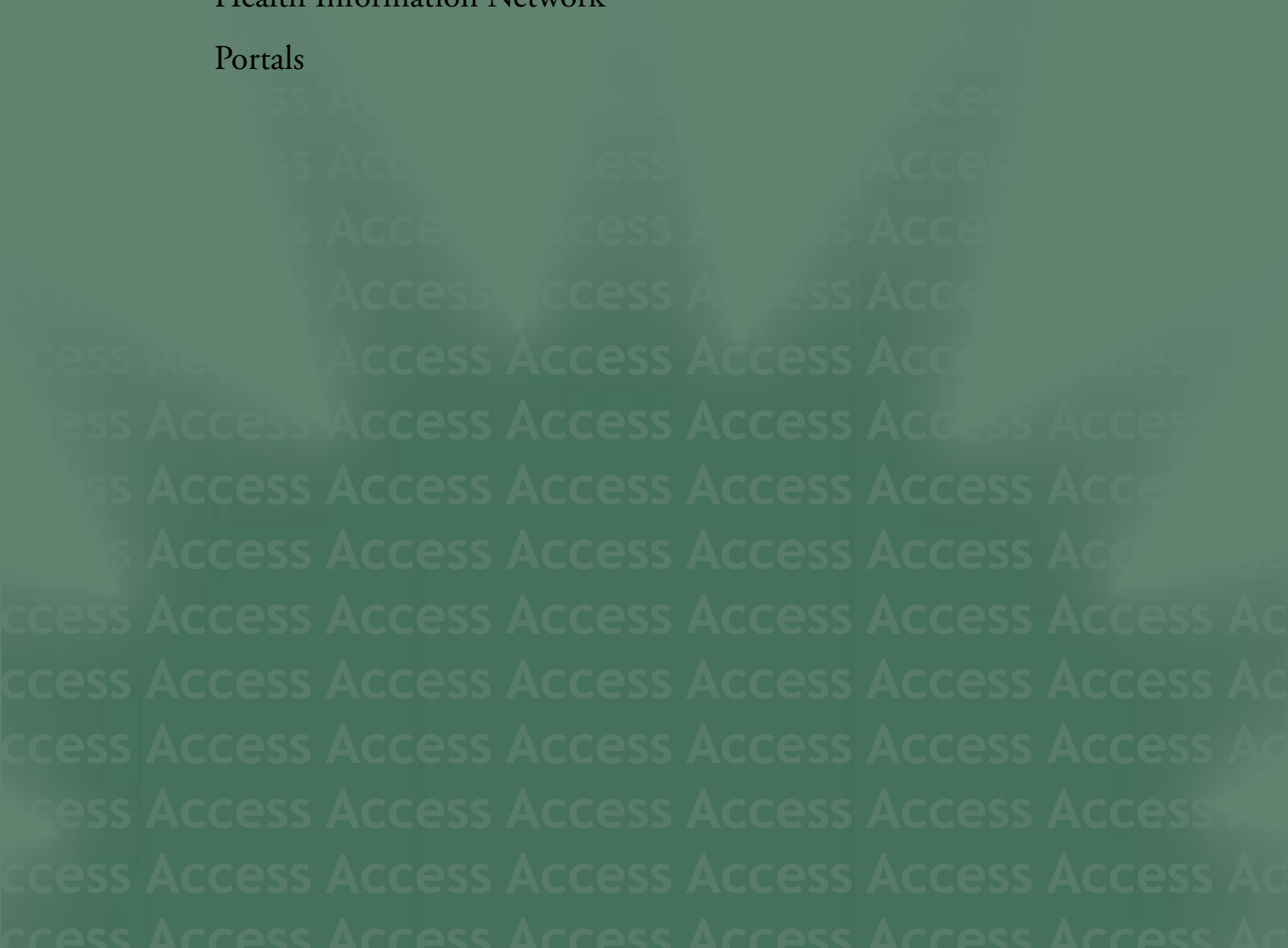
Translation

Libraries

Knowledge Network

Health Information Network

Portals



Right to Education

October 23, 2006

NKC believes that providing universal access to quality school education is a cornerstone of development and a minimum necessary condition for any progress towards making India a knowledge society. NKC is in the process of extensive consultations and will make detailed recommendations on various issues relating to school education at a later date.

However, at this point NKC would like to respond specifically to the recent initiative of the Central Government of sending a model Right to Education Bill to the Secretaries of State Education Departments, with incentives for the State Governments to enact this bill. NKC has perused the bill and consulted with a wide range of experts and educationists. It feels that the model bill is flawed for a number of reasons, and most importantly that such legislation must be enforced by the Central Government following upon the commitment made in the Constitutional Amendment Article 21A.

NKC recognises that there may be concerns about federalism, since school education is dominantly the responsibility of the State Governments at present. However, it feels that this matter can be resolved through an appropriate central legislation which takes into account the following proposals:

1. Central Legislation

Legislation at the national level is required to affirm the Right to Education, which is a fundamental right mandated by Article 21A. Since it cannot be dependent upon which state a citizen lives in, a model bill sent to be enacted individually by State Governments is not adequate to meet the constitutional responsibilities of the Government of India. Therefore, a central legislation should be enacted along the lines of the Panchayati Raj (Amendment) Act, requiring the states to enact Right to Education Bills within a specified time period, and with the primary financial responsibility for this resting with the Central Government.

2. Financial Commitment

The Central Government must provide the bulk of the additional funds required to ensure the Right to Education. Therefore there must be financial provision in the central legislation, requiring the Central Government to share the revenues of the Prarambhik Shiksha Kosh with State Governments and to provide additional resources as required to meet the requirement of ensuring the right to all children. Estimates for the additional resources required to achieve the goal of universal elementary education currently range from 0.8 per cent to 2.5 per cent of GDP, depending on the criteria used. However, the required financial resources are likely to be at the lower end of these estimates, since there is already close to universal provision in several states and there has been recent progress in providing more access through the Sarva Shiksha Abhiyan in other states.

3. Time Frame

The state-level legislation should specify the period within which universal education of reasonable quality is sought to be achieved, preferably within three years. The model bill does not provide any time frame for adoption and implementation of the provisions.

4. Schedule of Norms and Standards

To ensure a minimum quality of education, it is important to have a schedule of norms for all schools to follow. The model bill does not have such a schedule of norms, and there is no specification of the minimum quality of education that schools should provide. There is only a reference to 'equitable quality' without defining the parameters of quality. While ensuring quality is a complex matter, certain norms regarding infrastructure, number of teachers per school and per student, teaching methods and other facilities, must be adhered to as necessary conditions.

5. Specification for Teachers

Since teachers are critical to ensuring the quality of education, it is particularly important to lay down well-defined but flexible norms for the minimum qualifications of teachers. The model bill has no specification of a teacher, or the qualifications and in-service training needed for the position. A teacher is only defined as a person who teaches in the classroom. It is necessary to specify norms for teacher qualification and training.

6. Justiciability

Any right, including the Right to Education, is only meaningful if it is justiciable. However, in the model bill sent to State Governments, the onus is placed on parents or guardians of the child. The responsibility of the Government, at different levels, must be recognised and made justiciable. The example of the National Rural Employment Guarantee Act (NREGA) could be used in this context.

7. Redressal Mechanism

To ensure justiciability, a redressal mechanism should be outlined and an appropriate procedure must be set in place for students or parents in case the right is not upheld.

8. Universal Schooling

School education must be provided to all. This necessarily also requires that children of the disadvantaged, landless and minority communities must also be integrated, along with children with disabilities or special needs. There should be no distinction made in terms of the type of schooling provided within the government system for children from different social, economic and cultural backgrounds. The model bill has the potential of creating a parallel and discriminatory system of schooling which can result in stratification of the education system for children from disadvantaged communities and backgrounds, because it requires only provision of non-formal education in such cases, rather than mandating the provision of regular schooling.

Obviously, in all cases, the school system should be flexible enough to cater to particular needs of students.

NKC can offer detailed explanations on these points. Continuing to consult with stakeholders and examine

other issues in relation to school education, it is focussing in particular on the questions of how to ensure better quality across the board; the institutional structures and forms of control by local communities that could contribute to improved quality of schooling; issues related to common schooling and neighbourhood schools; ensuring adequate quantity and quality of school teachers, especially in specified areas. NKC will make a broader set of recommendations on school education in the near future.

In a subsequent letter to the Prime Minister, NKC reiterated that the proposed central legislation on RTE must include a financial commitment on the part of the Central Government. NKC believes that the potential expenditure on this is probably less than has been estimated earlier. The Kapil Sibal Committee that had prepared the CAGE draft had estimated an expenditure of Rs. 2,20,643 crore for the period 2008-2012. However, this was based on population projections for the future that have since been revised downwards by the Census of India. For example, current population projections suggest that there will be at least 6 million less children in 2011-12 than the earlier projections used by the Sibal Committee had indicated. This in turn means a significant reduction in the estimated costs for universal schooling. Using the same per capita spending with the new population projections gives a total cost for the five year period 2008-2012 of Rs. 1,51,273 crore, based on 50:50 division of SSA. This amounts to an average of just above Rs. 30,000 crore per annum, which is much less than 1 per cent of GDP and also less than 8 per cent of total central government spending.¹

In this connection, NKC would also like to express its concern about the recent decision of the central government to reduce the central funding for the Sarva Shiksha Abhiyan from 75 per cent to 50 per cent. There is a fear that this may lead to a sharp curtailment of progress towards universal school education, especially in the more backward states where the gap is greater. It is worth noting that state governments are already incurring the bulk of school education expenditure.² NKC strongly recommends that, in addition to 50 per cent of SSA, the Centre should provide all the necessary funding to ensure the Right to Education in those states where the state government is already spending at least 15 per cent of its total budget on school education.

¹ If the centre provides 75 per cent of the spending for SSA, the additional cost would be Rs. 37,000 crore over the 11th Plan period, that is around Rs. 7,000 crore per annum.

² Currently, the ratio of central government to state government spending for school education, including SSA, is 12:88. If mid-day meals are included, it is 20:80.

Language

October 20, 2006

The National Knowledge Commission has emphasised the importance of an inclusive society as the foundation for a knowledge society. NKC has also recognised the significance of language, not only as a medium of instruction or a means of communication but also as a determinant of access. An understanding and command over the English language is a most important determinant of access to higher education, employment possibilities and social opportunities. School-leavers who are not adequately trained in English as a language are always at a handicap in the world of higher education. More often than not, teaching is in English. Even if it is not, in most subjects, books and journals are available only in English. And those who do not know English well enough find it exceedingly difficult to compete for a place in our premier educational institutions. This disadvantage is accentuated further in the world of work, not only in professional occupations but also in white-collar occupations overall.

This reality is not lost on our people, who recognise that the English language is a critical determinant of access to, and opportunities for a better life. Available information suggests that middle-income or lower-income households spend a large proportion of their modest income on sending their children to relatively expensive English medium schools. Such educational opportunities for children are a priority that is almost at par with health care for the family. But there are a very large number of people who simply do not have the resources for such investment. The outcome is exclusion. We believe that inclusion is possible through public provision.

There is an irony in the situation. English has been part of our education system for more than a century. Yet English is beyond the reach of most of our young people, which makes for highly unequal access. Indeed, even now, no more than one per cent of our people use it as a second language, let alone a first language.

These realities cannot be changed overnight. But NKC believes that the time has come for us to teach our people,

ordinary people, English as a language in schools. Early action in this sphere, would help us build an inclusive society and transform India into a knowledge society. In just 12 years, it would provide the country's school-leavers with far more equal access to higher education and, three to five years thereafter, much more equal access to employment opportunities.

The Commission engaged in informal consultations on this subject with a wide range of people in government, academia, media and industry. It consulted some Chief Ministers in the states. It consulted Members of Parliament. It consulted people in professions such as medicine and law as well as civil society organisations. There was unanimity that this can and should be done. A Working Group was constituted to work out the modalities in terms of first steps. The report submitted by this group was used as an input in NKC's deliberations.

NKC recommends that the teaching of English as a language should be introduced, along with the first language (either the mother-tongue or the regional language) of the child, starting from Class I in school. This phase of language learning should focus on using both languages to create meaningful learning experiences for the child without disproportionate emphasis on grammar and rules.

NKC recognises that nine States (of which six are in the north-east) and three Union Territories have already introduced English as a compulsory subject from Class I onwards. In addition, as many as 12 States and three Union Territories have made English a compulsory subject, at different stages in primary school, by Class V at the latest. However, the implementation is slow and the quality of English language teaching is simply not good enough. The support systems, such as the number of teachers or materials for teaching, are neither adequate nor appropriate. NKC is recommending a fundamental change that seeks to introduce, nationwide, the teaching of English as a language from Class I onwards. This is not meant to be a stand-alone, add-on subject, but is meant to be integrated into the school curriculum.

Language learning cannot be separated from, and must be integrated with, content learning. Therefore, English should also be used to teach some non-language, content subjects, starting from Class III in school. The choice of subjects for this purpose can be left to schools depending on the proficiency of teachers and availability of materials. This would, in effect, create multi-medium schools. It would also help reduce the divide between English medium schools and regional language-medium schools.

The pedagogy of language learning as well as teaching should be suitably contextualised, to lend meaning to real situations and daily lives. Moreover, assessment should be based on proficiency rather than specifying achievement targets that reward mastery of single texts acquired through rote learning. To this end, a National Testing Service (NTS) for certification of language competence as well as recruitment of language teachers should be set up.

In order to meet the requirement for a large pool of English language teachers, graduates with high proficiency in English and good communication skills should be inducted without formal teacher-training qualifications. They could be selected through an appropriate procedure developed by the National Testing Service and then given a short-term orientation. The nearly four million school teachers all over the country, regardless of their subject expertise, especially teachers at the primary level, should be trained to improve their proficiency in English through vacation training programs or other short-term courses. Most teacher training programs are not based on a real assessment of needs of teachers. Thus, the entire teacher training system catering to pre-service and in-service training that exists today, including training for language teaching, needs to be thoroughly reviewed, recognising the centrality of language in the curriculum.

A multiplicity of English textbooks should be made available to address the diversity of English language

environments in the country. However, to ensure that certain standards are maintained, benchmarks may be laid down for the content of textbooks at each stage. For this purpose, an expert group should be set up to develop pedagogically sound English textbooks for every level, from Class I to XII. These should be used as models by states and made freely available on the web to allow easy access. While the State Council for Educational Research and Training (SCERT) may continue to be a nodal agency for textbook development for state board schools, the writing of textbooks needs to be further decentralised. To make the exercise more collaborative, civil society organisations with expertise in the domain should be involved in developing textbooks. Since language learning takes place not only through direct instruction but also through assimilation from the environment, the classroom needs to be equipped with appropriate supplementary audio-visual and print material. Resource libraries could be set up in every classroom, comprising of a collection of books, magazines, newspapers, audiovisual material and posters, appropriate to the age of the students, on a variety of subjects. Language learning opportunities should also be created outside the classroom through specific bi-lingual radio and TV channels, which could be introduced for formal and informal teaching and learning of English. Knowledge clubs could be formed to discuss and disseminate knowledge as well as extend the use of English outside the classroom. Given that language learning requires extensive resources, a centrally sponsored scheme of financial assistance for developing English language resources (teachers and materials) should be instituted to address this requirement.

State Governments would need to be equal partners in the implementation of this idea. NKC therefore proposes that the Prime Minister discuss this matter with all Chief Ministers at the National Development Council, to formulate a National Plan for the teaching of English as a language, in addition to the regional language, starting in Class I. This would also ensure that at the end of twelve years of schooling, every student is proficient in at least two languages.

Translation

September 1, 2006

There is an urgent need to expand the quantity and improve the quality of translation of different types (human, machine-aided, or instant) and in different domains (literary, scientific, technical, business) that would provide greater access to knowledge across the country. The current facilities available are inadequate and less than what is socially required. There is latent unrecognised demand which is not being met because of incomplete and asymmetric information. Inadequacy of information, compounded by the lack of coordination between potential users, also leads to market failures. There is inadequate dissemination of good quality translations which would provide a benchmark and create incentives for more private activity in this area. This therefore requires some amount of public intervention, not as a permanent feature, but as a set of measures to kick-start a process of encouraging private initiative so that the large commercially viable provision of high quality translation in different areas becomes feasible. The direct and indirect employment generation potential of translation activities is very high, and could absorb a substantial part of educated unemployed youth.

Based on these insights, NKC formed a Working Group led by Dr. Jayati Ghosh to bring together people and agencies involved in translation, publishing and dissemination activities. They included representatives of some of the relevant government bodies, academics, language experts, publishers, teachers and others associated with translation activities in India. They met several times for workshops and consultations.

As a result of their work and discussions NKC recommends the following:

1. **Provide impetus for developing translation as an industry** in the country. Going by the experiences of other countries, in a country like India with its many languages, as well as the huge potential for foreign language translation, the entire translation industry has the potential eventually to employ between 200,000 and half a million people.
2. **Establish a store-house of information** on all aspects of translation involving Indian languages, and make this available by creating, maintaining and constantly updating information on translations published, training programs, translation tools/instruments and new initiatives, and facilities such as a 'National Register for Translators'.
3. **Promote printed as well as virtual publication** of works on translation studies; provide a clearing house for all translation activities, both in theoretical and applied subjects, in as many Indian languages as possible.
4. **Create and maintain various tools for translation**, including digital tools like Thesauri, Bilingual Dictionaries and software for translation. In addition, promote machine translation, leveraging emerging technologies to provide a rapid and large volume of translation at a relatively low cost.
5. **Provide quality training** and education for translators. This could be done through short term training programs, course packages for translators that could be incorporated in language teaching programs, and fellowship programs and research projects to encourage quality. There is also need for guidance in the methodology of translation and for action to enrich teaching and training activities in translation studies.
6. **Translate pedagogic materials** at all levels (including primary onwards to tertiary education) specifically in natural and social sciences.
7. **Project Indian languages and literatures within South Asia and outside** through high-quality translation.
8. **Set up a national web portal** on translation as a one-stop shop for all information on translation and to provide a forum for dialogue by creating a bulletin board for people to post questions and answers.

9. **Organise annual national conferences** on translation to take stock of activities and initiatives in the field, for experts, industry and practitioners in the field to confer.
10. **Promote book launches, festivals, fellowships and prizes** and encourage collaborative translation work, as well as long-term multi-translator projects, and organise workshops for translators to interact and exchange views and experiences.

NKC feels that in order to achieve these goals as rapidly and efficiently as possible, the Government of India may establish a National Translation Mission (NTM), which would take up these tasks in a systematic way. The NTM would be a relatively small body in terms of its own infrastructure and be flexible in organisation, but would have a budget sufficient to enable it to carry out targeted funding in identified areas. It would not function in a centralised way but will require involvement of state and local levels, and co-ordination with many different agencies. Since immediate requirements may be different from future needs not only in terms of translation activities but also the nature of interventions required, the NTM should be flexible

and responsive to current and future social realities and market conditions.

It is envisaged that a National Translation Mission performing these activities could be set up during the 11th Plan, with a proposed budget of Rs 250 crore for the entire Plan period (around Rs 80 crore for organisational costs, manpower and scholarships, and around Rs 170 crore for all other activities, which would involve funding other collaborating institutions or parties). Depending upon the experience during the 11th Plan period, the extent of this support could be enhanced subsequently. In addition, the NTM would require some one-time support for creating and developing the necessary infrastructure.

A proposal on these lines was sent to the Planning Commission which made some further suggestions on the organisation and structure of the National Translation Mission.

Translation activities should be seen in tandem with the plan to increase access to English language training across the population, and the promotion of English in school education at the primary level. Both are aspects of the goal of increasing access to knowledge.

Public libraries play a pivotal role in dissemination of knowledge and are an extremely important element of the foundation of a knowledge economy. There is widespread agreement that there is an urgent need for reform in the Libraries and Information Services (LIS) sector. Several initiatives in this regard have already been taken by the Government. NKC has consulted extensively with diverse stakeholders, including a Working Group of experts and professionals. NKC's recommendations for formulating strategies in the LIS sector are as follows:

1. Set Up a National Commission on Libraries

A permanent, independent and financially autonomous National Commission on Libraries should be set up by the Central Government as a statutory body to address the information and learning needs of the citizens of India. To launch the process in a mission mode, a National Mission on Libraries should be set up immediately, for a period of three years.

2. Prepare a National Census of All Libraries

A national census of all libraries should be prepared by undertaking a nation-wide survey. Collection of census data on libraries would provide baseline data for planning. The Task Force that has been set up by the Department of Culture for this purpose should be given financial and administrative support to implement this activity and complete the survey on a priority basis (within one year). User needs and reading habits should be periodically surveyed at the national level as part of the National Sample Survey.

3. Revamp LIS Education, Training and Research Facilities

The proposed Mission/Commission on Libraries must assess as soon as possible the manpower requirements

of the country in the area of LIS management, and take necessary steps to meet the country's requirement through LIS education and training. To keep the LIS sector abreast of latest developments, necessary encouragement should be given to research after evaluating the research status in this field. Establishing a well-equipped institute for advanced training and research in library and information science and services would provide the necessary impetus to this task.

4. Re-assess Staffing of Libraries

In the changed context, it is necessary to assess the manpower requirements for different types of libraries and departments of library and information science, keeping in mind job descriptions, qualifications, designations, pay scale, career advancement and service conditions.

5. Set Up a Central Library Fund

A specified percentage of the Central and State education budgets must be ear-marked for libraries. In addition, a Central Library Fund should be instituted for upgrading existing libraries over a period of 3-5 years. The initial funding from the Government may be Rs 1,000 crores, which may be matched by the private sector through corporate philanthropy. This fund should be administered by the National Mission/Commission on Libraries.

6. Modernise Library Management

Libraries should be so organised and the staff so trained that they become relevant to user communities (including special groups) in every respect. Also, to optimise resources, efforts should be made to synergise the strengths of different types of libraries through innovative collaboration. NKC proposes the creation of a model Library Charter, a list of services to be performed by libraries, a Library Network and a National Repository for Bibliographic Records.

7. Encourage Greater Community Participation in Library Management

It is necessary to involve different stakeholders and user groups in the managerial decision-making process for libraries. Public libraries must be run by local self-government through committees representing users of the library. These committees should ensure local community involvement and should be autonomous enough to take independent decisions to conduct cultural and educational community-based programs. Libraries should integrate with all other knowledge-based activities in the local area to develop a community-based information system. In the rural sector, the responsibility for village libraries or Community Knowledge Centres must lie with the Panchayats. These should be set up in close proximity or on the premises of schools.

8. Promote Information Communication Technology (ICT) Applications in All Libraries

The catalogues of all libraries should be put on local, state and national websites with necessary linkages. This will enable networking of different types of libraries and setting up of a National Repository of Bibliographic Records and a centralised collaborative virtual enquiry-handling system using the latest ICT. To enable equitable and universal access to knowledge resources, libraries should be encouraged to create more digital resources by digitising relevant reading material in different languages, which can be shared at all levels. Peer-reviewed research papers resulting from publicly funded research should also be made available through open access channels, subject to copyright regulations. It is recommended that open standards and free and open source software may be used for the above.

9. Facilitate Donation and Maintenance of Private Collections

There are numerous rich private and personal collections in India which need to be identified, documented and preserved for posterity. While there is a need to create a decentralised model for identification of personal collections, it is also necessary to sensitise organisations to receive and preserve donations of personal collections through a simplified process. The National Mission/Commission may set up a committee on private and personal collections under the chairpersonship of an eminent scholar. Since special facilities for maintaining private or personal collections are not easily available, it is suggested that 10 regional centres with specific mandates be set up in different parts of the country for this purpose.

10. Encourage Public-Private Partnerships in LIS Development

Philanthropic organisations, industrial houses and other private agencies should be encouraged through fiscal incentives to support existing libraries or set up new libraries. The ingenuity of civil society may also be utilised to prepare necessary infrastructure to meet the special ICT needs of the LIS sector.

In order to facilitate the coordinated development of libraries across different sectors and to provide the legislative framework, required legal support and financial backing to the library sector, the Government could, in course of time, consider including libraries in the Concurrent List of the Constitution of India. This should be done without in any way abrogating the existing responsibilities of the states towards libraries.

Knowledge Network

December 21, 2006

NKC strongly feels that to optimally utilise the potential of institutions engaged in generation and dissemination of knowledge in various areas, such as research laboratories, universities and other institutions of higher learning, including professional institutions, it is important to connect them through a high-speed broadband network. In order to explore the feasibility of establishing broadband connectivity among such institutions, NKC spent six months studying various issues and alternatives. Extensive consultations with experts, potential users, telecom service providers, government officials and various educational and research institutions provided insights on the requirements, implementation issues and benefits of creating an integrated national knowledge network.

The purpose of such a knowledge network goes to the very heart of the country's quest to build quality institutions with requisite research facilities and to create a pool of highly trained persons. Considering the magnitude of the challenge, NKC believes an immediate objective of the network will be to share the existing content, coursework, expertise, ideas, innovations, equipment and facilities available in the limited number of centres of excellence, with a wider group of institutions, educators and students.

Globally, research and development activities and innovations are increasingly multidisciplinary, and collaborative, and require substantial computational power. The key to successful research today is live consultations, data sharing and resource sharing. Therefore it is essential to provide broadband connectivity to our knowledge institutions to improve access, quality and quantity of R&D activities.

The primary objective is to interconnect all our knowledge institutions in various fields, and at various locations throughout the country, through an electronic digital broadband network with adequate capabilities and access speed to encourage sharing of resources and collaborative research.

NKC commissioned an expert to examine what it would take to create a national knowledge network. NKC also held detailed discussions with the office of the Principal Scientific Adviser (PSA) to the Government of India. The discussions yielded a consensus on the optimal approach to be adopted for setting up such a network, whether it is for a broad range of institutions as envisaged by NKC or a specific community of Science and Technology (S&T) research institutions. Based on the various discussions NKC recommends the following:

1. National Knowledge Network

Build a national knowledge network with gigabit capabilities to connect all universities, libraries, laboratories, hospitals and agricultural institutions to share data and resources across the country. This will ultimately require provision of connectivity to around 5,000 nodes covering all major institutions. The actual implementation could be in phases targeting 500 to 1,000 nodes in the first phase. However, the design of the network will have to be based on the final network. The prioritisation of the nodes for implementation purposes should be on the basis of the institutions which are most likely to use the network from day one and which would be able to demonstrate the benefits. Based on a detailed analysis of the country's existing optic fibre infrastructure and technologies available, it is estimated that a 500 to 1000-node network can be commissioned within three to six months.

2. Options

Wide consultations with experts and technology providers suggest that there are four possible networking options:

- The first one involves hiring dark fibres that have been extensively laid out by various telecom service providers and lighting them.
- The second involves lit fibres and differs from the first in not requiring transmission equipment procurement and its maintenance.

- The third involves using existing commercial networks, making capital investment in equipment unnecessary. It requires minimum maintenance and operations organisation.
- The fourth is a hybrid approach where the Core consists of two layers in which the inner higher-speed layer is wholly owned by the stakeholders while the lower layer is provided by commercial service providers.

From the viewpoint of cost, the third approach based on the utilisation of the available commercial networks appears to be most attractive to start with. This is because the capital expenditure is negligible if the operator chosen has a well established network which is being used by a large number of existing customers. However, lack of experience of architectural flexibility and security aspects of virtual private networks (VPNs) set up on a commercial basis, do not allow prospective users to be entirely comfortable with this approach. Therefore, NKC recommends that existing commercial networks be utilised. Subsequently, feedback from this exercise could enable a shift to a hybrid network with a central Core, preferably of a relatively few nodes, and an outer network constituted by practically each one of the other operators' networks.

3. Architecture

The network should consist of a Core using Internet Protocol (IP) and Multi-Packet Labeled Services (MPLS) technology, an Aggregation or Distribution network, and an Access or Edge network linking the institution's local area network (LAN) to the Core. The Core network could be a single hierarchy or a two-stage Knowledge network with a higher speed network at the top to accommodate architecture flexibility and security concerns in a VPN-based commercial Internet Protocol-Multi Protocol Label Switching (IP-MPLS) network. The detailed specification of the network will have to be drawn up with a view to inviting bids for speedy implementation. The network should be implemented in phases. The first phase should cover about 1000 institutions and should be commissioned in three to six months.

4. Congruence with E-governance

The question of whether the network for E-governance and the Knowledge Network should be one single network assumes importance and relevance depending

upon the approach adopted for the realisation of the network. In the recommended approach in the first phase, namely VPNs on commercial MPLS networks on Dense Wavelength Division Multiplexing (DWDM), this question becomes irrelevant because several VPNs can be created on a commercial network and they could be entirely un-correlated, as may be the case with these two networks. This question would assume importance only if the country were to implement a purely owned network on lighted fibres. On the other hand, even in the hybrid approach, the E-governance network with an entirely different geographical spread and much lower bandwidth requirements, can be realised as VPNs and the security and flexibility could be addressed by the inner core. The issue of congruence of the two networks therefore no longer remains important and the two aspects can be totally de-linked.

5. Security and Privacy

Methods will have to be evolved both at the time of commissioning of the network as well as during operations, to ensure security of data along with privacy and confidentiality. Access to data from the Data Centre of a given institution should be under the control of the institution being addressed. An arrangement for authentication and authorisation, with the participation of the connected institutions is essential to launch the network.

6. One-time Support for LANs

The proposed broadband network envisages higher access bandwidth and therefore almost all user institutions will have to upgrade their networks to be able to cater to these speeds. While several institutions may have the resources for doing this, a large number will need one-time capital support to set up Fast Ethernet LAN (FELAN) which includes expenditure on routers, switches and optic fibre cable on the campus.

7. Costs

The Knowledge Network initially proposed to be launched on existing commercial networks will therefore involve a recurring cost of Rs 20-40 lakh per institution connected, amounting to Rs 200-400 crores annually for 1000 institutions in the first phase. In addition, there will be a one-time capital investment in upgrading the LANs of these institutions to a 100

Mbps capability Fast Ethernet LAN. Thereafter, based on feedback, the installation of the inner core network of 10 Gbps or higher capability will be taken up. This will involve a capital investment of around Rs 1,000 crores on a 7 or 8-node Inner Core network, its Gigabit connectivity to the commercial IP-MPLS networks, as also direct connectivity to a few users who are particularly concerned about the security and internetworking experiments. This expenditure will be incurred over a period of time. There will be an additional recurring expenditure for this Inner Core on hiring large bandwidths from bandwidth service providers. This amount will depend on the number of nodes and the negotiated or bid-based price.

8. Organisation

To ensure day to day coordination, operation and efficient utilisation NKC recommends establishing a Special Purpose Vehicle (SPV) consisting of major stakeholders. Such an SPV should have professional experts pooled from various stakeholder institutions for coordinating and guiding various private vendors for speedy implementation. The policy, security and overall management should be the responsibility of the SPV and the operational support requirements should be met by the industry. One of the compelling reasons for such a mechanism is to provide assurance that the use of cyber space will in no way compromise the security concerns of the country.

9. Ownership

The Knowledge Network should be owned by the SPV consisting of major stakeholders. Government ownership is not desirable, despite the fact that substantial funding will be from the Government, because:

- It is the Government's policy to withdraw from direct operations and maintenance activities in the ICT sector.
- The type of trained manpower needed, though not large, is in great demand in the market, and therefore will require special remuneration and incentives.

10. Special Group

NKC recommends the setting up of a special Working Group of experts to finalise specifications, implementation plans, cost estimates, and network plans, as well as to carry out the actual task of procurement and commissioning of the network. This group will also establish the SPV needed for running the network on a day to day basis.

NKC believes that a National Knowledge Network interconnecting our knowledge institutions and infrastructure with access speeds of 100 mbps and more will give a major push to collaborations and sharing needed to enhance the quality of our education, research and applications and at the same time will empower our people to be competitive in the global economy.

Health Information Network

October 12, 2007

National Knowledge Commission (NKC) is convinced that extensive use of IT in health care will promote the delivery of efficient health care in the country. However as the use of IT in the management of healthcare and medical knowledge will increase, the health care establishments will develop and use their own health IT systems. It has been the experience of western countries that these individually developed systems are often not interoperable with other establishments, which makes the health care system inefficient and expensive. NKC believes that India has a unique opportunity to learn from the world experience and adopt only the proven best practices in the field.

In this context NKC constituted a working group, under the chairmanship of Dr. N.K. Ganguly, Chairman Indian Council for Medical Research (ICMR) to study the use of IT in future health care. The working group studied the future need, conducted several meetings and deliberations, and held consultations with various national and international experts. NKC believes that the use of IT in health care needs a national direction for its proper implementation and makes the following recommendations for developing a Health Information Network:

1. Initiate Development of Indian Health Information Network

India needs to develop a web-based network, connecting all health care establishments, in both private and public sector. When fully functional, all health care transactions will be recorded electronically and this data will be available in the health data vault to authorised users when they need it and where they need it.

The proposed Knowledge Network with gigabit capabilities may provide the backbone and network infrastructure on which the Health Information Network may ride. The network will be a 'hub and spoke model'. All health care establishments in a district will connect to a central data repository at the district

level. All the district nodal data repositories will connect with a state level data bank, which in turn will connect with a central data bank.

There should be active involvement of private and public health entities to effectively address the creation of this network, portals, electronic health records, health data vault, security, privacy and other related issues in future, which will encourage the participation of the following:

- Citizens
- Health care providers and players
- Education, research institutions and investigators
- Government departments and institutions
- Public health agencies and NGOs
- Pharmaceutical industry and medical device makers
- Telemedicine institutions
- Software and hardware developers

The ready availability of information will accrue enormous benefits to public health planning, medical education, cost control, medical research, drug development, prevention of fraud, disaster management and improved patient care.

2. Establish National Standards for Clinical Terminology and Health Informatics

For a web based interoperable national grid it is imperative to have common clinical nomenclature, or else disparate programs developed by the industry will not be interoperable. The clinical standards will establish a common lexicon to be used in electronic transactions. This will enable all geographically scattered entities to communicate in one common language and facilitate data transmission and collection. It is important to develop common nomenclature standards for the traditional medical systems, as large numbers of people depend on these systems for their medical needs. Besides the common clinical language, adoption of a common national standard in health informatics will facilitate the messaging, collation and analysis of data.

3. Create a Common Electronic Health Record (EHR)

An electronic health record (EHR) is the record of a person from birth to death where all health care encounters are recorded. Health transactions are presently recorded in a paper format, like a hospital patient chart, prescriptions, laboratory tests etc. The technology to capture and store this information electronically already exists and has been developed by many private and public organisations in India. For uniform data capture, storage and subsequent use, it is recommended to create a common national EHR based on common clinical and IT standards. The record should be able to capture data generated by the 'traditional medicine' health providers. To promote the early adoption of the health IT, this EHR may be given free of cost or at subsidised rates to all users. The other IT tools and applications can be developed by the private industry and should be compatible with the national EHR.

4. Frame Policies to Promote Use of IT in Health Care

The use of IT in health care needs an impetus from the government; otherwise the development and penetration will be slow and arbitrary. These policies should be formed, not to hamper, but promote the health IT business in the country and generate employment in this sector. The Central Government should declare a time period after which all transactions in health care in the country will be in electronic format. Sufficient time should be given for the health establishments to adopt electronic transaction. NKC feels 7-10 years is an adequate time for all parties to evolve electronic transactions after which all health establishments should be able to comply.

5. Create Appropriate Policy Framework to Protect Health Data of Citizens

The integrity of data at the primary data collection site will determine the usefulness of this enterprise. To ensure that only correct patient and other health data is collected, it is of utmost importance to gain the confidence of the citizens that their health data will not be misused by the health providers, insurance companies,

employers and the government. Both technological and legal framework is important to achieve this. While encryption, anonymity and other IT security measures should be in place; it is also important to have rules in place. It is important to maintain confidentiality and security of the personal health data and to govern the access and use of data.

6. Medical Informatics to be Part of Medical and Paramedical Curriculum

Medical education needs to take full advantage of the power of ICT. A well-structured health informatics curriculum needs to be made an integral part of medical education at all levels. Basic ICT facilities, such as good quality access to Internet and e-Journals, need to be made compulsory for all medical colleges in the country. For capacity building, ICT tools should be effectively deployed to train the large number of health workers. Short and medium term courses need to be developed and made available on the net to address training needs of all health workers in the field. It should be made affordable, accessible and easily available for small players. There is a need to evolve common formats for data reporting to facilitate IT enablement of medical manpower at all levels. Education related portals should also be set up for training of medical manpower.

7. Create an Institutional Framework for Implementation

An autonomous body with the Ministry of Health should be responsible for planning and implementing the project in a time bound manner. This body should be autonomous and a non-profit organisation with representation from private, public and voluntary sectors.¹ All stakeholders should be represented in this body and it should have the resources to promote and implement the plan. It should also have the authority to ensure the smooth functioning of the Indian Health Information Network.

The objectives for this institutional body will be:

- To formulate an implementation plan
- To coordinate the participation of all stakeholders
- To create linkages with e-governance, medical education network

¹ It may be modeled after the Canadian Health Infoway, which is a non-profit autonomous body funded by the federal and provincial governments in Canada.

- To ensure financial viability of the project
- To set up a comprehensive and interactive national health portal
- To suggest common national standards
- To protect confidentiality and security of data
- To facilitate the ownership, access and flow of data
- To maintain and upgrade the system in future

The next step in the development of Indian Health Information Network is to formalise the institutional body with appropriate professional people with domain expertise, adequate budget, time tables, and measurable milestones to implement these recommendations. The body may consider conducting pilot programs before scaling at the national level.

Recognising that the Internet constitutes a powerful and democratic source of information and knowledge, the National Knowledge Commission (NKC) deliberated on ways to create a series of web portals. These web portals should become a decisive tool in the popular movements in support of the right to information, decentralisation, transparency, accountability and people's participation.

In order to increase openness and enhance accessibility, NKC recommends the creation of web portals to aggregate, organise and present relevant and useful content in local languages, in a highly uniform, customisable, user friendly and personalised way for several key areas related to basic human needs. In this context the Commission recommends the following:

1. Create National Portals for Basic Needs

National web-based portals should be set up on certain key sectors such as Water, Energy, Environment, Education, Food, Health, Agriculture, Employment, Citizen Rights etc. These would serve as a single point of access for consolidated information, applications and resources on the sector and will cater to a wide spectrum of users from citizens, entrepreneurs, small scale industries, students, professionals, researchers, local practitioners etc.

2. Management and Ownership by Consortium

While the government will be a key partner in the initial set up, the portals should be managed by a consortium with adequate representation from a wide range of stakeholders from the sector including NGOs, Research and Scientific Groups, Academic Institutions, Advocacy Groups, Government Agencies/Departments, International Bodies, Other Funding Agencies, Private Sector, Technology Experts, Educators, e-Learning experts etc.

This will ensure that:

- The portal remains a dynamic repository of information from multiple sources to aggregate content.
- A collaborative model is adopted so that all stakeholders such as citizens, NGOs, businesses etc. participate in the creation, collaboration, sharing and discussions in a rich and meaningful way such that information cannot be monopolised by any one group.
- The portal would have greater community ownership in order to ensure its success.
- Experiences, technology, processes etc. would be shared between various portals.

3. Establish Procedures

A set of procedures should be followed for setting up Portals:

- Agreement on the subject area
- Identification of champion/lead organisation/s
- Submission of proposal on architecture of the portal by the champion organisations for consideration of the Commission
- Identification of stakeholders and partners and setting up of framework for portal management.
- Development of content
- Launch of Portal
- Development of rich, useful and relevant content

The cycle is expected to take between nine months to a year to complete, at the end of which a portal would be put in place which could then continuously be enhanced, populated and promoted.

4. Provide Access to Government Held Data

There are a host of issues related to data for a portal, such as sourcing, validation, quality and formats. The government is a major source of extensive data on various sectors. All government departments should easily make

available data sets they have, in a digital format to the portal consortium. Data from different sectors needs to be analysed holistically so that planning becomes more data-driven and reflects the ground situation. This means that data that is traditionally collected and managed separately, unrelated to each other, should now be seen together. There are no platforms or mechanisms currently in place to allow this to be done easily. Clear guidelines should be developed under which this data could be sourced in appropriate formats and regularly updated. The Right to Information may make this easier, but it continues to be a long drawn process. These procedures need to be streamlined and made simpler.

5. Encourage Collaborative Funding

The Portal effort can escalate quickly as the scale of content, partnerships and the scope is very large. The issue of funding for the effort includes big line items like technology development, map preparation, data gathering, developing applications, content creation, organising and coordinating partnerships. Solutions need to be evolved depending on the sector in question. Several possibilities including public private partnerships and new business models should be explored. The government may also look at providing some public money for these efforts through grants.

6. Reform Mapping Policy

The advance in computer based Geographic Information Systems (GIS) has given mapping and use of maps a huge impetus in various fields. The ability to make sense of large amounts of interrelated data in spatial and attribute form has helped in visual decision making in various areas such as Agriculture, Transport, Disaster Management etc. An unambiguous mapping policy coupled with clear guidelines for use of spatial data are necessary to share GIS data and thereby maximise the use of cutting edge technology and applications. Under the new mapping policy announced in May 2005, there is still some ambiguity about publishing of GIS maps on the Internet by NGOs, Government and other development oriented agencies. Rich GIS based content in various sectors like Water, Health, Education etc. can be delivered by various organisations and bodies in order to share information, foster an informed debate and allow for more effective planning. The mapping

policy needs to allow for such access and provide clear guidelines.

7. Enhance Internet Penetration and Access

At this stage, the use of Portals may be limited by the low Internet penetration in the country, where less than 5 per cent of population has access to Internet. To address this challenge it is essential that the portal team should work proactively with NGO and Government networks, use mass distributions channels like radio, television and the print media to ensure this knowledge is leveraged to precipitate change on the ground. There needs to be a firm commitment to support alternate non-web outreach methods that make this knowledge accessible to all sections of society (the digital haves and have nots).

An alternate IT technology can support those who do not have Internet access. This calls for a locally resident tool that is run on a desktop PC which can provide information and run applications pertaining to specific topics. Since these applications are not relying on the Internet or storing information at a distant server, they can be used locally at the site without network connectivity.

Subsequently, it would be useful to be able to connect to a server to upload local data or download updates and information. These software thick client applications can be the source of bottom-up data, since NGOs and individuals can upload local data over the Internet for analysis at a central server. This provides an alternative bottom-up way of collecting fine grained local data in a continuous manner.

The portal will thus address the needs of a very diverse spectrum of users from researchers and policy makers to local practitioners at the ground level who stand to benefit greatly from the comprehensive availability of information on a sector relevant for them in an open and transparent manner.

8. Translate into Indian Languages

The portals should be translated into all Indian languages to reach a wider audience. Interactive applications and e-learning content must be made available in local languages for it to be relevant.

Knowledge Concepts

School Education

Vocational Education and Training

Higher Education

Legal Education

Medical Education

Management Education

Engineering Education

Open and Distance Education

Open Educational Resources

More Talented Students in Maths and Science

More Quality Ph.Ds

School Education

February 3, 2008

Ensuring quality school education to all is the foundation upon which any further advances towards a knowledge society must be based. Noting the crucial importance of school education, the National Knowledge Commission held a series of workshops and consultations around the country involving a very wide range of stakeholders, to discuss issues of quantity, quality and access in school education.

NKC recognises that the primary responsibility for school education is borne by the State Governments, and therefore any policy changes must be with the full participation and involvement of the states. Nevertheless, NKC believes that positive changes in systems of schooling will require the active involvement of the Central Government as well as State Governments, not only in the matter of providing resources but also in promoting organisational and other changes.

NKC has a number of suggestions and recommendations covering the different aspects of school education, but the essential thrust can be summarised in terms of more resources, more decentralisation and more flexibility.

1. Central Legislation for the Right to Education, backed by Financial Commitment

NKC endorses the speedy enactment of a central legislation that will ensure the right of all children in the country to good quality school education up to Class VIII, supported with financial commitments of the Central and State Governments. This obviously requires substantially increased public spending for both elementary and secondary school education, which must be seen as a priority area for spending. Currently school education is highly segmented, even in government-run institutions, as a result of the parallel track of “education centres” in some states. These separate systems must be integrated to give all children access to schools of acceptable quality, which will obviously require additional spending.

2. More Flexibility in Disbursal of Funds

However, there is a strong case for changes in the manner in which such expenditure is incurred. The current norms for central government disbursal to states of funds for [including for Sarva Shiksha Abhiyan (SSA)] the planned SUCCESS program for secondary education and other central schemes, are too rigid and must be made more flexible. NKC strongly recommends a system of funds transfer and accounting that will allow for regional and other differences as well as changing requirements over time, and thereby allow State Governments to use the resources in the most effective way. There should also be greater flexibility in disbursing funds down to the school level and a greater degree of autonomy of local level management in the use of funds. The norms and rules should allow schools to adapt to local conditions and meet particular requirements of their students.

3. Decentralisation and Greater Local Autonomy

Community participation is an important instrument to ensure accountability and improve the day-to-day functioning of schools. This in turn means that the management of schools, including the use and management of funds, should be decentralised to local authorities as far as possible, whether they be panchayats, Village Education Committees or municipalities, and to School Boards that have representation of all stakeholders including parents.

4. Expansion of Functional Literacy

NKC would like to stress the continuing importance of a focus on expanding functional literacy among the population. Illiteracy remains a major problem, even among the age group 15-35 years, and therefore literacy programs must be expanded rather than reduced, and given a different focus that is directed towards improving life skills and meeting felt needs, especially (but not only) among the youth.

5. Planning for School Infrastructure

It is important to remember that land is an essential requirement of schools, and this requirement is likely to increase in the near future given the expansion implied by demographic changes and need to ensure universal schooling. Therefore, urban master plans and local development plans must explicitly incorporate the physical requirements for schooling, including provisions for playgrounds and other school facilities.

6. Enabling and Regulating Mechanisms for Private Schools

Since private schools play an important role in the provision of education, there is need for both enabling and regulating mechanisms to be developed and strengthened for them. There should be transparent, norm-based and straightforward procedures for the recognition of private schools, to reduce harassment and bureaucratic delay. There should also be transparent criteria as for the disbursement of aid from the government to some self-financing schools, especially those which cater to underprivileged children, and clear norms with respect to the ability of school managements to raise resources from other sources. The monitoring of private schools, in terms of ensuring a transparent admissions process, regulation of fee structures, as well as meeting minimum set standards for quality of teaching and infrastructure, also requires attention. The possibility of greater exchange between schools, including mentoring of one school by another, should be allowed and encouraged.

7. Database on School Education

Educational planning and monitoring are made much more difficult because of the lack of comprehensive and accurate data on schools, school-age children and actual attendance of both students and teachers. The collection and speedy dissemination of accurate and current data on schooling must be made a priority. It is necessary to create a complete database on schools and school-age children so as to track the actual coverage and quality of schooling at different levels, and to make it widely available in a timely manner. Such data collection may be made an essential part of the fund allocation for school education, with appropriate institutional mechanisms.

8. More Co-ordination between Departments

The multiplicity of management structures and government departments that currently governs

schooling creates confusion, unnecessary replication and possibly inconsistent strategies across different schools. There must be greater co-ordination between different departments of government on school education policy, even while ensuring more autonomy to the local management of schools.

9. National Evaluation Body for Monitoring Quality

Educational administration also needs to be more conscious of actual learning outcomes at different levels, which will determine both policy and functioning. NKC therefore proposes a national evaluation body to monitor the quality of both government and private schools, using a results-based monitoring framework based on a short list of monitorable criteria that include both process and outcome indicators.

10. Revamping School Inspection

The system of school inspection needs to be revamped and revitalised, with a greater role for local stakeholders and greater transparency in the system. The solution does not lie in simply expanding the system – rather, we need to develop systems to ensure meaningful monitoring, including provision of greater facilities to school inspectors, a separation of inspection of qualitative and administrative aspects, transparency in the criteria of inspection, and greater involvement of local stakeholders.

11. Teachers and Teacher Training

Teachers are the single most important element of the school system, and the country is already facing a severe shortage of qualified and motivated school teachers at different levels. It is urgent to restore the dignity of school teaching as a profession and provide more incentives for qualified and committed teachers. Non-teaching official duties such as electoral activities should not be allowed to interfere with the teaching process. Forums that allow and encourage teachers to exchange ideas, information and experiences, including a web-based portal, should be developed.

At the same time, there should be transparent systems for ensuring accountability of school teachers. As far as possible, teachers should be recruited to particular schools.

The training of teachers is a major area of concern at present, since both pre-service and in-service training of

school teachers is extremely inadequate and also poorly managed in most states. Pre-service training needs to be improved and differently regulated in both public and private institutions, while systems for in-service training require expansion and major reform that allows for greater flexibility.

12. Reforms in the Curriculum and Examination System

Curriculum reform remains a critically important issue in almost all schools. School education must be made more relevant to the lives of children. There is need to move away from rote-learning to understanding concepts, developing good comprehension and communication skills and learning how to access knowledge independently. This also requires substantial changes in the examination system, especially at Board level but also earlier.

13. Use of Information and Communication Technology

Wherever feasible, ICT should be made more accessible to teachers, students and administration for learning, training, research, administration, management, monitoring etc. This requires the provision of more facilities such as computers as well as connectivity and broadband facilities. Computer-aided learning also requires training of teachers and other staff in order to make the best use of technology.

14. English Language Teaching

Proficiency in English is widely perceived as an important avenue for employment and upward mobility, which also greatly facilitates the pursuit of higher education. The incorporation of English into the curriculum through the teaching of English as a language in Class I and teaching of one other subject in English medium in later classes requires making pedagogical changes to contextualise language learning, increasing the availability of English language teachers and providing more bilingual and supplementary teaching materials. At the same time, multi-linguality must be promoted and language issues must be explicitly taken on board in designing school curricula and methods of pedagogy.

15. Interventions to Ensure Access of Educationally Deprived Categories

Special interventions are necessary to ensure greater access to education of educationally deprived categories, and some proposals for this are developed in more detail in the accompanying Note. Obviously, specific measures are required to ensure greater enrolment and retention of girl students. Education of SC children must be a priority, which necessitates both flexibility of approach and avoidance of discrimination. The access of children from Scheduled Tribes requires more flexible and sensitive schooling strategies. Language issues must be explicitly taken on board in designing school curricula and methods of pedagogy. Special strategies are required to ensure greater access to schools for children in backward regions, remote locations and difficult terrains. Official strategies for ensuring better access of Muslim children to schooling are excessively focused on madrasas which cater to only a tiny minority of such children; the emphasis should be on creating enabling conditions for Muslim children in the general school system. Children of seasonal migrants require special conditions and efforts to ensure continuous access to schooling. Similarly, labouring children require incentives and bridge courses. The needs of physically disadvantaged children, as well as teachers, have to be factored in more thoroughly in provisions for school education.

There is wide diversity across states in terms of progress towards achieving universal elementary education, and also diversity within states with respect to the quality of school education. But NKC believes that these proposals, which require the active involvement of the Central Government as well as State Governments, will go some way in terms of ensuring universal access to elementary education, wider access to secondary education as well as better quality and greater relevance of all schooling. Given the strong synergies between this and other areas such as libraries, translation, knowledge networks etc, these suggestions should be seen in conjunction with other recommendations that have already been made in these other areas, as part of a systematic set of knowledge initiatives for the young.

Note on School Education

The Prime Minister has repeatedly emphasised that ensuring quality school education to all is one of the most important priorities of the government, and the National Knowledge Commission has also recognised the crucial significance of this as the foundation upon which any further advances must be based. NKC has held a series of workshops around the country, addressing issues of quantity, quality and access in school education, and tried to involve a very wide range of stakeholders in the consultations.

NKC recognises that the primary responsibility for school education is borne by the State Governments, and therefore any policy changes must be with the full participation and involvement of the states. Also, there is wide diversity across states in terms of progress towards achieving universal elementary education, and also diversity within states with respect to the quality of school education. Nevertheless, NKC believes that positive changes in systems of schooling that will ensure universal access to elementary education, wider access to secondary education as well as better quality and greater relevance of all schooling, will require the active involvement of the Central Government as well as State Governments. Such involvement is necessary not only in the matter of providing resources but also in promoting organisational and other changes. NKC has a number of suggestions and recommendations covering the different aspects of school education, but the essential thrust can be summarised in terms of **more resources, more decentralisation and more flexibility**. Outlined below are the most important areas of possible intervention. NKC is aware that while some proposals are new, other recommendations have found expression in different ways in previous reports and studies. However, NKC has chosen to reiterate them because they are still crucial and relevant.

NKC would also like to emphasise that there are very strong synergies between these recommendations for school education and other proposals of NKC with respect to libraries, translation, networks, language in schools and vocational education. These suggestions

should therefore be seen in conjunction with the other recommendations that have already been made in these areas, as part of a systematic set of knowledge initiatives for the young.

1. Quantity and Resources

1.1 Substantially increased public spending is required for both elementary and secondary education.

NKC strongly endorses the speedy enactment of a central legislation that will ensure the right of all children in the country to good quality school education up to Class VIII. We also believe that this should be extended to cover universal schooling up to Class X as soon as possible. NKC has emphasised that a vibrant, good quality and universally accessible government school system is the basic foundation upon which the schooling system in the country must rest.

Therefore this must be supported with a financial commitment of the Central Government, in such a way as to ensure that the right to quality school education is provided to all children of the country, regardless of which state they are residing in. This necessarily requires a significant expansion of the resources to be provided to elementary school education. While the government has increased allocations for school expenditure, the amounts are still far below what is required to achieve universal school education of reasonable quality for all. This is even more true because of the need to upgrade the “Education Centres” that are operating in many states to proper schools that meet all the norms in terms of trained teachers, minimum facilities etc. Therefore NKC strongly recommends a substantial increase in Central Government allocation.

NKC has already expressed concern on the recent decision of the central government to reduce the central funding for the Sarva Shiksha Abhiyan (SSA) from 75 per cent to 50 per cent. This may lead to a sharp curtailment of progress towards universal school

education, especially in the more backward states where the gap is greater. It is worth noting that State Governments are already incurring the bulk of school education expenditure. NKC strongly feels that, in addition to 50 per cent of SSA funds, the Centre should provide all the additional funding required to ensure the Right to Education in those states where the state government is already spending at least 15 per cent of its total budget on school education.

At the same time, the importance of increased spending on secondary education is greater than ever before. There is a huge shortage of middle and secondary schools, which is one of the important reasons for the low rates of retention after Class V. Currently, secondary education is massively under-funded, which in turn creates not only absolute shortages but also problems of inadequate quality in many government secondary and higher secondary schools. The aim should be to reach universal secondary school education within a maximum of 10 years. Given the demographics, this implies that expenditure on secondary schooling must be increased by several multiples within the next two years, indeed by at least five times the current level if the CABE estimates are used. Currently, many primary schools are being upgraded to secondary school status, without provision of sufficient teachers, rooms and other pedagogical requirements, which severely comprises on the quality of such secondary education. The norms for secondary schools, which include not only provision for specialised subject teachers but also for science labs, counselling etc, must be strictly adhered to when new schools are created and when primary schools are upgraded.

1.2 Urban planning and local planning must explicitly incorporate the physical requirements for schooling, including provisions for playgrounds and other school facilities.

It is important to remember that land is an essential requirement of schools, and this requirement is likely to increase in the near future given the expansion required by demographic changes and the need to ensure universal schooling. In the context of rapid urbanisation, it has been found that urban conglomerations often come up without adequate provision for ensuring the physical space required for schools in the vicinity. This is particularly a problem in new settlements with quickly increasing density of population, not only in large cities but also in smaller towns and fast growing villages. This

makes it difficult to establish schools where required, and to ensure that schools are able to provide all the necessary facilities including sports fields etc. It is essential that the urban land use policies and regulations in all states and municipalities explicitly factor in the physical requirements of schools in areas of a certain population density.

Similarly in rural areas, there must be adequate provision for land for setting up schools in areas that surpass a certain population density. In rural areas with low population density, difficult terrain or extreme climatic conditions, the government may consider setting up residential schools, which could also address the problem of migrant labourers and nomadic populations.

1.3 The norms for central government disbursal to states of Sarva Shiksha Abhiyan (SSA) funds and other central schemes for school education are too rigid and must be made more flexible.

The current system of funds transfer and the accounting rules create unnecessary rigidities that often do not allow the State Governments to use the money in the most efficient or desirable way, and also lead to less than complete utilisation of the budgetary allocation.

Some of these problems include:

- very rigid norms on unit costs and what is allowed in terms of spending, that do not recognise the diverse requirements of different states or particular regions;
- inadequate financial provisions for infrastructure such as buildings etc, especially for some states and cities, which leads to the creation of poor quality infrastructure;
- an inflexible accounting system that does not allow transferring funds across heads to meet particular or changing requirements, and therefore inhibits full utilisation and also prevents synergies from developing;
- insufficient allocation for repair and maintenance of infrastructure;
- treating rural and urban schools in the same manner even though the requirements are often very different (for example, urban government schools may require different infrastructure and facilities in order to attract students); and
- treating all districts and geographical areas in the same manner regardless of the degree of backwardness, topographical conditions etc. (This is especially a

problem for schools in hilly or heavily forested areas or those with poor physical connectivity, for which per capita allocations are the same as for other more accessible areas);

- problems in the timing of fund transfer, as well as uncertainties in fund provision created by the insistence on matching funds and the fact that plan ceilings keep changing every year.

NKC strongly recommends a less rigid and more flexible system of funds transfer and accounting that will allow for regional and other differences as well as changing requirements over time, and thereby allow State Governments to use the resources in the most effective way. This recommendation is both for the SSA and for the planned SUCCESS program for secondary education, and also for other centrally sponsored schemes relating to school education.

1.4 There should be greater flexibility in disbursing funds down to the school level and a greater degree of autonomy of local level management in the use of funds.

Even within the states, the norms for fund disbursement and the requirements are often very time consuming and breed delays and unnecessary rigidities. There should be recognition of differences in per capita resource requirement according to particular criteria, such as geographical and spatial characteristics, the presence of children with special needs, seasonality and other features.

In addition, there is a strong case for providing greater autonomy to local level management of schools, including locally elected bodies, school boards, Village Education Committees etc., in the use and management of funds, subject to some overall criteria. Within the stipulated norms for expenditure, there should be scope for greater flexibility in the use of funds in response to local needs and local innovation.

1.5 There should be transparent, norm-based and straightforward procedures for the recognition of private schools, as well as for the disbursement of aid from the government to self financing schools and the ability of school management to raise resources from other sources.

Private schools play a significant role in dispensing school education. It is estimated by NUEPA that around 15 per cent of schools in the country are privately owned

and managed, while in some urban areas, private schools cater to a very large proportion of school going children. Their role must be recognised, and those providing quality education should be encouraged, especially when they cater to less privileged children.

However, many private schools have identified the time consuming procedures for renewal of recognition from the government, which have to be undertaken at relatively frequent intervals, as a source of harassment. It is necessary to simplify the rules and reduce the multiplicity of clearances required for private schools, by developing a modality for coordinated point of clearance as far as possible. There is also a case for increasing the time period for which recognition is granted to such schools, especially those with a proven track record. Transparency in dealings between the government and private schools will also be aided if the information on rules and criteria for registration and the results of all school applications for granting of recognition are made public in an accessible form, including by making the relevant information available on websites.

Those charitable schools that provide quality education to children from underprivileged and marginalised sections of society deserve encouragement, and may be considered for receipt of government resources, according to transparent and norm-based procedures. However, all mechanisms of government aid disbursement to privately run schools should be transparently conducted and according to defined norms.

There is a widespread perception that government rules currently reduce the ability of school managements to raise resources from other sources for the expansion of infrastructure or to provide other facilities. This varies across states, but in general in most states the current system does allow schools to raise funds from donations, resources extended from the panchayat and other sources. However, it is important to ensure that the available flexibility for school management to raise resources should be widely known and publicised. In addition, innovative methods of raising additional resources could be allowed and encouraged. For example, schools, particularly in urban areas, could use assets such as buildings during non-school hours to generate additional funds to improve the quality of facilities.

1.6 Illiteracy remains a major problem, and therefore literacy programs cannot be ignored or given less importance. Expenditure on the National Literacy

Mission (NLM) must be expanded rather than reduced, and given a different focus.

The shift in policy focus from the National Literacy Mission (NLM) to the Sarva Shiksha Abhiyan has led to a declining emphasis on the need to ensure universal functional literacy. However, according to the 2001 Census, a significant proportion of the population – nearly half of all females and one-quarter of males – remains functionally illiterate. According to the NSSO, a significant proportion of households in 2004-05 (more than a quarter in rural India and nearly 10 per cent in urban India) have no literate member. The lack of functional literacy is much more marked among women, those residing in backward areas and those from marginalised social groups. Also, a significant proportion of young people – around 30 per cent of the age-cohort of 15-35 years – is functionally illiterate, since they were too old to benefit from the SSA and also slipped through the net of the literacy programs. This is of great concern because such people will continue to be active citizens for the next half century and therefore, must not be denied the capacities and opportunities that come from being literate.

NKC therefore recommends the following measures for literacy:

- Ensure greater funds for the NLM, including provision for more pedagogical resources including not only ICT but also locally generated teaching material as well as local hiring of temporary staff wherever required.
- Encourage the NLM to shift to creating Continuing Education Centres in both rural and urban areas, to impart functional literacy that is of relevance and interest to those who are currently illiterate or recently literate, as well as provide further learning material and other resources and facilities to the newly literate.
- Orient the post-literacy and continuing education programs to the emotional, physical and psychological needs of adults rather than children, incorporating issues regarding citizens' rights, human rights, sex education, health and livelihood government programs etc.
- Use a variety of methods to ensure functional literacy, which combine more centralised schemes based on ICT and other new technology with continuous work at the local level based on a clear institutional structure. While new technologies such as ICT provide important new methods for imparting literacy in a short time, they necessarily

have a limited role. They cannot be seen as stand-alone quick-fix solutions, but must be combined with other methods.

- Move to a sustainable system of literacy generation that does not rely on underpaid “volunteer” labour alone, which therefore involves budgetary provision for better remuneration for literacy workers.
- Create synergies between NLM and the proposed Skill Development Mission, while taking local needs and field requirements into account. For example, in some primarily agrarian economies, undue emphasis on industrial skills in ITIs may be incongruous while horticultural and animal husbandry skills may be more relevant.

1.7 Early childhood education is extremely important and must be universalised.

There are two aspects to ensuring the universalisation of early schooling and pre-school education. The first is the systematic extension of balwadis with trained staff to handle child pedagogy. The second is the provision for one year of pre-schooling in all institutions of elementary education. Both of these have implications for resource allocation and recruitment of the requisite staff.

1.8 The collection and speedy dissemination of accurate and current data on schooling must be made a priority. It is necessary to create a complete database on schools and school-age children so as to track the actual coverage and quality of schooling at different levels, and to make it widely available in a timely manner. Such data collection may be made an essential part of the fund allocation for school education, with appropriate institutional mechanisms.

India has an extensive and regular mechanism of data collection for primary education. However, its methodology and use leave much to be desired. For example, at present there is no reliable method for establishing which children are in schools. Data collection is too extensive, time-intensive and done almost entirely by teachers, rather than by independent and specialised personnel. There is minimal cross tabulation, coordination and cross referencing of data. The results are typically revealed to administrators, schools etc. too late to be relevant – often several years after the survey takes place. It is immensely difficult even for stakeholders, as well as other concerned citizens,

to access the data lying with official sources, despite repeated requests.

It is necessary to have a system to provide reliable school education statistics which must be transparently formulated and freely available to all. This requires mechanisms that are incorporated into the funding for all school education, at central and state government levels. These would ensure data collection and access, provide up to date information as rapidly as possible, make it more relevant for planning and implementation and more accessible for everyone. The following goals are relevant in this context:

- The process of data collection must be streamlined, made less time consuming and more relevant.
- A comprehensive mapping is required of schools and children of school-going age, so as to have accurate information on which children in which localities are enrolled, and attending which schools, as well as those not enrolled. This would also map out localities where there are high rates of drop out and/or non-enrolment.
- A tracking mechanism for all school children should be set up, to track their individual school going status, and progress in school. This tracking should cover both government schools and private schools. This would ensure universal access for children in all locations, as well as for girls and specific categories. A tracking mechanism will also facilitate checking for drop outs and related problems, and allow for speedy intervention to address such problems. It should be noted that there are already ongoing initiatives in this regard in some states, which can be replicated and scaled up.
- Data collected for the purposes of planning must provide all the relevant information. This is also important with respect to information on infrastructure provision: for example, the number of rooms should also mention whether these are electrified; where availability of toilets is described, there should also be information on the availability of water in the toilets.
- Safeguards must be instituted against “creative readjustment” of data, which is a common problem given the structure of incentives and the fact that the data are most often provided by the teachers or school management. This requires that data should be collected by independent agencies as far as possible, or necessarily subject to frequent and random cross-checks.
- ICT must be integrated for data collation and management, wherever required. A local area

network with digital entry provisions could be set up to make it easier for the teachers and others who provide and use the data.

- The data thus collected must be freely available and easily accessible, provided on dedicated websites in addition to the usual means of publication.
- More specialised micro level surveys and research should be commissioned. There should also be attempts to bring together other relevant research for easy access by practitioners.

2. Quality and Management

2.1 Currently school education is highly segmented, even in government run institutions, as a result of the parallel track of “education centres” in some states. These separate systems must be integrated to give all children access to schools of acceptable quality. This will require additional spending.

In a number of states, funds under various schemes (SSA, EGS and AIE) were used to create “Education Centres” (Shiksha Kendras) rather than proper schools. These typically involve “teachers” who are essentially local women who have just passed Class VIII (or even Class V in some cases) and are paid between Rs. 1000 to Rs. 3000 per month in the different states. They typically receive no training or a two-week training at best, and may have to teach multi-grade classes often in single rooms. The proportion of children in such schools varies widely, but the all India average amounts to around 16 per cent of total enrolment in primary education, according to the Planning Commission. All such children are described in the official statistics as enrolled in schools, even though going to an Education Centre cannot be treated as school enrolment on par with the proper schools, and such instructors do not meet the required norms for teachers. Currently, State Governments allow these parallel (and deeply unequal) systems of schooling to continue to be run by different departments – “proper schools” by the Education Department, and education centres under the panchayats and therefore by the Panchayat Department.

The need to integrate these two parallel systems must be explicitly recognised. This requires special budgetary allocations for upgradation and quality improvement of the Education Centres through better infrastructure, as well as intensive training of existing teachers and additional employment of adequate numbers of qualified teachers – all of which will have financial implications.

2.2 At the same time, planning for school education must take into account the ecology of education – the need to adjust school systems to agro-climatic and other local variations.

This requires flexibility with respect to school timings, vacations, teacher recruitment – but without sacrificing quality. Norms for schools must recognise the possibility of regional and local differences as well as the particular requirements of certain communities, such as nomadic groups, tribal communities, short-term migrant households etc.

2.3 School management must be decentralised as far as possible.

Decentralisation of the management of schools, combined with community participation, is the most effective instrument for ensuring accountability, improving the day-to-day functioning of schools and allowing for flexible responses to local requirements. Therefore, there should be devolution of authority to local levels, whether to panchayats, Village Education Committees or municipalities. School Management Committees that include representatives of all stakeholders, including parents and teachers, should be empowered to make many decisions. Social audits of schools should be supported and encouraged.

2.4 There is a multiplicity of management structures and government departments in the administration of school education. This creates confusion, unnecessary replication and possibly inconsistent strategies across different schools. There must be greater co-ordination between different departments of government on school education policy, even while ensuring more autonomy to the local community in matters of day-to-day management of schools.

Currently schools are run or funded and monitored not only by the Central and State Governments, but also by different departments within State Governments – the Education Department, the Panchayat Department, the Department for Tribal Welfare, the Department for Minority Welfare etc. This creates overlapping and conflicting structures of authority, an excess of bureaucratic tangles, unnecessary replication of some

activities (and even replication of enrolment in some cases!), different guidelines and differential standards for acceptable quality and other sorts of confusion. For example, in the rural areas of several states, the local Panchayati Raj Institution (PRI) runs parallel to the SSA run Village Education Committee (VEC). The exact remit of each is not clear and the policy intentions of both become diluted in the process.

It is necessary to make systematic efforts to integrate or at least co-ordinate the activities of these separate management structures. The precise roles and responsibilities of each local level and state level department should be clearly specified, but even more than that, there should be some sort of pressure for these different bodies to work together as far as possible and provide a common and equal schooling. Education policy must be part of the integrated framework of decentralised planning.

In the day-to-day management of schools, it is also necessary to work towards segregating teachers from managers in the school administration. At the same time, as noted above in point I.4, the decentralisation of authority is critical in improving and maintaining the quality of education. Therefore, the local level management of schools, including locally elected bodies, school boards, Village Education Committees, must be allowed a significant degree of autonomy in handling matters relating to their schools, including not only the exact allocation of funds, but also other matters relating to school functioning and monitoring of teachers etc.

2.5 There is need for a national body to monitor the quality of both government and private schools, to ensure that minimum standards are met in terms of learning outcomes.

Currently there is no systematic and continuous feedback on the actual impact and outcome of various educational schemes and initiatives, or the actual quality of education imparted in schools. There is a strong case for a testing body at the national level for quality assessment of schools. A results-based monitoring framework with due process indicators and outcome indicators needs to be evolved. This should be based on a short list of monitorable criteria. These should include fixed infrastructural requirements, enrolment and attendance, as well as outcome indicators such as learning levels achieved in certain basic areas such as language skills and numeracy etc. Such a process of

assessment needs to be applied to all schools – both public and private. However, the testing of students must not involve topics or questions that provide any incentives for rote-learning. The tracking mechanism should ideally be concerned with the profile of skill attainment of each student.

Since school education is largely a state subject, but it is also important to achieve minimum schooling norms at the national level, the institutional framework for this could be at the national level with state subsidiaries. The role of this testing body will simply be to provide information on the results of its assessments, with the State Governments free to act upon this information. The results of such regular tests must be made publicly available in a format accessible to all, including websites.

The monitoring of private schools, in terms of ensuring a transparent admissions process, regulation of fee structures, as well as meeting minimum set standards for quality of teaching and infrastructure, also requires attention. There is currently no exact data on the numbers and enrolment of unrecognised private schools in the country, their fee structure or admissions policy, or their standards of infrastructure and quality. Private schools should become the subject of regulation and inspection within a set framework which is universally applicable.

2.6 The system of school inspection needs to be revamped and revitalised in most states, with a greater role for local stakeholders.

The current inspection system is overburdened and inadequate, with a small number of inspectors required to cover a large number of schools, often spread over wide physical areas. The solution does not lie in simply expanding the system – rather, we need to develop systems to ensure meaningful monitoring. NKC recommends that the strategy for the revitalisation of the school inspection system should include the following:

- Local stakeholders should be involved in the monitoring of schools, whether in the form of Village Education Committees, parent associations, or other such bodies.
- The number of inspectors needs to be increased in many states, and they must be provided the facilities to undertake their activities properly, such as transport, communications devices etc.
- The inspectors themselves must be accountable to the stakeholders of the area, through appropriate checks and balances.

- The criteria for inspection, the dates on which inspection of particular schools has taken place and the results should be made publicly available, including by posting on websites.
- The monitoring and inspection of schools must be separated from school administration, as the two functions require completely different orientations.
- The criteria for inspection should include not only infrastructure, facilities and teacher presence but also minimum standards for quality.

2.7 The dignity of school teaching as a profession must be restored, and at the same time there should be transparent systems for ensuring accountability of school teachers.

Teachers constitute the basic foundation of the school education system. However, there is a general decline in morale among school teachers, especially those in primary schools, and consequently it is no longer seen as an attractive profession for qualified young people. Two types of public perceptions, also propagated in the media and among officialdom, contribute to the low morale among school teachers: first, that anyone can teach and no particular pedagogical skills or training are required; second, that in any case most teachers do not work much and are frequently absent from school. While the latter may be the case for a relatively small minority of teachers, most school teachers are committed to their profession even if they have to function under very difficult conditions. However, they are also subject to many other pressures such as political pressure and obligations to perform non-teaching duties, which can prevent them from fulfilling their teaching duties adequately.

It is essential to ensure that qualified teachers are hired and provided with the necessary incentives to enable them to work better. The professional status of teachers should not be diluted, and all drives at recruiting untrained teachers must be checked, although it is important to allow for flexibility in recruitment of teachers for specific subjects such as art, craft and livelihood skills. The use of para-teachers must be treated as a strictly transitional measure until proper schools are established.

The imposition of a wide range of non-teaching duties, such as that of manning poll booths and collecting data for surveys etc., cuts into the available teaching time and also undermines the professional status of teachers. These activities should be shared out among a wider range of

public employees or even those hired specifically for the purpose, and the burden of such work on teachers must be reduced. Specifically, unemployed local youth and recently retired people may be considered for such activities as far as possible.

The recruitment of teachers from the locality has many advantages, as they can become accountable to the community, and have added stakes in improving the quality of education in their schools. In cases where local language or dialect is different from the state language, teachers familiar with the local language are likely to make better teachers.

NKC proposes that teachers should be recruited to particular schools as far as possible. At the very minimum, school teachers should be appointed to a particular location for a minimum fixed term of at least five years, since a major problem cited by many teachers in the government school system is that of frequent transfers. (The specific case of attracting teachers to remote and backward areas is considered below under Access.)

There should be increased attempts to improve public recognition of the contribution of school teachers, through various incentives such as more local, state-level and national awards etc.

It is necessary to monitor the emoluments and working conditions of teachers in private schools, which vary substantially, and prevent exploitation of teachers by private school employers as far as possible.

However, in addition to improving the working conditions of teachers, it is also necessary to institute measures to provide greater accountability of school teachers not only to their superiors, but to students, parents and the local community. Currently, any mention of increasing teacher accountability is viewed with hostility and suspicion by teachers themselves. Such an outlook needs to be changed. There is clearly a need for greater accountability of teachers to the community and the school, and this will be facilitated by greater decentralisation of school management to local stakeholders as has been suggested above. This should be accompanied by recognition of the concerns of teachers and allowing them more space to be active in school management and school activities. The actual administrative arrangements whereby this is done should be left to be decided at the state and local level. Systems of self-evaluation and peer evaluation of teachers should be encouraged.

2.8 The training of school teachers is extremely inadequate and also poorly managed. Pre-service training needs to be improved and regulated, while systems for in-service training require expansion and major reform in all states.

Both pre-service and in-service teacher training programs face major problems at present, at the national level and in almost all states. With respect to pre-service training, there is a proliferation of private colleges awarding the B.Ed. degree, and these are inadequately monitored or regulated. A significant proportion of those who receive B.Ed. degrees do so through correspondence or distance learning courses, which involve absolutely no practical exposure. In any case, classroom experience is underplayed in standard B.Ed courses. At the same time, the employment of ad hoc teachers and those without even high school diplomas as teachers in the parallel stream perpetuates the notion that it is not necessary for school teachers to have systematic and prolonged pre-service training.

In-service training shows problems of inadequate quantity, uneven quality, outdated syllabi, and poor management. A very large proportion of school teachers in the country have received no in-service training at all. In any case, many DIETs are currently understaffed, demoralised, and incapable of giving good quality training to teachers. In part, this is because teacher training positions are often occupied by those who have not themselves been school teachers. In many states the administration of DIETs is left to bureaucrats who view this as a punishment posting and have no pedagogical experience. Further, DIETs typically lack adequate infrastructural facilities. Even when in-service training is regularly held, there is no mechanism which can monitor the impact of in service teacher training courses on the subsequent teaching-learning process in the classroom. Most SCERTs themselves hire contract teachers since there are very few qualified and regular teachers and lecturers. These therefore find it difficult to supervise functions at the block level unless their numbers are greatly increased. Funds are needed from the central government for human resource development at this level.

NKC therefore suggests the following for teacher training:

- Institutions providing pre-service teacher training and granting B.Ed degrees should be subject to the same regulatory authority, and there should be

adequate monitoring of the training provided by private organisations.

- The budgetary allocation for teacher training needs to be enhanced and made explicit, and central government provisions are required for this.
- There has to be greater flexibility in the modalities of teacher training. Diverse strategies such as greater use of ICT, Visiting Trainers and empowering local trainers who would visit schools should be encouraged.
- State-level teacher training needs to be revamped in most states. The system of DIETs needs to be restructured. In some smaller states, there is a strong case for one state-level institution for teacher training. In other states, the DIETs need to be strengthened and undergo structural changes. The faculty of SCERTs, SIEs and DIETs must be expanded, and include experienced school teachers. The use of contract teachers must be kept to a minimum. In addition, the link between university departments and school teaching needs to be strengthened.
- The administrative hierarchies within DIET and SCERT have to be restructured, so that there is a clear separation of personnel engaged in administrative and academic activities. (This distinction is currently blurred in most states.)
- The teacher training course should not be seen in terms of a finite period of time, but as a process by which the quality of teaching and learning in the classroom can be regularly improved, in a context that fosters an attitude of lifelong learning. Therefore, there should be a mechanism for feedback and subsequent interaction between teachers and the training institutes, especially for pedagogical techniques that are new or require more continuous innovation from the teacher.
- Currently in-service training is offered through pre-determined themes which trivialise the role of personal meaning while upholding requirements dictated by educational reform agendas. Greater freedom of choice would help to increase personal initiative and absorption of training inputs. NKC therefore, suggests the provision of short term in-service courses (in both contact and distance mode) that teachers can choose from. These could include courses developed outside the DIET/SCERT structure, subject to a thorough review of quality.
- In addition to being made more flexible, in-service teaching courses need to be incentivised, possibly by making attendance at and completion of such courses prerequisites to professional advancement.

- There is need for curricular reform in both pre-service and in-service teacher training. The curriculum should be framed in ways that are directly relevant to teachers and the requirements of particular classroom situations, such as multi grade teaching, special needs of first-generation learners etc. This means that curricula should be framed with greater inputs from teachers themselves, and their practical requirements in the classroom.
- ICT must be incorporated more fully into teacher training programs, which in turn leads to ICT being used more freely in the classroom.
- It is necessary to develop content for and access to open educational resources for teacher training.

2.9 It is important to develop and nurture leadership for managing schools.

Even talented individuals who could be suitable for the tasks of school management need to be trained for this purpose. Such capacity building would create a pool of potential principals or heads. There are several ways in which this can be done. State Governments could assign such training to existing institutions such as SCERTs or SIEs, leveraging the expertise available in Navodaya Vidyalayas, Kendriya Vidyalayas, other government schools and private schools. Such training programs, as well as re-training programs for existing principals, could also seek the expertise of specialists in management education. Also, individual mentoring programs for school leaders could be evolved.

2.10 The possibility of greater exchange between schools, including mentoring of one school by another should be allowed and encouraged.

The current system creates many distinctions and prevents interaction between schools. There is a need to constitute mechanisms of exchange and interaction between students and teachers of different schools. In addition, schools that wish to do so should be allowed to exercise the option of being 'mentored' by another school to improve facilities and teaching methods.

2.11 Curriculum reform remains an important issue in almost all schools. School education must be made more relevant to the lives of children. There is need to move away from rote-learning to understanding concepts, good comprehension and communication

skills and learning how to access knowledge independently.

Successive Commissions and Committees set up by the government have emphasised the need to make the curriculum more interesting, relevant, creative and useful for students. The National Curriculum Framework 2005 also clearly articulated such an approach. Nevertheless it appears that in a majority of schools across the country, a significant emphasis on rote-learning and memorising facts remains the norm. Also, there is evidence of children being overburdened with too much detail and an excess of scholastic requirements at the elementary level.

It is important to orient students towards independent and continuous learning. This makes it essential to make greater efforts to change the attitude to learning and knowledge. It has been noted in several states that learning results have improved considerably upon providing inputs for communication and comprehension in language and basic mathematical skills using activity-based and imaginative pedagogical strategies. The focus of primary schooling in particular must be on good language and communication skills, basic foundation maths and inculcation of self-learning and critical examination through innovative teaching methods. For language teaching in particular, there should be much greater emphasis on communication skills at a practical level.

It is also important to ensure that the curriculum contains locally relevant content that children can relate to their own lives. For example, in certain parts of the country (such as, but not only, the Northeast) the curriculum at both primary and secondary levels could also include training in disaster management, especially for floods, while in other parts of the country responses to earthquakes may be more relevant. In rural areas, horticulture and pisciculture techniques should be included in the syllabus. Co-curricular reading material should be propagated, such as children's books with local stories and histories to strengthen the linkages between school and home.

To make secondary school education more relevant, and also address the problem of drop outs, NKC recommends the setting up of Livelihood Centres in secondary schools that would impart practical employable skills and provide career counselling to students. All school children should be encouraged to be involved in some practical activities that require working with the hands. These activities should not be treated as catering to a

parallel stream, but should be provided to all students and integrated with the overall syllabus. Once again, links with the Skill Development Mission should be developed wherever possible.

2.12 Changes in the examination system are required, especially at Board level but also earlier, to ensure that the pressure for rote-learning is reduced.

The current over-emphasis on details, memorising of facts and similar abilities rather than on understanding and accessing knowledge independently is reflected in the pattern of examinations. Board examinations in which marks are awarded based on the ability to recall lots of details or on rapidity of response or on the ability to do large numbers of sums in a limited period through practice in pattern recognition, are not sufficiently discriminatory and may end up providing misleading results. They also put pressure on schools to ensure that memory and pattern recognition skills are developed at the expense of genuine understanding.

This is also reflected in the pattern of annual examinations which many schools continue to run even in junior classes such as Class III and Class V. Performance in such examinations then becomes the basis for choosing students who will be eligible for scholarships or gain entrance to Navodaya Vidyalayas and similar schools. Forcing children to undergo a large number of examinations in different subjects, with an emphasis on memory rather than comprehension, must be discouraged at the primary level.

For curriculum reform to be successful, it is necessary to make major changes in the examination system. This applies equally to some of the national school boards (such as CBSE) and the state-level boards. It is also crucial to push for such reform in the annual examinations held by schools, where the testing must be focused on language and comprehension, numeric and quantitative skills, and ability to use knowledge creatively.

2.13 New technologies, especially but not only ICT, should be used as much as possible to reduce costs, enable more effective use of resources, and provide wider exposure to students and teachers.

The use of ICT as a teaching and learning device needs to be more firmly incorporated into the classroom. Both

teachers and students need to be far more familiar with ICT, and get practical experience of web based research. Therefore ICT should be made more accessible to teachers, students and administration for learning, training, research, administration, management, monitoring etc. This requires the provision of more facilities such as computers as well as connectivity and broadband facilities. Computer-aided learning also requires training of teachers and other staff in order to make the best use of the technology.

2.14 There is need for a web-based portal for teachers to exchange ideas, information and experiences.

A forum for teachers needs to be developed where they may interact, share experiences and ideas. This needs to be incorporated into teacher training programs, and also provided generally for in-service teachers. A web-based teachers' portal can play an important role as such a networking forum.

3. Access

3.1 Special strategies are required to ensure greater access to schools in backward regions, remote locations and difficult terrains.

There is a tremendous shortage of teachers and also great difficulty in ensuring minimum schooling infrastructure in some areas that have been historically deprived or have difficult topographical conditions. Distance and difficulty of physical access are important reasons for school drop out, especially in such areas. Sometimes it is also the case that such areas are inhabited by particular communities with their own language or dialect that is different from the state language. In order to ensure access to schools for children in such areas, special measures must be taken.

NKC recommends the following measures for such areas:

- Financial norms for schools in such locations must be different from those in more accessible areas, as they will require additional resource allocation based on particular conditions.
- Special incentives, including a financial incentive (such as a “hardship bonus”) need to be provided for teachers to take up jobs in such areas. Two different models may be considered – one based on recruiting local teachers on a permanent basis

for a job in a particular school without transfer; and another based on a transfer policy that divides locations into hard/middle/easy categories and allows teachers to rotate among them at specified intervals. Ideally, there should be at least one local teacher and one non- local teacher to ensure some variation, local acceptability and quality.

- Residential arrangements must be made for teachers in such locations, by providing quarters next to or near the school. The cost of building such quarters should be factored into the costs of the school building.
- There are some geographical zones especially in mountainous regions, that are plagued by unique problems due to vast tracts of land, difficult topography, and a sparse and nomadic population. In such areas, well equipped residential schools should be set up instead of insisting on a school in every habitation. These schools must be equipped to look into the needs of very young children living away from their families.

3.2 Measures are required to ensure greater enrolment and retention of girl students.

The high drop out rate of girls especially from Class V onwards is a matter of great concern. One major reason, as noted above, is the sheer lack of secondary schools nearby, as parents are reluctant to send girls to travel long distances to school. However, social conditioning and other constraints also play a role. Some policies to address this include:

- Special incentives for girls in secondary education where these are required (they are not required everywhere), in addition to free textbooks and uniforms, such as bicycles.
- Girls-only schools especially in particular areas.
- An enhanced scholarship scheme especially for girls, with particular emphasis on girls from socially deprived groups.
- The need for separate and functional toilets for girls in all schools, with access to water, is very important, especially but not exclusively in urban areas.

3.3 Language issues must be explicitly taken on board in designing school curricula and methods of pedagogy.

Language has been found to be a highly alienating factor in the education of many school children, particularly amongst minorities, tribal communities with languages without a script, as well as linguistic minorities in most

states. Many children resent the imposition of the state language as the medium of instruction, or as second language in school.

More teachers for teaching minority languages must be appointed in government schools to increase the intake of children from minority language communities. Qualified teachers from the local community and therefore speaking the same language must be recruited on a larger scale, as a means of encouraging retention amongst those who feel marginalised, as well as a means of bringing greater community control in the school. This would also act as a boost to confidence, and provide role models to students from disadvantaged backgrounds.

3.4 The teaching of English should be introduced along with the first language, starting from Class I in school.

Proficiency in English is widely perceived as an important avenue for employment and upward mobility, which also greatly facilitates the pursuit of higher education. The incorporation of English into the curriculum, through the introduction of English as a language in Class I and the teaching of one other subject in English medium in later classes, requires pedagogical changes to contextualise language learning, increasing the availability of English language teachers and those who can teach at least one subject in English, as well as bilingual and supplementary teaching materials.

At the same time, school education must commit to promoting multi-linguality, given the multilingual nature of our country.

3.5 There is need to re-orient official strategies for ensuring better access of Muslim children to schooling.

Areas with Muslim majority population have tended to be overlooked in the implementation of government educational schemes. In addition, with a few exceptions, there has been less private initiative in this regard. As a consequence, Muslims as a community, have access to fewer government schools, girls schools, and higher educational institutions.

It is important to rectify this gap and ensure adequate public expenditure to ensure that the physical and social infrastructure for schooling is made available. This means that the government should have a minority component in all its school development schemes and

budget outlays, which should be in proportion to the minority population.

The strategy cannot be based solely on more public resources provided to madrasas for their modernisation, as according to the Sachar Committee Report, 96 per cent of Muslim children do not attend madrasas for schooling. Indeed, if the modernisation of madrasa education is the only policy for increasing access for Muslim school children to modernised education, it will only result in their being further isolated.

It is important to ensure that children from all minorities and socially deprived groups are not discriminated against in the process of attending school. This must be an active and concerted campaign, in which syllabi and curriculum are checked to avoid prejudice, teachers are sensitised and instances of discrimination are punished. This also requires grievance redressal mechanisms at the school level and also at higher levels.

3.6 The access of children from Scheduled Tribes requires more flexible and sensitive schooling strategies.

Tribal children face problems of inadequate geographical access, discrimination at school and issues of language, which have been discussed earlier but are especially relevant in these cases. Tribal students have to compete with SC students, often at a disadvantage to the former. All of these must be addressed at the local level as well as at the district and state level.

Every state should have an education policy for tribal and minority education, with a long term vision of eventual integration into the mainstream.

Rather than setting up separate schools for those who have dropped out because they felt discriminated against, teachers should be better sensitised to the needs of students from such communities, as well as the particular needs of first generation learners.

The issue of language is particularly important in areas with tribal population, and care must be taken to find and train teachers who can deal with children in their own language, rather than forcing them to adjust to the regional language.

3.7 Education of SC children must be a priority, but with the required flexibility and avoidance of discrimination.

The points made earlier with respect to discrimination are especially valid also for SC children, and must be addressed in similar ways.

In addition, scholarships should be increased and provided to much larger numbers of Dalit children, along with other provisions such as free textbooks up to Class X and other incentives.

3.8 Children of seasonal migrants require special conditions and efforts to ensure continuous access to schooling.

Seasonal and short-term migration is a major cause for early drop outs and non enrolment. In order to ensure that such children have access to a quality and complete education, their economic insecurity has to be taken into account while formulating educational schemes. Tent schools and mobile schools must be made a part of the urban landscape for migrant children, while rural schools also have to be made aware of the need to admit migrant children. This requires a significant change in the way that school admissions and enrolment are carried out, as well as greater sensitivity, flexibility and effort on the part of the school administration, all of which require hard and soft resources. It is necessary to identify good practices in this regard which can serve as a model to be emulated elsewhere.

3.9 Labouring children require incentives and bridge courses.

Some sort of monetary stipend may have to be paid to labouring children to bring them into schools. In addition, synergies must be created with NREGA to look into school education concerns of labouring children. Pre-school systems like balwadis and anganwadis must be strengthened, so that a school going habit can be ingrained, as well as providing a space for small children to be cared for, while their elder siblings may go to school. Alternative Centres

for Education must be utilised specifically to provide bridge courses aimed at different age groups and classes for drop outs. However, the use of Alternative Centres for Education must be no more than in a transition capacity. AIE should not become the only option for access to poor school children for a school education.

Study Centres must be provided for first generation learners and seasonal migrants as a space which is more conducive to learning than what may be available at home. These may also be used as community centres, libraries etc.

3.10 The needs of physically disadvantaged children, as well as teachers, have to be factored in more thoroughly in provisions for school education.

The goal in all schools should be inclusive education, which means that all systems must be oriented to allow the greatest possible access to children with different needs and abilities. This requires substantial changes in both infrastructure and pedagogical methods. School buildings must have provisions for access and navigation for the visually impaired, the physically handicapped etc. Teachers must be trained, sensitised and empowered to deal with children with different abilities in the classroom situation.

While this is the ultimate goal, it must also be recognised that current schooling patterns are not always conducive to bringing out the full potential of physically disadvantaged children, and therefore, there is still a case for special schools. There is a perception that government mechanisms may not be best suited to provide sustained and sympathetic support for learners with special needs and severely disabled children (such as the blind). In this context, it may be better to identify appropriate and willing institutions outside the government who may become partners.

Vocational Education and Training

December 1, 2006

NKC considers Vocational Education and Training (VET) to be an important element of the nation's education initiative. In order for VET to play its part effectively in the changing national context and for India to enjoy the fruits of the demographic dividend, there is an urgent need to redefine the critical elements of imparting vocational education to make them flexible, contemporary, relevant, inclusive and creative. The Government is well aware of the important role of VET and has already taken a number of important initiatives. Through consultations with industry groups, academics, civil society and practitioners, NKC has deliberated on ways and means to strengthen these initiatives and recommends the following long and short-term strategies.

1. Place vocational education entirely under the Ministry of Human Resource Development (MHRD)

In view of the role of VET in human resource development and importance of its linkages with other streams of education, the Government may consider placing all aspects of VET under MHRD. Currently, VET falls under the purview of MHRD as well as the Ministry of Labour, which leads to fragmented management of the VET framework. MHRD may consider setting up a National Institute for Vocational Education Planning and Development to formulate strategy, advise the Government, and undertake research and development in areas pertaining to technology and workforce development.

2. Increase the flexibility of VET within the mainstream education system through the following steps

- i. Aspects of general education (such as numeracy skills) should be retained in VET as far as possible, to

enable students to return to mainstream education at a later stage.

- ii. Courses in training institutes and polytechnics should have distinct tracks for students of different educational attainments.
- iii. Entry requirements for certain trades should reflect the requirement of the trade (as appropriate, for instance the entry requirement of Class X could be relaxed to Class VIII in some cases). Students should be permitted multiple entry and exit options in the vocational education stream.
- iv. Links should be established between the vocational education stream and school education as well as higher education.
- v. Courses devoted to certain skills training at the primary and secondary level should be introduced in all schools.
- vi. Vocational training should be made available in various literacy and adult education schemes.
- vii. Schemes for lifelong skill up-gradation, through short training programs, should be introduced.
- viii. There should be a provision for generating a cadre of multi-skilled persons.

3. Quantify and monitor the impact of vocational education

Data should be collected periodically and analysed in order to assess the impact of training on employability. Empirical evidence on wage premium or other advantages enjoyed by VET graduates, seat utilisation in training institutes, nature of employment post-training, and the efficacy of various schemes is essential for continuous improvement. A detailed exercise of manpower analysis is a necessary step to understanding the nature and quantum of demand for VET and the mismatch between the skills of VET certificate holders and the requirements of the labour market. This exercise may be undertaken by the proposed National Institute for Vocational Education Planning and Development.

4. Increase resource allocation to vocational education

In per capita terms, vocational education costs more than general education, however public expenditure on vocational education has been extremely low, as compared to general secondary education. Given the demand for skilled manpower in manufacturing and services, the Government should aim to spend at least 10-15 per cent of its total public expenditure on education, on vocational education. Some options that may be considered for raising additional funds to finance a modernised VET scheme are:

- i. Enhancing fees, coupled with student loan schemes. This would also make VET institutions more responsive to market needs.
- ii. Raising funds through a cess on employers (for instance two per cent of salaries of all employees, as in Singapore).
- iii. Making it obligatory for companies to finance public vocational education and training programs (as in Korea).

5. Expand capacity through innovative delivery models

In order to meet the burgeoning requirements of skilled and unskilled labour, a massive increase in quantity of training is needed. The Government could explore new delivery models to increase capacity such as public private partnerships, decentralised delivery, distance learning and computerised vocational training. At the same time, the Government must introduce certain minimum standards as a measure of quality, and ensure that all public and private VET institutions adhere to these.

6. Enhance the training options available for the unorganised and informal sector

The greatest challenge lies in providing training for potential entrants in the unorganised/informal sector, which accounts for the largest proportion of employment. Systematic efforts need to be made to impart the skills required by the unorganised sector. These should be formally introduced in the curricula and practical training courses. In order to achieve this, the Government should act as a facilitator and provide financial support. This aspect of VET is critical for the success of the system as a whole.

7. Strengthen the current institutional structure

The existing Industrial Training Institutes (ITIs) and Industrial Training Centres (ITCs) are widely recognised to face problems such as poor quality trainers, lack of flexibility, and outdated infrastructure. Measures to improve the existing institutions are as follows:

- i. Extent of functional autonomy must be increased, ITIs should be given more power to strengthen and adapt their training programs to better meet local market needs.
- ii. Indicators of internal and external efficiency should be developed (by the proposed National Institute) to incentivise good performance.
- iii. Modules on literacy, numeracy, communication skills, entrepreneurship and other general skills relevant to workplace requirements must be introduced in all courses.
- iv. Different tracks within courses for different levels of specialisation should be introduced.
- v. Students should be offered incentives such as tools, membership of trade associations etc., as part of their degree or diploma.
- vi. Industry and trade involvement should be enhanced not only at the internship stage, but also at the time of examinations and placements.
- vii. Curricula should be constantly monitored and updated.
- viii. The skills and courses offered should be reviewed periodically. The number of skills currently offered needs to be increased.
- ix. Teaching should be conducted in English as well as local languages.
- x. Infrastructure should be regularly upgraded.
- xi. Quality of teaching should be drastically improved.

8. Ensure a robust regulatory and accreditation framework

In order to achieve the desired modernisation and expansion, a critical aspect will be to regulate entry of new institutions and accreditation of all institutions. NKC therefore recommends that an independent regulatory agency for VET be established. This body would license accreditation agencies and prescribe standards for certification. The procedures and methodologies adopted by the body would need to be simple and transparent to ensure unhindered growth in the sector.

9. Ensure proper certification

At present, the process of certification is handled by the National Council for Vocational Training (NCVT), in association with State Councils for Vocational Training (SCVTs). Clear demarcation between the roles of the NCVT, the SCVTs and the Directorate General of Employment and Training is essential for the proper functioning of the certification process. In order to ensure recognition of certification by employers, both in India and abroad, an electronic database of certified training providers as well as electronic identification for certified workers should be introduced. Electronic identification should contain information regarding skills and qualifications (and eventually other relevant information as well) about certified individuals and can be used to facilitate mobility of workers, encourage bank linkages and entrepreneurial initiatives.

10. Undertake a re-branding exercise

It is widely recognised that a crucial problem with vocational training in India is a negative association

with manual labour. In order to match the modern requirement of the skills and competitiveness of the workforce, a massive re-branding exercise is of the highest priority. This could be the prime task of the recently announced National Skills Mission. Initiatives such as replacing the use of terms like 'vocational education' by 'skill development' are a step in the right direction. Training institutes should try to chart out a career path for their students and introduce entrepreneurship training modules.

It is crucial to significantly increase public and private investment in VET. However, a detailed analysis of manpower requirements in terms of numbers, skills and competitiveness is essential before formulating a master plan and deciding the quantum of expenditure in the 11th Plan. A robust framework put in place as a visible and dedicated resource in the MHRD is a pre-requisite to ensuring quality and facilitating significant private investment and participation. Most importantly, the quality as well as the image of VET needs to be actively promoted in order for it to be viewed as comparable to general secondary education, and as relevant.

Higher Education

November 29, 2006

Higher education has made a significant contribution to economic development, social progress and political democracy in independent India. But there is serious cause for concern at this juncture. The proportion of our population, in the relevant age group, that enters the world of higher education is about 7 per cent. The opportunities for higher education in terms of the number of places in universities are simply not adequate in relation to our needs. Large segments of our population just do not have access to higher education. What is more, the quality of higher education in most of our universities leaves much to be desired.

Foundations are critical. NKC believes that an emphasis on expansion and reform of our school system is necessary to ensure that every child has an equal opportunity to enter the world of higher education. It is engaged in consultations on school education and will submit recommendations in this crucial area in due course. In this recommendation, it focuses on higher education. NKC has engaged in formal and informal consultations on the issue with a wide range of people in the world of higher education. In addition, it consulted concerned people in parliament, government, civil society and industry. Concerns about the higher education system are widely shared. There is a clear, almost unanimous, view that higher education needs a systematic overhaul, so that India can educate much larger numbers without diluting academic standards. Indeed, this is essential because the transformation of economy and society in the 21st century would depend, in significant part, on the spread and the quality of education among our people, particularly in the sphere of higher education. It is only an inclusive society that can provide the foundations for a knowledge society.

The objectives of reform and change in our higher education system must be expansion, excellence and inclusion. NKC recognises that meaningful reform of the system, with a long-term perspective, is both complex and difficult. Yet, it is imperative.

I. Expansion

1. Create many more universities

The higher education system needs a massive expansion of opportunities, to around 1500 universities nationwide, that would enable India to attain a gross enrolment ratio of at least 15 per cent by 2015. The focus would have to be on new universities, but some clusters of affiliated colleges could also become universities. Such expansion would require major changes in the structure of regulation.

2. Change the system of regulation for higher education

The present regulatory system in higher education is flawed in some important respects. The barriers to entry are too high. The system of authorising entry is cumbersome. There is a multiplicity of regulatory agencies where mandates are both confusing and overlapping. The system, as a whole, is over-regulated but under-governed. NKC perceives a clear need to establish an Independent Regulatory Authority for Higher Education (IRAHE). The IRAHE must be at an arm's length from the Government and independent of all stakeholders including the concerned Ministries of the Government.

- The IRAHE would have to be established by an Act of Parliament, and would be responsible for setting the criteria and deciding on entry.
- It would be the only agency that would be authorised to accord degree-granting power to higher education institutions.
- It would be responsible for monitoring standards and settling disputes.
- It would apply exactly the same norms to public and private institutions, just as it would apply the same norms to domestic and international institutions.
- It would be the authority for licensing accreditation agencies.
- The role of the University Grants Commission (UGC) would be re-defined to focus on the

disbursement of grants to, and maintenance of, public institutions in higher education. The entry regulatory functions of the All India Council for Technical Education (AICTE), the Medical Council of India (MCI) and the BCI would be performed by the IRAHE, so that their role would be limited to that of professional associations.

3. Increase public spending and diversify sources of financing

The expansion of our system of higher education is not possible without enhanced levels of financing. This must necessarily come from both public and private sources.

- Since government financing will remain the cornerstone, government support for higher education should increase to at least 1.5 per cent of GDP, out of a total of at least 6 per cent of GDP for education overall.
- Even this would not suffice for the massive expansion in higher education that is an imperative. It is essential to explore other possibilities that can complement the increase in public expenditure.
- Most public universities are sitting on a large reservoir of untapped resources in the form of land. It should be possible to draw up norms and parameters for universities to use their available land as a source of finance.
- It is for universities to decide the level of fees but, as a norm, fees should meet at least 20 per cent of the total expenditure in universities. This should be subject to two conditions: first, needy students should be provided with a fee waiver plus scholarships to meet their costs; second, universities should not be penalised by the UGC for the resources raised from higher fees through matching deductions from their grants-in-aid.
- India should nurture the tradition of philanthropic contributions through changes in incentives for universities and for donors. At present, there is an implicit disincentive in both tax laws and trust laws. These laws should be changed so that universities can invest in financial instruments of their choice and use the income from their endowments to build up a corpus.
- Universities should also seek to tap other sources such as alumni contributions and licensing fees. There is need to create supportive institutional mechanisms that allow universities to engage professional firms for this purpose.
- It is essential to stimulate private investment in education as a means of extending educational

opportunities. It may be possible to leverage public resources, especially in the form of land grants, to attract more (not-for-profit) private investment.

4. Establish 50 National Universities

NKC recommends the creation of 50 National Universities that can provide education of the highest standard. As exemplars for the rest of the nation, these universities would train students in a variety of disciplines, including humanities, social sciences, basic sciences, commerce and professional subjects, at both the undergraduate and post-graduate levels. The number 50 is a long-term objective. In the short run, it is important to begin with at least 10 such universities in the next three years. National Universities can be established in two ways, by the Government, or by a private sponsoring body that sets up a society, charitable trust or Section 25 company.

Since public finance is an integral constituent of universities worldwide, most of the new universities shall need significant initial financial support from the Government. Each university may be endowed with a substantial allocation of public land, in excess of its spatial requirements. The excess land can be a subsequent source of income generation. Exceptions need to be made in existing income tax laws to encourage large endowments. There should be no restriction on the utilisation of income in any given period or in the use of appropriate financial instruments. These universities should have the autonomy to set student fee levels and tap other sources for generating funds.

The National Universities, NKC proposes, will admit students on an all-India basis. They will adopt the principle of *needs-blind admissions*. This will require an extensive system of scholarships for needy students. Undergraduate degrees in the National Universities, in a three-year program, should be granted on the basis of completing a requisite number of credits, obtained from different courses. The academic year will therefore be semester based and students will be internally evaluated at the end of each course. Transfer of credits from one National University to another would also be possible. An appropriate system of appointments and incentives is required to maximise the productivity of faculty in these National Universities. Strong linkages would be forged between teaching and research, universities and industry, and universities and research laboratories. The National Universities shall be department-based and shall not have any affiliated colleges.

II. Excellence

5. Reform existing universities

The endeavour to transform higher education must reform existing institutions. Some essential steps are:

- Universities should be required to revise or restructure curricula at least once in three years.
- Annual examinations, which test memory rather than understanding, should be supplemented with continuous internal assessment which could begin with a weight of 25 per cent in the total to be raised to 50 per cent over a stipulated period.
- NKC proposes a transition to a course credit system where degrees are granted on the basis of completing a requisite number of credits from different courses, which provides students with choices.
- Universities must become the hub of research once again to capture synergies between teaching and research that enrich each other. This requires not only policy measures but also changes in resource allocation, reward systems and mindsets.
- There must be a conscious effort to attract and retain talented faculty members through better working conditions combined with incentives for performance.
- The criteria for resource allocation to universities should seek to strike a much better balance between providing for salaries or pensions and providing for maintenance, development or investment. It should also recognise the importance of a critical minimum to ensure standards and strategic preferences to promote excellence.
- The elements of infrastructure that support the teaching-learning process, such as libraries, laboratories and connectivity, need to be monitored and upgraded on a regular basis.
- There is an acute need for reform in the structures of governance of universities that do not preserve autonomy and do not promote accountability. Much needs to be done, but two important points deserve mention. The appointments of Vice-Chancellors must be freed from direct or indirect interventions on the part of governments, for these should be based on search processes and peer judgment alone. The size and composition of University Courts, Academic Councils and Executive Councils, which slow down decision-making processes and sometimes constitute an impediment to change, need to be reconsidered on a priority basis.
- The need is for smaller universities which are responsive to change and easier to manage, and these should be created.

6. Restructure undergraduate colleges

The system of affiliated colleges for undergraduate education, which may have been appropriate 50 years ago, is no longer adequate or appropriate and needs to be reformed. There is an urgent need to restructure the system of undergraduate colleges affiliated to universities.

- The most obvious solution is to provide autonomy to colleges either as individual colleges or as clusters of colleges, on the basis of criteria that have been stipulated. However, this would provide a solution for a limited proportion, or number, of undergraduate colleges.
- Some of these affiliated colleges could be remodelled as community colleges, which could provide both vocational education and formal education.
- A Central Board of Undergraduate Education should be established, along with State Boards of Undergraduate Education, which would set curricula and conduct examinations for undergraduate colleges that choose to be affiliated with them. These Boards would separate the academic functions from the administrative functions and, at the same time, provide quality benchmarks.
- New undergraduate colleges could be established as community colleges and be affiliated with the Central Board of Undergraduate Education or State Boards of Undergraduate Education, or with some of the new universities that are established.

7. Promote enhanced quality

The higher education system must provide for accountability to society and create accountability within. An expansion of higher education which provides students with choices and creates competition between institutions is going to be vital in enhancing accountability.

- There should be stringent information disclosure norms for all educational institutions such as their financial situation, physical assets, admissions criteria, faculty positions, academic curricula, as also their source and level of accreditation.
- Evaluation of courses and teachers by students as well as peer evaluation of teachers by teachers should be encouraged.
- There must be a focus on upgrading infrastructure, improving the training of teachers and continuous assessment of syllabi and examination systems.
- It is particularly important to enhance the ICT infrastructure. Websites and web-based services would

improve transparency and accountability. A portal on higher education and research would increase interaction and accessibility. A knowledge network would connect all universities and colleges for online open resources.

- It may be necessary to rethink the issue of salary differentials within and between universities along with other means of attracting and retaining talented faculty members. Such salary differentials between and within universities could be effective without being large.
- It is necessary to formulate appropriate policies for the entry of foreign institutions into India and the promotion of Indian institutions abroad, while ensuring a level playing field for foreign and domestic institutions within the country.
- The system of higher education must recognise that there is bound to be diversity and pluralism in any system of higher education, and avoid a uniform 'one-size fits all' approach. This sense of pluralism must recognise, rather than ignore or shy away from, such diversity and differentiation.

III. Inclusion

8. Ensure access for all deserving students

Education is the fundamental mechanism for social inclusion through the creation of more opportunities. It is therefore essential to ensure that no student is denied the opportunity to participate in higher education due to financial constraints. NKC proposes the following measures.

- Institutions of higher education should be encouraged to adopt a needs-blind admissions policy. This would make it unlawful for educational institutions to take into account any financial factor while deciding whether or not to admit a student.
- There must be a well-funded and extensive National Scholarship Scheme targeting economically

underprivileged students and students from groups that are historically, socially disadvantaged.

9. Affirmative action

A major aim of the higher education system must be to ensure that access to education for economically and historically socially underprivileged students is enhanced in a substantially more effective manner.

- Reservations are essential, but they are only a part, and one form, of affirmative action.
- Disparities in educational attainments are related to caste and social groups, but are also strongly related to other indicators such as income, gender, region and place of residence. There is need to develop a meaningful and comprehensive framework that would address the multi-dimensionality of differences that still persist. For example, a deprivation index could be used to provide weighted scores to students and the cumulative score could be used to supplement a student's school examination score.

NKC's recommendations require action at three different levels: reforms within existing systems, changes in policies, and amendments in, or the introduction of, new statutes or legislation. The suggested changes would also be implemented at three different levels: universities, state governments and the Central Government.

It is important to recognise that there is a quiet crisis in higher education in India which runs deep. The time has come to address this crisis in a systematic and forthright manner. NKC's recommendations constitute an important beginning; the changes suggested would make a real difference. Of course, the process of reform and change is continuous. There is more to be done, and NKC will continue to think about next steps, but it emphasises the urgency of the situation, because India's future depends on it. It is important to act here and now.

Note on Higher Education

1. Introduction

The spread of education in society is at the foundation of success in countries that are latecomers to development. In the quest for development, primary education is absolutely essential because it creates the base. But higher education is just as important, for it provides the cutting edge. And universities are the life-blood of higher education. Islands of excellence in professional education, such as Indian Institutes of Technology (IITs) and Indian Institutes of Management (IIMs), are valuable complements but cannot be substitutes for universities which provide educational opportunities for people at large.

There can be no doubt that higher education has made a significant contribution to economic development, social progress and political democracy in independent India. It is a source of dynamism for the economy. It has created social opportunities for people. It has fostered the vibrant democracy in our polity. It has provided a beginning for the creation of a knowledge society. But it would be a mistake to focus on its strengths alone. It has weaknesses that are a cause for serious concern.

There is, in fact, a quiet crisis in higher education in India that runs deep. It is not yet discernible simply because there are pockets of excellence, an enormous reservoir of talented young people and an intense competition in the admissions process. And, in some important spheres, we continue to reap the benefits of what was sown in higher education 50 years ago by the founding fathers of the Republic. The reality is that we have miles to go. The proportion of our population, in the age group 18-24, that enters the world of higher education is around 7 per cent, which is only one-half the average for Asia. The opportunities for higher education, in terms of the number of places in universities, are simply not enough in relation to our needs. What is more, the quality of higher education in most of our universities requires substantial improvement.

It is clear that the system of higher education in India faces serious challenges. It needs a systematic overhaul, so that we can educate much larger numbers without diluting academic standards. This is imperative because the transformation of economy and society in the 21st century would depend, in significant part, on the spread and the quality of education among our people, particularly in the sphere of higher education. It is only an inclusive society that can provide the foundations for a knowledge society.

The challenges that confront higher education in India are clear. It needs a massive expansion of opportunities for higher education, to 1500 universities nationwide, that would enable India to attain a gross enrolment ratio of at least 15 per cent by 2015. It is just as important to raise the average quality of higher education in every sphere. At the same time, it is essential to create institutions that are exemplars of excellence at par with the best in the world. In the pursuit of these objectives, providing people with access to higher education in a socially inclusive manner is imperative. The realisation of these objectives, combined with access, would not only develop the skills and capabilities we need for the economy but would also help transform India into a knowledge economy and society.

We recognise that a meaningful reform of the higher education system, with a long-term perspective is both complex and difficult. Yet, it is imperative. And we would suggest the following building blocks in this endeavour. First, it is essential to reform existing public universities and undergraduate colleges. Second, it is necessary to overhaul the entire regulatory structure governing higher education. Third, every possible source of financing investment in higher education needs to be explored. Fourth, it is important to think about pro-active strategies for enhancement of quality in higher education. Fifth, the time has come to create new institutions in the form of National Universities that would become role models as centres of academic excellence. Sixth, the higher education system must be so designed that it provides access to marginalised and excluded groups.

2. Universities

Universities perform a critical role in an economy and society. They create knowledge. They impart knowledge. And they disseminate knowledge. Universities must be flexible, innovative and creative. They must be able to attract the best talent whether teachers or students. They must have the ability to compete and the motivation to excel. We cannot even contemplate a transformation of our higher education system without reform in our existing universities.

There is, however, a serious cause for concern about universities in India. The number of places for students at universities is simply inadequate. The quality of education at most universities leaves much to be desired. The gap between our universities and those in the outside world has widened. And none of our universities rank among the best, say the top 50, in the world. The symptoms are clearly visible, even if we do not wish to diagnose what ails our universities. Of course, every problem does not exist everywhere. And there are exceptions. But the following problems are common enough to be a cause for concern. First, curricula, which have remained almost unchanged for decades, have not kept pace with the times, let alone with the extending frontiers of knowledge. Second, learning and creativity are at a discount in a system of assessment that places a premium on memory rather than understanding. Third, the milieu is not conducive to anything beyond the class room, for it is caught in a 9.30 to 1.30 syndrome. Fourth, the academic calendar is no longer sacrosanct for classes or for examinations, as there are slip pages in schedules so much so that, at several places, classes in the timetable are not held and results are often declared with a time-lag of 6 to 12 months. Fifth, the infrastructure is not only inadequate but also on the verge of collapse. Sixth, the boundaries between disciplines have become dividing walls that constitute barriers to entry for new disciplines or new courses, while knowledge is developing most rapidly at the intersection of disciplines. Seventh, the importance attached to research has eroded steadily over time. Eighth, the volume of research in terms of frequency of publication and the quality of research reflected in the frequency of citation or the place of publication, on balance, is simply not what it used to be. Ninth, as in most public institutions, there is little accountability, because there are no rewards for performance and no penalties for non-performance. Tenth, structures of governance put in place 50 years ago are not responsive to changing times and circumstances but the system is readily subverted by vested interests.

It is difficult enough to provide a complete diagnosis of what ails our universities. It is even more difficult, if not impossible, to outline a set of prescriptions for our universities. Nevertheless, it is clear that a reform of existing institutions must be an integral part of our endeavour to transform higher education. We recognise that this is easier said than done. Even so, we believe that reforms in the following spheres, along the lines suggested by us, are not only possible but would also make a difference.

Number and size: India has about 350 universities. This number is simply not enough with reference to our needs in higher education, or in comparison with China which has authorised the creation of 1250 new universities in the last three years. Yet, some of our universities are much too large, for ensuring academic standards and providing good governance. We need to create more appropriately scaled and more nimble universities. The moral of the story is not only that we need a much larger number of universities, say 1500 nationwide by 2015, but also that we need smaller universities which are responsive to change and easier to manage.

Curriculum: The syllabi of courses in universities, which remain unchanged for decades, need to be upgraded constantly and revised frequently. The laws of inertia reinforced by resistance to change must be overcome. Universities should be required to revise or restructure curricula at least once in three years. These revisions must be subjected to outside peer review before implementation. The process for such revisions should be streamlined and decentralised, with more autonomy for teachers, through a change in statutes wherever necessary. For existing systems often act as major impediments to a timely or speedy revision of curricula. There should be some mode of censure for departments or universities that do not upgrade their courses regularly. It needs to be recognised that it is very difficult to introduce new courses or innovative courses in universities because of departmental divides. Appropriate institutional mechanisms should be put in place to resolve this problem.

Assessment: The nature of annual examinations at universities in India often stifles the teaching-learning process because they reward selective and uncritical learning. There is an acute need to reform this examination system so that it tests understanding rather than memory. Analytical abilities and creative thinking should be at a premium. Learning by rote should

be at a discount. Such reform would become more feasible with decentralised examination and smaller universities. But assessment cannot and should not be based on examinations alone. There is a clear need for continuous internal assessment which empowers teachers and students alike, just as it breathes life back into the teaching-learning process. Such internal assessment would also foster the analytical and creative abilities of students which are often a casualty in university-administered annual examinations. To begin with, internal assessment could have a weight of 25 per cent in the total but this should be raised to 50 per cent over time.

Course credits: The present system is characterised by too many rigidities and too few choices for students. Universities that are smaller, or run semester-based systems, are obviously more flexible. Even in large universities, however, it is necessary to introduce greater diversity and more flexibility in course structures. This would be the beginning of a transition to a course credit system, where degrees are granted on the basis of completing a requisite number of credits from different courses. Every student should be required to earn a minimum number of credits in his/her chosen discipline but should have the freedom to earn the rest from courses in other disciplines. It is essential to provide students with choices instead of keeping them captive.

Research: We attempted to create stand-alone research institutions, pampered with resources, in the belief that research should be moved out of universities. In the process, we forgot an essential principle. There are synergies between teaching and research that enrich each other. And it is universities which are the natural home for research. What is more, for universities, research is essential in the pursuit of academic excellence. It is time to reverse what happened in the past and make universities the hub of research once again. This would need changes in resource-allocation, reward-systems and mindsets. Substantial grants should be allocated for research. The provisions of these grants should be competitive and the criteria for these grants should be different from the usual criteria for non-plan and plan grants.

Faculty: There must be a conscious effort to attract and retain talented faculty members. This is necessary because talented students who are potential faculty members have choices that are far more attractive in other professions in India or in the academic profession outside India. It is necessary to provide working conditions in the form of office space and research support combined with housing. But it may not be sufficient. This must

be combined with some incentives and rewards for performance. There is, however, another dimension to the problem. Universities do not always choose the best in part because of native son/daughter policies which leave them to select their own former students. This tends to lower quality and foster parochialisation in universities. Therefore, cross pollination between universities should be encouraged. It may be worth introducing a ceiling, say one-half or even one-third, on the proportion of faculty members than can be hired from within the university. This would almost certainly engender greater competition and more transparency in faculty appointments.

Finances: There is a serious resource crunch in universities which leaves them with little financial flexibility. In general, about 75 per cent of maintenance expenditure is on salaries and pensions. Of the remaining 25 per cent, at least 15 per cent is absorbed by preemptive claims such as rents, electricity, telephones and examinations. The balance, less than 10 per cent, is not even enough for maintenance let alone development. Laboratories and libraries languish while buildings crumble. But that is not all. In most universities, plan (investment) expenditure is less than 5 per cent of non-plan (maintenance) expenditure. Such a small proportion of investment in total expenditure can only mortgage the future. It is doing so. The time has come for some strategic thinking on the re-allocation of budgets for universities with some allocation for development grants and on needs other than salaries. The criteria for resource allocation should seek to strike a much better balance between providing for salaries/pensions and providing for maintenance/development/investment. These criteria should recognise the importance of a critical minimum to ensure standards and strategic preferences to promote excellence.

Infrastructure: The elements of infrastructure that support the teaching-learning process, most directly, need to be monitored and upgraded on a regular basis. This means attention, particular attention to libraries and laboratories, in addition to class rooms, sports facilities and auditoriums. It is imperative that universities provide broadband connectivity to all students and teachers in campuses. In parallel, information technology systems should be used for admissions, administration and examinations along with other relevant web services for campus communities. And, as soon as possible, a digital infrastructure for networking universities should be put in place.

Governance: There is an acute need for reform in the structures of governance of universities. The

present system is flawed. On the one hand, it does not preserve autonomy. On the other, it does not promote accountability. The autonomy of universities is eroded by interventions from governments and intrusions from political processes. This must be stopped. At the same time, there is not enough transparency and accountability in universities. This must be fostered. It is exceedingly difficult to provide generalised prescriptions. Some steps, which would constitute an important beginning, are clear. First, the appointments of Vice-Chancellors should be based on search processes and peer judgment alone. These must be freed from direct or indirect intervention on the part of governments. Once appointed, Vice Chancellors should have a tenure of six years, because the existing tenure of three years in most universities and five years in central universities is not long enough. Second, the size and composition of University Courts, Academic Councils, and Executive Councils slows down decision-making processes and sometimes constitutes an impediment to change. University Courts, with a size of 500 plus, which are more a ritual than substance, could be dispensed with. Large Academic Councils do not meet often. Even when they meet, decisions are slow to come. Thus, Standing Committees of Academic Councils, which are representative, should be created for frequent meetings and expeditious decisions. The Vice-Chancellor should, then, function as a Chief Executive Officer who has the authority and the flexibility to govern with the advice and consent of the Executive Council which would provide checks and balances to create accountability. Third, experience suggests that implicit politicisation has made governance of universities exceedingly difficult and much more susceptible to entirely non-academic interventions from outside. This problem needs to be recognised and addressed in a systematic manner not only within universities but also outside, particularly in governments, legislatures and political parties.

3. Undergraduate Colleges

Undergraduate education, which accounts for about 85 per cent of the enrolled students, is the largest component of our higher education system. It is imparted through colleges where students enrol for first degrees in Arts, Science or Commerce. There are a total of about 17,700 undergraduate colleges. Of these, a mere 200 colleges are autonomous. The rest, as many as 17,500 colleges, are affiliated to, or constituent in, 131 universities. On average, each university has more than 100 affiliated colleges, but there are some universities each of which has more than 400 affiliated colleges.

This system of affiliated colleges for undergraduate education, which may have been appropriate fifty years ago, is neither adequate nor appropriate at this juncture, let alone for the future. It is cumbersome to manage. And it is difficult to ensure minimal academic standards across the board. The problem has at least three dimensions. First, it imposes an onerous burden on universities which have to regulate admissions, set curricula and conduct examinations for such a large number of undergraduate colleges. The problem is compounded by uneven standards and geographical dispersion. Second, the undergraduate colleges are constrained by their affiliated status, in terms of autonomy and space, which makes it difficult for them to adapt, to innovate and to evolve. The problem is particularly acute for undergraduate colleges that are good, for both teachers and students are subjected to the 'convoy problem' insofar as they are forced to move at the speed of the slowest. There is also a problem for undergraduate colleges that are not so good, or are poor, because universities cannot address their special needs or unique problems. Third, it is difficult to set curricula and assess performance for such a large number of students where there is such a large dispersion in performance at school before entering college. This reality tends to make courses less demanding and examinations less stringent across the board. In fact the design of courses and examinations needs to be flexible rather than exactly the same for large student communities.

There is an urgent need to restructure the system of undergraduate colleges affiliated to universities. In doing so, it is important to make a distinction between undergraduate colleges that already exist and undergraduate colleges that will be established in the future. It is also important to remember that undergraduate colleges are afflicted by problems which are very similar to those that afflict universities.

The most obvious solution is to provide autonomy to colleges, either as individual colleges or as clusters of colleges.

Individual colleges: Colleges with a proven record of academic excellence and efficient administrative functioning can be granted autonomy in terms of academic self-governance. Existing affiliated or constituent colleges should be granted autonomy in phases after due assessment by professional accreditation bodies. A review of performance of these colleges should be institutionalised and they may be granted university status on the fulfilment of stated criteria of academic

and administrative performance. The college authorities should be given financial autonomy with regard to internal allocation of resources. However existing methods of financing should be retained. In operational terms, then, the autonomy would be accorded in setting of curriculum and evaluation of students.

College clusters: Autonomy can be provided to clusters of colleges, selected on the basis of criteria such as similar standards or geographical proximity. These colleges could then form a group, complementing each other, offering different courses between them. In time, these clusters could be upgraded to universities. The course-credit system can be implemented in these autonomous clusters, whereby different colleges offer semester-based courses on a credit system and credits can be transferred across colleges. A mechanism for the administration of courses across colleges and for the resolution of problems should be institutionalised with provision for representation in committees.

Such autonomous colleges, or clusters of colleges, would constitute a part of the 1500 universities we propose nationwide by 2015. It must be recognised, however, that this is, at best, a limited solution. There are two discernible problems.

The first problem with the model of autonomous colleges is the principal-agent problem of providing autonomy as an option. It becomes necessary to distinguish between the motivations and the capabilities of colleges. We need to make a distinction between colleges that wish to become autonomous but do not deserve to, and colleges that have the capabilities to be autonomous but do not wish to opt for autonomy. For colleges that wish to become autonomous but may not be suitable, clear cut criteria should be put in place as a filtering mechanism for colleges wishing to attain autonomous status: critical number of faculty and disciplines, governance, track record in terms of students, faculty and research, administrative competence measured by utilisation of grants, regularity of audits, office resources and account maintenance, contribution to university processes, infrastructural facilities and ratings, if available, by accreditation agencies. For colleges that can be autonomous but do not wish to be, appropriate incentives have to be designed, especially for the teaching staff to encourage a move towards autonomy. Institutional incentives relating to funding and resource generation and professional incentives for staff including positions of professors, research grants and greater mobility should be provided.

The second problem with the model of autonomous colleges is that it would be able to provide a solution for a limited proportion, or number, of undergraduate colleges. There would be a significant number of undergraduate colleges that would remain because they may not have the capabilities to become autonomous or join an autonomous cluster. The obvious solution would be for this latter group to continue as affiliated colleges with their present universities. In that event, problems will persist not only for these undergraduate colleges but also for their affiliating universities. Nevertheless, a proportion of these undergraduate colleges will continue to be affiliated to their present universities on the basis of stipulated criteria. There are two other possibilities that could be explored.

The first possibility is that some of these affiliated colleges could be remodelled as community colleges. These colleges could provide both vocational education through two-year courses and formal education through three-year courses. This would serve the needs of a particular segment of the student population better. They could focus on promoting job-oriented, work-related, skill-based and life-coping education. These community colleges could provide a unique opportunity to provide holistic education and eligibility for employment to the disadvantaged.

The second possibility is that we establish a Central Board of Undergraduate Education along with State Boards of Undergraduate Education which would set curricula and conduct examinations for undergraduate colleges that choose to be affiliated with them. These Boards would separate the academic functions from the administrative functions and at the same time provide quality benchmarks. Governance would become much simpler. It is possible that some of the existing undergraduate colleges, particularly those that are at some geographical distance from their parent university, may wish to affiliate themselves to these Boards.

New undergraduate colleges are bound to be an integral part of the expansion of opportunities in higher education. Where would these be located? It would be difficult for them to become autonomous colleges without a track record. It may be possible for some to join a cluster of autonomous colleges but this would be more the exception than the rule. It would not be possible for them to affiliate with existing universities which are already overloaded. Hence, there are three possible options for new undergraduate colleges to come. First, they could be established as community

colleges. Second, they could be affiliated with the Central Board of Undergraduate Education or State Boards of Undergraduate Education. Third, they could be affiliated with new universities that are established.

There are, of course, issues related to governance, curricula, examinations, course credits and access which arise in the context of undergraduate colleges. These have been discussed in the context of universities in the preceding section of this note.

4. Regulation

There is a clear need to establish an Independent Regulatory Authority for Higher Education (IRAHE). Such a regulatory authority is both necessary and desirable.

It is necessary for two important reasons. First, in India, it requires an Act of Legislature of Parliament to set up a University. The deemed university route is much too difficult for new institutions. Entry through legislation alone, as at present, is a formidable barrier. The consequence is a steady increase in the average size of existing universities with a steady deterioration in their quality. The absence of competition only compounds problems. Second, as we seek to expand the higher education system, entry norms will be needed for private institutions and public-private partnerships. The institutional framework for this purpose must be put in place here and now.

It is desirable for four important reasons. First, it would minimise conflicts of interest as it would create an arm's-length distance from stakeholders. Second, it would replace the present system which is over-regulated but under-governed, through more appropriate forms of intervention. Third, it would rationalise the existing system where mandates are both confusing and overlapping. Fourth, it would dispense with the multiplicity of regulatory agencies to provide a single-window clearance.

The present regulatory system in higher education is flawed in many respects. The barriers to entry are too high. The system of authorising entry is cumbersome. And there are extensive rules after entry, as the UGC seeks to regulate almost every aspect of an institution from fees to curriculum. The system is also based on patently irrational principles. The UGC Act section 3.1.2(a) suggests that permission for receiving grants will be accorded only if the Commission is satisfied that the

existing institutions in the state are not adequate to serve the needs of the state. The other regulators, say in the sphere of professional education, are often inconsistent in their adherence to principles. There are several instances where an engineering college or a business school is approved, promptly, in a small house of a metropolitan suburb without the requisite teachers, infrastructure or facilities, but established universities experience difficulties in obtaining similar approvals. Such examples can be multiplied. These would only confirm that the complexity, the multiplicity and the rigidity of the existing regulatory structure is not conducive to the expansion of higher education opportunities in India.

In sum, the existing regulatory framework constrains the supply of good institutions, excessively regulates existing institutions in the wrong places, and is not conducive to innovation or creativity in higher education. The challenge is therefore to design a regulatory system that increases the supply of good institutions and fosters accountability in those institutions. An independent regulator has to be the cornerstone of such a system.

The proposed IRAHE will rationalise the principles on which entry is regulated. There are two aspects to this rationalisation: what is to be regulated and what are the principles used for regulation.

In higher education, regulators perform five functions: (1) Entry: licence to grant degrees. (2) Accreditation: quality benchmarking. (3) Disbursement of public funds. (4) Access: fees or affirmative action. (5) Licence: to practice profession.

India is perhaps the only country in the world where regulation in four of the five functions is carried out by one entity, that is, the UGC. The purpose of creating an IRAHE is to separate these functions. The proposed IRAHE shall be responsible for setting the criteria and deciding on entry. It would, in addition, license agencies to take care of accreditation. The role of the UGC will be limited to disbursing public funds. Issues of access will be governed by state legislation on reservations and other forms of affirmative action. And, professional associations may, in some institutions, set requirements to determine eligibility for conducting a profession. All other regulatory agencies such as the AICTE will need to be abolished while the MCI and the BCI will be limited to their role as professional associations. These professional associations could conduct nationwide examinations to provide licences for those wishing to enter the profession.

The second aspect of regulation is the principle used to regulate. The IRAHE will determine eligibility for setting up a new institution based on transparent criteria rather than discretionary controls. Its main role would be to exercise due diligence at the point it approves a licence to grant degrees. In doing so, it would assess the academic credibility and the financial viability of the proposed institution on the basis of information submitted in accordance with the stipulated criteria. It will apply exactly the same norms to public and private institutions, just as it will apply the same norms to domestic and international institutions.

The IRAHE would be constituted as follows. It would have a Chairperson and six Members. The tenure of the Chairperson would be six years. The tenure of the Members would also be six years. One-third of the Members of the Authority will retire every two years. The Chairperson would be a distinguished academic from any discipline with experience of governance in higher education. The Members would be distinguished academics drawn from the following sets of disciplines: physical sciences, life sciences, social sciences, humanities and professional subjects such as engineering, medicine, law or management. The IRAHE could have some part-time members or standing committees drawn from academia to advise the Authority in each of the aforesaid sets of disciplines. The Chairperson and the Members of the IRAHE would be appointed by the Prime Minister based on the recommendations of a Search Committee.

The IRAHE would have to be established by an Act of Parliament. It would be the only agency that would be authorised to accord degree granting power to higher education institutions. It would also be responsible for monitoring standards and settling disputes. It should also be thought of as the authority for licensing accreditation agencies. The IRAHE must be at an arm's-length from the government and independent of all stakeholders including the concerned Ministries of the Government. The Acts of the UGC, AICTE, MCI and BCI would have to be amended. The role of the UGC would be re-defined to focus on the disbursement of grants to, and maintenance of, public institutions in higher education. The entry regulatory functions of the AICTE, the MCI and the BCI would be performed by the IRAHE, so that their role would be limited to that of professional associations. These professional associations could conduct nationwide examinations to provide licenses for those wishing to enter the profession.

5. Financing

The expansion of our system of higher education, which is both necessary and desirable, is not possible without financing. For an increase in supply of quality education depends upon an increase in investment which, in turn, requires financial resources. There are several sources of such financing.

Government support: There is no system of higher education in the world that is not based upon significant public outlays. And government financing will remain the cornerstone of any strategy to improve our system of higher education. The present support for higher education, at 0.7 per cent of GDP, is simply not adequate. In fact, over the past decade, in real terms, there has been a significant decline in the resources allocated for higher education, in the aggregate as also per student. In an ideal world, government support for higher education should be at least 1.5 per cent, if not 2 per cent of GDP, from a total of 6 per cent of GDP for education. This is easier said than done. But the government should endeavour to reach these levels by 2012. Even this magnitude of state financing, however, would not suffice for the massive expansion in higher education that is an imperative. Therefore, it is essential to explore a wide range of possibilities which can be complements to the increase in public expenditure.

Better asset management: Most public universities are sitting on a large reservoir of untapped resources in the form of land. In effect, with some imagination, many of our universities can be converted into institutions that are similar to land grant universities. Each university should thus have an innovative asset management plan. Such plans should be in consonance with objectives of universities. At the moment, however, universities have no strategy in this sphere. And there is considerable room to think in strategic terms about the use of physical assets in the possession of universities. It should be possible to draw up norms and parameters for universities to use their land as a source of finance.

Rationalisation of fees: On an average, fees constitute less than 10 per cent of total expenditure in our universities. And, in most universities, fees have remained unchanged for decades. In theory, universities have the freedom to decide on fees. In practice, however, universities have not exercised this freedom in part because of some genuine concerns about access but in larger part because of the rhetoric and populism in the

political process. The problem has been compounded by the UGC method of providing grants-in-aid to bridge the difference between income and expenditure. Consequently, there is no incentive for universities or colleges to raise income through higher fees as that sum would be deducted from their UGC (or State government) grants. The low fees in public universities, without any means test, have meant unquantifiable benefits for unintended beneficiaries. But private players and foreign institutions have not been restrained in charging fees that the market can bear. The time has come to rethink, as we have no choice but to rationalise fees. It is for universities to decide the level of fees but, as a norm, fees should meet at least 20 per cent of the total expenditure in universities. In addition, fees need to be adjusted every two years through price indexation. Such small, continuous, adjustments would be absorbed and accepted far more easily than large, discrete changes after a period of time. This rationalisation of fees should be subject to two conditions: first, needy students should be provided with a fee waiver plus scholarships to meet their costs; second, universities should not be penalised by the UGC for the resources raised from higher fees through matching deductions from their grants-in-aid.

Philanthropic contributions: It is clear that we have not exploited this potential. In fact, the proportion of such contributions in total expenditure on higher education has declined from more than 12 per cent in the 1950s to less than 3 per cent in the 1990s. It should be possible to nurture this tradition of philanthropy through changes in incentives for universities and for donors. In the present system, there is an explicit disincentive. If universities mobilise resources from elsewhere, they are in effect penalised through a matching deduction in their grant-in-aid. What we need to do is exactly the opposite. Universities which mobilise resources through contributions should be rewarded with matching grants-in-aid. At present, there is also an implicit disincentive in both lax laws and trust laws. Endowments of universities can only be placed in specified securities where rates of return are low and barely keep up with rates of inflation. What is more, trusts must spend 85 per cent of the income stream from the endowment in the same year, so that only 15 per cent of the income stream can be used to build up the corpus in the endowment. These laws should be changed so that universities can invest in financial instruments of their choice and use the income from their endowments to build up a corpus.

Other sources: Obviously, universities must not be driven by commercial considerations. But it would be

both prudent and wise to tap other sources such as alumni contributions, licensing fees, or user charges (for facilities in universities used by people from outside). We need to create supportive institutional mechanisms that allow universities to engage professional firms for this purpose. Mobilising resources, even from former students, is a task that cannot be performed by academics because it needs specialised talents and experience. Current UGC practice also penalises universities for any resources mobilised with a matching deduction from the grants-in-aid provided to the institution. Rather than penalising universities for raising resources, the UGC should incentivise them. In addition, universities must have the autonomy and flexibility to mobilise resources from elsewhere by creating or using appropriate institutional mechanisms.

Private investment: In three professions – engineering, medicine and management – there has been a de facto privatisation of education so that two-thirds to three-fourths of the seats are in private institutions. But private investment in university education, where more than 70 per cent of our students study, is almost negligible. It is essential to stimulate private investment in higher education as a means of extending educational opportunities. We must recognise that, even with the best will in the world, government financing cannot be enough to support the massive expansion in opportunities for higher education on a scale that is now essential.

Public-private partnerships: It might be possible to leverage public funding, especially in the form of land grants, to attract more (not-for-profit) private investment. The present system of allotment of land, where political patronage is implicit, discourages genuine educational entrepreneurs and encourages real estate developers in disguise. In principle, it should be possible to set up new institutions in higher education, not just more IITs and IIMs but also more universities, as public-private partnerships where the government provides the land and the private sector provides the finances. Such public-private partnerships which promote university-industry interface would also strengthen teaching and research.

International students: India is not an attractive destination for international students, not even as much as it used to be 30 years ago. It is time for us to make a conscious attempt to attract foreign students to India for higher education. This would enrich our academic milieu. This would enhance quality. This would be a significant source of finance. Even 50,000 foreign students charged fees at an

average rate of US\$ 10,000 per annum would yield US\$ 0.5 billion: the equivalent of Rs 2,300 crore per annum in current prices at current exchange rates. The other side of the coin is perhaps even more important. Estimates suggest that there are about 160,000 students from India studying abroad. If their average expenditure on fees and maintenance is US\$ 25,000 per student per year, Indian students overseas are spending US\$ 4 billion: the equivalent of Rs 18,400 crore per annum in current prices at current exchange rates. This has an enormous potential as a source of finance for higher education in India, if only we could create more opportunities for students with increased places and enhanced quality in our system.

6. Quality

The introduction of an independent regulator in higher education, the reform of existing public universities and the creation of national universities, taken together, would contribute to enhancement of quality in higher education. But this needs to be supported with some pro-active steps that would foster quality in higher education.

Accountability: The quality of higher education depends on a wide range of factors. But accountability, at every level, is a critical determinant. The higher education system must, therefore, provide for accountability vis-à-vis the outside world and create accountability within the system. Accountability of universities must not be confused with control of the state. Institutional mechanisms, based on checks and balances, constitute the most effective system for this purpose. The essential objective of accountability to society must be to empower students to take decisions rather than simply increase the power of the state. Stipulated performance criteria or inspections are forms of control. We need to create systems that enable students, or their parents, to choose between and assess universities.

Competition: The supply constraint on higher education is an impediment to accountability. When students have relatively few choices, institutions have greater power over them. An expansion of higher education which provides students with choices and creates competition between institutions is going to be vital in enhancing accountability. Such competition between institutions within India is, of course, essential. But the significance of competition from outside India, more qualitative than quantitative, must not be underestimated. For this purpose, we must formulate appropriate policies

for the entry of foreign institutions into India and the promotion of Indian institutions abroad. Such policies must ensure that there is an incentive for good institutions and a disincentive for sub-standard institutions to come to India. The present regime does the opposite: sub-standard players rush in while premier universities stay away as they care more about their autonomy and wish to set benchmarks for themselves. However, a level playing field should be ensured and all rules that apply to domestic institutions should also be applicable to foreign institutions. At the same time, policies must encourage rather than discourage Indian institutions to create campuses abroad not as business opportunities but as competition opportunities in their quest for academic excellence. Of course, expansion abroad should not be at the cost of domestic provision, either at present or in the future.

Accreditation: So far, we have sought to create accountability by increasing the powers of government regulators. Yet, it has done little to improve the quality of higher education. Consider, for example, the National Accreditation and Assessment Council (NAAC). This system has three characteristics which significantly erode its credibility. First, it grants one institution, the NAAC, monopoly power over accreditation. Second, NAAC itself does not have the capacity to rate all the institutions. It has rated just about 10 per cent of the total number so far. Third, the methodology of NAAC is much too discretionary. Instead of vesting one institution created by the state with monopoly power, the IRAHE may be empowered to license a number of accreditation agencies, public and private, to do the ratings. In doing so, the regulator would set standards for them. This will need to be accompanied by stringent information disclosure norms for all educational institutions, including the source and level of their accreditation. The rapid growth in higher education, particularly in the private sector, has created a strong need for empowering students and parents with reliable information from a credible accreditation process. This system can be supplemented with the creation of self-regulatory bodies in the higher education system and the freedom to seek recognition from global accreditation systems.

Internal systems: In most universities, the main stakeholders, students, are minimally part of any mechanism for accountability. Obviously, student evaluations need to be used with care. Even so, they can be part of a baseline set of accountability measures which could at least establish whether classes scheduled in the timetable are held. But that is not all. Evaluation

of courses and teachers by students is also needed, just as much as we need peer evaluation of teachers by teachers. Such internal systems of evaluation would strengthen accountability in the teaching-learning process. These must be combined with institutional mechanisms for accountability in other dimensions of university systems.

Information: Almost everywhere, information in the public domain is an important source of accountability. Higher education should be no exception. There should be disclosure norms for universities and institutions imparting higher education. They should be required to place basic information relating to their financial situation, physical assets, accreditation ratings, admissions criteria, faculty positions, academic curricula, and so on, in the public domain. This would empower students and parents and enable them to make informed choices. Information, along with competition, fostered by increased supply, will close the accountability loop.

Incentives: Even if we cannot introduce penalties for non-performance, it is necessary to introduce rewards for performance. We must, of course, recognise that universities are different from the hierarchical worlds in governments and corporate structures. The web of incentives is far more subtle. Even so, the time has come to think of salary differentials within and between universities as a means of attracting and retaining talented faculty members. The salary differentiation among teachers within the same university needs to reflect the opportunity costs for teachers in some departments. This will help retain talent in some disciplines where remuneration in the market is much higher than in other subjects. Salary differentiation may enable some universities to develop centres of excellence in some disciplines. At the same time, it is important to ensure that disciplines which are essential for a good liberal education such as social sciences and humanities, as well as basic sciences which are not necessarily rewarded by the market, are given appropriate incentives to attract both teachers and students. Such salary differentials between and within universities could be effective without being large. Indeed, there is a good reason to stipulate a maximum ratio for differences in salaries between faculty members so as not to threaten the identity of the professoriate. Obviously, universities cannot compete with salaries elsewhere, but they should endeavour to provide a comfortable minimum for all, with some premium for those who perform. It is also important to think of other incentives, such as housing, good facilities for teaching and research and some flexibility for non-teaching professional activities so long

as these do not impinge on the primary responsibilities to the institution.

Differentiation: We have to recognise that there is bound to be diversity and pluralism in any system of higher education. Therefore, in a country as large as India, we cannot afford to adopt the principle that one-size-fits-all. We must allow diversity to blossom. This could have many dimensions: curriculum, specialisation, institutional architecture, students' composition, and so on. Similarly, differentiation is inevitable if not natural. Even if we do not wish to recognise it, such differentiation is a reality. Students and parents have clear preferences, possibly implicit rankings, based on their perceptions derived from available information. Our sense of pluralism must recognise, rather than ignore or shy away from, such diversity and differentiation. It is characteristic of every higher education system in the world. For higher education is about a quest for excellence. It is, at least in part, about distinction and not always about levelling. The institutions which excel are the important peaks that raise the average. They are also role models others seek to emulate. And institutions that become such role models could mentor and guide other selected institutions.

7. National Universities

We need to create substantial additional capacity in higher education for achieving a quantum jump in the gross enrolment ratio for a rapidly expanding population of young people. It would be expeditious to do so by simply expanding on our existing educational infrastructure. A fundamental paradigm shift in our understanding of quality and standards in higher education, however, requires creating completely new institutions that operate unconstrained by the current institutional and regulatory framework. We recommend the creation of up to 50 National Universities that can provide education of the highest standard. As exemplars for the rest of the nation, these universities shall train students in a variety of disciplines, including humanities, social sciences, basic sciences, commerce and professional subjects, at both the undergraduate and post-graduate levels. The number 50 is a long term objective. In the short run, it is important to begin with at least 10 such universities in the next three years. It is worth noting that the National Universities need not all be new universities. Some of the existing universities could also be converted into National Universities, on the basis of rigorous selection criteria, to act as exemplars. We recognise that there could be a human

resource constraint if faculty members are not available in adequate numbers to establish these universities. But, for such centres of academic excellence, it should be possible to attract talent from among those who choose other professions in India or the academic profession outside India.

National Universities can be established in two ways, by the government, or by a private sponsoring body that sets up a Society, Charitable Trust or Section 25 Company. Since public finance is an integral constituent of universities worldwide, most of the new universities shall need significant initial financial support from the government. This could be in several forms. Each university may be endowed with a substantial *allocation of public land*, in excess of its spatial requirements. The excess land can be a subsequent source of income generation, its value rising over time due to the growing stature of the university. In the case of privately executed Charitable Trusts, exceptions need to be made in existing Income Tax laws to encourage large *endowments*. In particular, there should be no restriction on the utilisation of income in any given time period, the Trusts should be allowed to invest their funds in financial instruments of their choice, and all proceeds from the sale of capital assets should be exempt from capital gains tax. These universities shall have the autonomy to invest in financial instruments of their choice, by employing private fund managers if required. Appropriate mechanisms also need to be put in place for the *optimal management of physical assets*, like laboratories, libraries, classrooms and other facilities. Finally, these universities shall have the autonomy to set student fee levels and tap other sources for generating funds such as industry collaborations, overseas operations, as also commercial use of university facilities and alumni networks.

The National Universities we propose shall admit students on an all-India basis. They shall adopt the principle of *needs-blind admissions*, thereby ensuring that an applicant's ability or inability to pay shall not influence the admission decision made by a university. Further, once admitted, the university should ensure that no student has to forego his/her place due to financial constraints. This will require a host of scholarships, freeships, bursaries and awards for economically disadvantaged students. At the undergraduate level, a nationwide test that objectively measures the verbal, quantitative and analytical abilities of applicants shall be administered by an independent testing body. Admissions shall be based on a combination of Class XII results, scores from the nationwide test, application materials

including written work and personal statements, as also interviews. At the postgraduate level, admissions shall be based on a combination of the applicant's academic record, application materials, interviews and academic or professional references that indicate his/ her aptitude for further studies in the relevant discipline.

Undergraduate degrees in the National Universities shall have a duration of three years so that these are in conformity with the duration of undergraduate courses elsewhere in India. In the first year, students shall have the opportunity to study foundation, analytical and tools courses before choosing a specific discipline in the second year. They shall also have the option, at the end of the second year, of completing an integrated five-year master's degree. Degrees should be granted on the basis of completing a requisite number of credits, obtained from different courses. Each student shall be required to earn a minimum number of credits in his/her chosen discipline, and shall have the freedom to earn the rest from courses in other disciplines. The academic year shall therefore be semester-based and students shall be internally evaluated at the end of each course. Transfer of credits from one National University to another shall also be possible. A wide variety of courses shall be offered, in traditional academic disciplines, employment-oriented specific areas and cross-cutting competencies. Syllabi shall be revised every year to keep up with changes and current developments in various disciplines. Departments that do not update their syllabus for two consecutive years shall be asked to provide justification. Students shall have the option of taking up internships in private companies or research institutions in lieu of a certain number of credits.

An appropriate system of appointments and incentives is required to maximise the productivity of faculty in the National Universities. There shall be scope for salary differentials between National Universities and also between disciplines. Faculty training will be contingent on periodical reviews of research output and student evaluation. The most accomplished faculty members shall be encouraged to teach undergraduate courses. There shall be no career advancement schemes and appointments at every level shall be through open competition. The total number of faculty positions may be specified, but there should be complete flexibility in choosing the level at which faculty appointments are made, so that, for talented faculty members, career paths are not constrained by the number of vacancies. In order to maintain the quality of the National Universities, mechanisms should be in place to monitor and evaluate

the performance and progress of teachers including peer reviews. The procedures and results of these evaluations will be open and transparent.

The research outputs of these universities shall be vital contributors to India's socioeconomic development and progress in science and technology. Strong linkages shall be forged between teaching and research, universities and industry, and universities and research laboratories.

The National Universities shall be department-based and shall not have any affiliated colleges. Each department will administer undergraduate and post-graduate courses. Nonteaching functions should be outsourced wherever possible, and a maximum ratio of 2:1 should be maintained between non-teaching and teaching staff. Each university should appoint an internal ombudsman for the redressal of faculty, staff, student and public grievances. Administrative processes, wherever possible, should be streamlined and made transparent and accountable by the use of information and communications technology.

8. Access

Education is an essential mechanism for inclusion through the creation of social opportunities. It is, therefore, essential that in addition to ensuring that no student is denied the opportunity to participate in higher education due to financial constraints, access to education for economically and historically socially underprivileged students is enhanced in a substantially more effective manner.

Economic barriers to higher education can be addressed by ensuring financial viability for all students wanting to enter the world of higher education. This can be done through two strategies. One is to adopt a *needs blind admissions* policy. This would make it unlawful for educational institutions to take into account any financial factor while deciding whether or not to admit a student. Every institution will be free to use a variety of instruments to achieve this aim: scholarships or cross-subsidies. In addition, academic institutions would be able to set a fee of their own choice subject to the provision that there are at least two banks that are willing to finance the entire cost of education at that institution, without any collateral other than the fact of admission. The cost of education includes not just fees but also reasonable living expenses including costs such as hostel and mess fees and any other expenses associated with the course of study. Since commercial banks may be wary of funding economically deprived students, especially

in non-professional courses, we need a well-funded and extensive National Scholarship Scheme targeting economically underprivileged students and students from historically socially disadvantaged groups, particularly students from rural and backward areas. The success of this proposal depends on generous government support. For instance, the government should endeavour to make available about 100,000 scholarships for such students. These scholarships should be set at a level where students are empowered to go to any institution of their choice.

We also need to undertake more proactive forms of affirmative action to ensure inclusion of marginal and excluded groups. Reservations are essential but they are a part, and one form of, affirmative action. Disparities in educational attainments are related to caste and social groups, but are also strongly related to other indicators such as income, gender, region and place of residence. Access to quality higher education is further limited for students from certain types of schools. Therefore deprivation of educational opportunities is a multi-dimensional problem and attention needs to be paid to different salient levels of deprivation faced by students. A meaningful and comprehensive framework would account for the multidimensionality of differences that still persist. Such a deprivation index could provide weighted scores to students and the cumulative score could be used to supplement a student's school examination score. After adding the score from the deprivation index, all students could compete for admissions.

The indicators need to be easily identifiable and verifiable for the system to work effectively. They should cover the different types of disadvantages that a student could face at the school level, and while applying for admissions to higher education. This system serves the dual purpose of considering various disadvantages and ensuring that a reserved category student who has otherwise enjoyed other benefits does not get great preference at the time of admissions.

Illustrative indicators of backwardness that need to be measured by such an index could include *social background* covering caste (keeping in view regional variations), religion and gender, *family education history*, *family income*, *type of school* distinguishing between government and private schools and between schools from different locations, the medium of instruction, *place of residence* distinguishing between urban and rural areas and accounting for regional deprivation by sorting districts along an index of infrastructure or access to social benefits and *physical disability*.

Appointment of Heads of Institutions

April 17, 2008

The recent measures introduced by the government leading to a major expansion of the higher education sector are probably among the most important steps in making India globally competitive in the long run. Expansion and inclusiveness, drawing larger sections of Indians into the arena of knowledge creation and utilisation will be the key drivers to a better future.

The National Knowledge Commission would like to draw attention to the central role of governance structures in allowing these new institutions to grow rapidly, efficiently and productively and also, to review procedures in some of our best existing institutions like IITs, IIMs, Central Universities and AIIMS.

It is imperative to separate governance mechanisms from the day-to-day operations of Ministries, in order to protect functional autonomy, in its fullest sense. NKC would like to draw attention to the following ideas.

1. The appointment of Directors/Vice Chancellors of the new IITs, IIMs, IISERs, Central Universities, AIIMS must be made by a Search Committee that has an independent Chair, capable of exercising the highest quality of judgment. The direct

involvement of administrative ministries can result in unfortunate situations.

2. The procedure for appointment of the Chairperson and members of governing Councils/Boards needs to be carefully crafted in order to ensure that institutions have the benefit of the widest inputs from academia and society.
3. The involvement of the Chair of the Governing Board and at least two independent members in the selection of the Director/Vice Chancellor will ensure smooth functioning at later stages of an institution's development.
4. Appointments of heads of institutions must be made well in advance of a vacancy arising, so that a smooth transition is effected. In view of fixed tenures, there is no reason that this cannot be done in all institutions.
5. The proposal for an independent regulatory body for higher education was also advanced by the Commission as an expression of its concern at the deteriorating ambience of institutions of learning in many parts of the country.

In summary, NKC believes, that governance issues may be central to any debate on improving the status of higher education in India.

Legal Education

October 15, 2007

The National Knowledge Commission, while deliberating on issues related to knowledge concepts, recognises legal education as an important constituent of professional education. The vision of legal education is to provide justice-oriented education essential to the realisation of values enshrined in the Constitution of India. In keeping with this vision, legal education must aim at preparing legal professionals who will play decisive leadership roles, not only as advocates practising in courts, but also as academics, legislators, judges, policy makers, public officials, civil society activists as well as legal counsels in the private sector, maintaining the highest standards of professional ethics and a spirit of public service. Legal education should also prepare professionals equipped to meet the new challenges and dimensions of internationalisation, where the nature and organisation of law and legal practice are undergoing a paradigm shift. Further, there is need for original and path breaking legal research to create new legal knowledge and ideas that will help meet these challenges in a manner responsive to the needs of the country and the ideals and goals of our Constitution. As part of a consultative process, NKC constituted a Working Group of experts, including distinguished members of the Bar, the bench and academia under the chairmanship of Justice M. Jagannadha Rao to suggest necessary measures to improve the quality of legal education in India. Based on further consultations with stakeholders, NKC has proposed the following:

1. Regulatory Reform: A New Standing Committee for Legal Education

A new regulatory mechanism under the Independent Regulatory Authority for Higher Education (IRAHE), vested with powers to deal with all aspects of legal education and whose decisions are binding on the institutions teaching law and on the union and state governments, should be established. The Standing Committee for Legal Education may consist of 25 persons (including eminent lawyers, members of the Bar Council of India/ BCI, judges, academics,

representatives from trade, commerce and industry, economists, social workers, students and others) and it must aim at revamping legal education to meet the needs and challenges of all sections of society.

At the time of enactment of the Advocates Act, 1961, it was envisaged that legal education would only produce lawyers for the courts and accordingly the BCI had been entrusted with the limited role of 'promoting legal education and laying down minimum standards of legal education' required for students who 'are entitled to practice'. In the last 50 years, and particularly after liberalisation in 1991, the entire concept of legal education has changed considerably. Today, legal education has to meet not only the requirements of the Bar but also the new needs of trade, commerce and industry, in the context of growing internationalisation of the profession. The need for improvement in overall quality to match global standards has become even more salient when viewed from such a perspective. In light of the changed scenario in the last 50 years and the existing gaps and deficiencies in overall quality, it is clear that the BCI has neither the power under the Advocates Act, 1961 nor the expertise to meet the new challenges both domestically and internationally. It is, therefore, necessary to constitute a new regulatory mechanism with a vision both of social and international goals, to deal with all aspects of legal education and to cater to the needs of the present and the future. The BCI would however continue to exercise its powers to recommend minimum standards required for practice in the courts. Further, the BCI would continue to enjoy its powers of discipline so far as the members of the Bar are concerned.

2. Prioritise Quality and Develop A Rating System

There is a need to develop an independent Rating System based on a set of agreed criteria to assess the standard of all institutions teaching law as a mechanism to ensure consistent academic quality throughout the country. The criteria for rating would be evolved by the Standing

Committee for Legal Education while the rating would be done by independent agencies licensed by IRAHE for the purpose. Recognition could be either granted or withdrawn on the basis of such ratings. The rating results should be reviewed annually, regularly updated, monitored and made available in the public domain.

3. Curriculum Development

Curriculum should be made contemporary, integrated with other disciplines ensuring regular feedback from stakeholders. Autonomy may be granted to universities, National Law Schools (NLSUs) and other law schools to decide the core and optional courses to be offered. This is a departure from current practice where the BCI largely determines curricula and syllabi. A committee should be formed that includes faculty and practitioners and seeks student feedback to discuss curricula, syllabi and reading material of all core and optional courses, and devise a 'model' syllabus for all core and optional courses. Law schools and universities would be free to use and depart from the 'model' syllabus.

Law teaching must be interwoven with related contemporary issues, including international and comparative law perspectives. The curricula and syllabi must be based in a multidisciplinary body of social science and scientific knowledge. Curriculum development should include expanding the domain of optional courses, providing deeper understanding of professional ethics, modernising clinic courses, mainstreaming legal aid programs and developing innovative pedagogic methods. Legal education must also be socially engaged and sensitise students on issues of social justice.

4. Examination System

The prevailing examination systems may be revised and evaluation methods be developed that test critical reasoning by encouraging essential analytical, writing and communication skills. The end-semester examination should be problem-oriented, combining theoretical and problem oriented approaches rather than merely test memory. Project papers, project and subject viva, along with an end-semester examination to be considered as pedagogic methods imperative for improving quality.

5. Measures to Attract and Retain Talented Faculty

To attract and retain talented faculty, better incentives, including improving remuneration and service conditions

may be introduced. It may be necessary to think of salary differentials within and between universities and law schools along with other means of attracting and retaining talented faculty members. Such salary differentials between and within universities and law schools could be effective without being large. This will help retain talent in legal academia where the problem of inadequate remuneration is far more acute than in other disciplines. Salary differentials could be considered as a means to retain quality talent and also promote a culture of excellence.

To foster quality and create better incentives, there is also need to remove fetters on faculty that pertain to opportunities in legal practice (such as consultancy assignments and legal practice in courts). These reforms need to be introduced in a balanced, reasonable and regulated manner to ensure adequate incentivisation for faculty without compromising on the maintenance of consistent academic quality. As a further incentive, it is necessary to create better opportunities for active involvement of academia in the shaping of national legal education policy.

There is also need to reconsider existing promotional schemes and avenues to promote meritorious faculty members. Other incentives for faculty include fully paid sabbaticals; adequate House Rent Allowance (HRA); instituting awards to honour reputed teachers and researchers at national and institutional levels; flexibility to appoint law teachers without having an LL.M degree if the individual has proven academic or professional credentials; faculty exchange programs with leading universities abroad and upgrading existing infrastructure.

6. Developing A Research Tradition in Law Schools and Universities

Creating a tradition of research in law schools and universities is imperative if India has to transform itself from being only a consumer of available legal knowledge to being a leading producer in the world of new legal knowledge and ideas. The following measures are required to develop such a serious culture of research: emphasising analytical writing skills and research methodology as integral aspects of the LL.B program; creating excellent infrastructure (including research friendly library facilities, availability of computers and Internet; digitisation of case law; access to latest journals and legal databases available worldwide); rationalising the teaching load to leave

faculty members sufficient time for research; granting sabbatical leave to faculty to undertake research; creating incentives if research results in peer reviewed publications, either through additional increments (beyond the UGC scheme) or in any other appropriate manner; institutionalising periodic faculty seminars; establishing quality peer-reviewed journals; prescribing research output as one of the criteria for promotion; creating a database of citations to identify the most cited and influential writings as well as considering such data for promotion purposes; establishing prerequisites such as a mandatory dissertation in the LL.M program, a pre-registration presentation and a course in methodology for M.Phil and Ph.D programs respectively; and establishing four new centres for advanced legal research.

7. Centres for Advanced Legal Studies and Research (CALSAR)

There is need to set up four autonomous, well networked Centres for Advanced Legal Studies and Research (CALSAR), one in each region, to carry out cutting edge research on various aspects of law and also serve as a think-tank for advising the government in national and international fora. The CALSARs would maintain adequate linkages and institutionalised interaction opportunities with law schools and universities, including continuing legal education for faculty. Some other specific functions and objectives of these centres would include: publishing a peer reviewed journal of international quality; facilitating multi disciplinary approaches to law; institutionalising arrangements for scholars in residence; organising workshops and undertaking in-depth research on new and developing areas of law.

Each CALSAR would require an initial investment of around Rs. 50 crore to build an academic complex, conference facilities, a world-class library and other infrastructure. These institutes would also need to be provided with an annual budget to the tune of Rs. 5 crore for salaries, fellowships, administrative expenses and related expenses. The initial investment and the annual budgets should be borne by the central and respective state governments (that would host the CALSAR) respectively, but the CALSARs should gradually aim at financial self-sustenance, through innovative financial methods.

8. Financing of Legal Education

It is for law schools and universities to decide the level of fees but as a norm, fees should meet at least 20 per cent of the total expenditure in universities. This should be subject to two conditions: first, needy students should be provided with a fee waiver plus scholarships to meet their costs; second, universities should not be penalised by the UGC for the resources raised from higher fees through matching deductions from their grants-in-aid. The central and state ministries may also be urged to endow chairs on specialised branches of law. State financing can be complemented with endowments from the private sector, including synergistic arrangements such as appropriate public private partnerships. Incentives such as tax holidays for donations above a high minimum threshold by the corporate sector may be considered. Institutions should be given the autonomy to evolve their own innovative methods of financing to maximise infrastructure and resource utilisation.

9. Dimensions of Internationalisation

Building world class law schools today will require creatively responding to the growing international dimensions of legal education and of the legal profession, where it is becoming increasingly necessary to incorporate international and comparative perspectives, along with necessary understanding of domestic law. Suggested initiatives to promote such international perspectives include building collaborations and partnerships with noted foreign universities for award of joint/dual degrees; finding ways of evolving transnational curricula to be taught jointly by a global faculty through video conferencing and Internet modes; as well as creating international faculty, international courses and international exchange opportunities among students.

10. Technology for Dissemination of Legal Knowledge

For maximum dissemination of legal knowledge, all information available in the Indian Law Institute (ILI), Supreme Court Library, Indian Society for International Law (ISIL) as well as those of all law schools, universities and public institutions in the country, be networked and digitised. Such networking is in addition to the need for adequate infrastructure such as computers, law journals, legal databases and excellent libraries in the institutions teaching law.

Medical Education

October 16, 2007

The quality, the quantity, distribution and availability of human resources for the health sector in India at present, need to be improved substantially to deliver care-driven, rural oriented and equitable health services. Over the years, health related education and training has become more urban oriented, doctor-centric and technology-driven. The environment of medical education needs to be both nationally sensitive and globally competitive. To realise these objectives, our medical education system needs radical reforms.

The National Knowledge Commission therefore considered it imperative to carry out a comprehensive appraisal of the system. For this purpose, a Working Group was constituted which included some of the most distinguished members of the medical profession in India, chaired by Dr. Sneha Bhargava, former Director, AIIMS. Based on the inputs provided by the Working Group and further consultations with concerned stakeholders, NKC recommended the following:

1. Regulation and Accreditation

Regulation

At present, medical education in India is regulated by the Medical Council of India (MCI). This system of regulation is neither adequate nor appropriate to meet the needs of the profession. Therefore, in conformity with NKC recommendations on Higher Education, a Standing Committee within the structure of the Independent Regulatory Authority for Higher Education (IRAHE) may be constituted. The primary function of the Standing Committee will be to ensure that medical practice and teaching are updated and revised regularly and minimum quality standards are maintained. The members of the Standing Committee would include faculty from recognised universities, practising physicians, members of civil society, students and a director from autonomous institutions representing educators. The Chairman and the members of the Standing Committee would be accountable to IRAHE.

The Standing Committee would look into manpower planning and development based on disease-profile, doctor-population ratio and skill-mix ratio.

Professional Councils

The Indian Medical Council Act should be amended such that MCI functions only as a professional association, with powers to conduct nationwide examinations, and to provide licenses for those who wish to join the profession. Similar changes are needed for all the other Councils viz. Nursing Council, Pharmacy Council, Dental Council and Rehabilitation Council.

Accreditation

IRAHE should be empowered to license suitable agencies for accreditation. Accreditation agencies could award different degrees of accreditation, such as “Full”, “Provisional” or “On Probation” and have the power to de-recognise. Institutions would have to ensure transparency in their admission processes, able and responsible faculties, a multidisciplinary academic learning environment, transparency in assessment of students and close linkages with regional health care and delivery systems, in order to be accredited.

Admission

Policies of admission and fee structure of private colleges have to be regulated, not only to stop them from becoming sources of political and financial power but also to arrest falling standards. There should be only one All India Common Entrance Test for all students who would like to get admission to Self Financing Medical Colleges. Since the CBSE conducted examination for the 15 per cent All India quota in Government Medical Colleges is taken by a very large number of students, this would appear to be the ideal examination whose ambit can be expanded. All self-financing Medical Colleges should announce their fees in their prospectus so that students can make their choice for admission. Information Technology should be used to

increase transparency and efficiency in the admission, examination, administration, teaching, content delivery and other related processes.

2. Quality

Curriculum

All institutions must constitute Curriculum Committees that plan curricula and instructional methods, which are regularly updated. The structure and composition of the curriculum must describe the content, scope and sequencing of the courses, including the balance between core and optional courses. Integration of ICT in the learning process is essential. Incorporating new skills like management, disciplines like health economics and frontier areas like bioinformatics should be considered.

Standards Test

An independent and standardised National Exit Examination at the end of 4½ years of study, is essential to conduct a national level assessment of skills and knowledge. The National Exit Examination could be conducted immediately after the University examination, and would also serve as a postgraduate entrance exam.

Internship Assessment

The internship year must be assessed to ensure skill development. The current practice of students continuing to study in the internship year without going to clinics needs to be addressed. There must be compulsory rotation from the teaching hospital to the community and district hospital during the internship period. Duration of the term in the district hospital should be six months, in the Community Health Centre three months and in the tertiary care hospital the remaining three months. Each intern should be assigned a “mentor” at the district hospital and the credits should be based on the assessment by the mentor. The entrance to postgraduate programs should be based on a summation of the pre- & post-internship examinations.

Continuing Education

There is a need to revamp Continuing Medical Education (CME) based on distance learning. All professionals should be required to undergo a re-certification process every five years, which can be evaluated by credits earned

through CME. ICT can be used extensively to provide CME at the convenience of the learner.

3. Faculty Development

Teaching

Attracting and retaining quality faculty should be accorded top priority. Measures such as opportunities to attend international conferences regularly, sabbaticals, dual appointments, rewarding research, fast-track promotions, and dissociating remuneration from government pay scales should be explored. All institutions must clearly lay down exact definitions of what constitutes conflict of interest for faculty members in public medical colleges, who have a private practice in addition to their official duties, and receive a full time teacher’s salary. Those who flout these regulations should be penalised.

Research

With a view to encouraging research in medicine, a Mentored Medical Student Research Program should be set up as a catalyst to introduce medical students to a potential career in patient-oriented/community-oriented research including interdisciplinary research. Two points of entry into Ph.D programs should be considered: one after MBBS and another after MD depending on the student’s interest. The government should facilitate setting up of research centres in medical colleges. Validating Indian Systems of Medicine using bio-sciences tools should form an integral component of the research effort.

Training

Five Regional Centres for teacher training/faculty development should be set up so that teachers from the outlying regions can be sent to these centres periodically for up-gradation of their teaching skills.

4. Post-graduate Education

General Physicians

The medical profession needs to be structured like a pyramid with the base made up of general physicians. At present there is little if any space for such doctors in post-graduate courses. Therefore, we suggest that adequate representation should be given to general physicians while carrying out expansion of post-graduate seats such that 50 per cent seats are reserved for general

physicians. New streams for post graduation should be looked at based on needs.

Admissions

Admission to post-graduate courses should be done on the basis of credits received in the National Exit Examination and pre- and post-internship clinically oriented exams after internship. There is a need to reserve post-graduate seats (up to 20 per cent of total available seats) for graduates who have worked in rural areas for at least three years.

5. Regional Balance

Location Priorities

The number of medical colleges in relation to population in some states is much higher than in other states. The Central Government should aid new colleges in these states to address this regional disparity. For instance, north eastern states require urgent attention in this context. The Central Government can develop a list of priority sites for establishing new colleges where the impact of new clinical facilities would benefit the surrounding rural population.

Role Models

Further at least one institution should be identified in each state that can serve as a centre of excellence and role model for the other institutions of the state. These institutions should have state-of-the-art infrastructural equipment such as research laboratories, teacher training facilities, and libraries, as well as talented faculty of adequate strength to act as a common resource and also to serve as a benchmark of excellence.

Medical education cannot be stand-alone. It requires support in the form of trained nurses, pharmacists, paramedic workers. It must all also serve the essential purpose of delivering health care to the people. Therefore, NKC also set out some recommendations on education for supporting services and public health.

6. Education for Support Services

Nursing

There is a need to create additional capacity for training nursing staff. In addition, every district hospital should have attached to it a nursing school, which offers

diploma in nursing specifically to operate primary health centres as nurse practitioners. A career growth pathway should be ensured for nurses after a specific period of primary health care service. For graduate nurses in city hospitals, specialised courses for family nurse practitioners, nurse anesthetists and in areas of tertiary care are recommended.

Pharmacy

Pharmacy education should be popularised and the number of seats for pharmacy education should be increased substantially. Gradual phasing out of untrained pharmacists should be considered.

Paramedics

The role of Paramedic workers should be expanded. A Paramedical Council needs to be immediately established, which would prepare training programs for multi skill and speciality technicians and oversee their delivery and quality. Paramedics, such as compounders, dressers, and laboratory technicians can also perform public health functions, such as health education, providing immunisation, and first aid. Such a health worker could be trained through vocational training at the higher secondary level followed by a one year diploma. Career paths should be built into their service in order to retain them because international demand is high.

7. Public Health

Education

A three tiered structure consisting of a one year diploma course, a three year B.Sc course and a three year Master's course may be introduced. These programs can be attached to departments of Community Medicine in all medical colleges for providing hands on training. All universities, all district hospitals and the Public Health Foundation of India can run them.

ASHA

The role of Accredited Social Health Activists (ASHA) needs to be re-conceptualised within this framework, and ASHA must be viewed as an accessible and effective health worker. The training period of the ASHA needs to be lengthened from its current duration. Steps should be taken to review the system of remuneration and improve the working conditions of the ASHA workers.

Management Education

October 15, 2007

Management education has seen phenomenal growth in the past six years with the number of institutions providing undergraduate and post-graduate level courses rising to over 1700. Of these, more than 1000 were added after the year 2000. This has been possible largely due to the entrepreneurial initiative of promoters, taking advantage of the ever increasing demand for management graduates, hence management education. Unfortunately, this has also led to an exploitative and commercial environment with quality being compromised. Regulatory focus only on physical infrastructure rather than research, qualified faculty and relevance of courses has created a mismatch between supply and demand.

As a part of its consultative process, NKC constituted a Working Group of experts from academia and industry under the chairmanship of Mr. P.M. Sinha. Based on the Working Group's inputs and consultations with concerned stakeholders, NKC proposed the following set of initiatives:

1. New Regulatory Framework

NKC advocates good governance rather than the prevalent system of a prior control being exercised by AICTE in this sphere. The current regulatory regime focuses on punitive actions rather than on nurturing institutions. NKC proposes that an autonomous Standing Committee for Management Education be set up under the Independent Regulatory Authority for Higher Education. Its main role would be to exercise due diligence at the point it approves a license to grant degrees/diplomas. In doing so, it would assess the academic credibility and the financial viability of the proposed institution on the basis of information submitted in accordance with the stipulated criteria. It will apply exactly the same norms to public and private institutions, just as it will apply the same norms to domestic and international institutions. It would, in

addition, license agencies to take care of accreditation. Other responsibilities of the Standing Committee will be to collate as well as communicate information on Management Educational Entities (MEEs)¹; set up an information exchange; conduct demand forecasting of managerial manpower and develop and maintain a low cost e-monitoring system.

2. Grading Institutions

The Standing Committee will stipulate grading norms and nominate independent rating agencies to assess and categorise MEEs. Mushrooming private MEEs necessitate a reliable rating system to help the market function better, enabling students and employers to compare different MEEs. Hence, a two stage rating process is recommended. In the first stage, rating covering infrastructure may be mandated before an MEE can admit students. The second stage would consist of rating of quality (admission process, teaching, research and publications) which shall be conducted every three years to ensure accountability. Grading norms for each of these steps should be established in consultation with experts. CRISIL and ICRA were consulted in the process and they have agreed to undertake rating of MEEs. The Standing Committee shall decide on a fair and transparent mechanism to deal with conflicting points of view between a rating agency and an MEE.

3. Accreditation

For MEEs which wish to go beyond rating, the Standing Committee shall determine the criteria and the processes of accreditation in consultation with experts from academia and industry. Mentoring to help MEEs sustain quality standards should be an integral part of the process. Select international accreditations may also be recognised. Branding of accreditation, similar to international standards such as ISO 9001, may be considered to encourage MEEs to pursue excellence.

¹ In view of the variety of institutions delivering management education, MEE is used to cover all educational institutions; Institutes, Departments, Affiliated and Autonomous colleges, Departments in Deemed Universities, Private Business Schools etc.

4. Improve Access

In addition to the framework of affirmative action already in place, we suggest improving access based on work experience and educational loans. NKC believes that management education can be made available to a much wider student community by adopting a two pronged approach. First, we suggest that more weightage be assigned to work experience in admissions. This would help in overcoming disadvantages faced by prospective students due to lack of proficiency in English. Secondly, steps may be taken to ensure easier access to educational loans through banks. Default concerns can be addressed if the respective MEE and the first employer cooperate with the banks. MEEs must also offer scholarships to socially disadvantaged students.

5. Social Context

It is essential to widen the scope of management studies and enhance its relevance.

- Sensitise management education to our unique socio-cultural situation by including India specific case studies in the curriculum, reflecting our diversity and incorporating traditional wisdom.
- Integrate management with other knowledge sources and increase research funding for management and supporting disciplines. With globalisation, the need for management education to pursue a wider scope and realise a more wholesome impact on society has increased. Management departments in universities should therefore draw upon knowledge sources in other departments.
- Encourage MEEs to design and offer executive programs for government officials, NGOs and defence personnel. Short term courses for government officials will help them in their role as economic managers.
- Revamp the existing Bachelor's degree in management, the Bachelor's in Business Administration, to cater to the burgeoning need of management graduates. Compulsory apprenticeship in organisations and study of under managed sector areas should be included as part of the program. The current bookish nature of the curriculum is not sufficient to prepare students for junior management levels.
- Distance learning has considerable potential in this domain. We therefore need to fully realise the potential of Online Management Programs to bridge the demand-supply gap.

6. Faculty Development

Non availability of adequate proficient faculty is a major constraint for sustainable growth of quality management education in India. An autonomous, financially sound and academically credible institute with active support from the leading management institutes, industry and Government should be set up for faculty development. Standards for curriculum covering the entire spectrum need to be set. Active involvement of MEE faculty in training, conferences, industry engagement and curriculum revision should be encouraged. Given the current demand-supply gap, additional faculty would need to be attracted by appropriate incentives.

7. Mentoring

To achieve excellence in the field of management, NKC recommends that all the leading Management Institutions adopt 3-4 MEEs for mentoring and upgradation of quality. Funding and other modalities can be mutually worked out between the institutions.

8. New Institutions

There is a need for a new wave of management institutions which will focus on entrepreneurship, leadership and innovation. These institutions will enable to launch India into the global arena, without the legacy associated with operating in a protected environment. These institutions should set new standards and become role models for MEEs that have the desire to become leaders in the global market place. Incentives need to be provided to Indian entrepreneurs/corporates to set up institutions of excellence on their own or in collaboration with foreign universities. We could also consider allowing reputed foreign universities to enter this field, regulations for them being at par with private institutions.

9. Autonomy

All existing management institutes excluding management departments in universities should register with the Standing Committee of IRAHE and be accorded independent status. In the case of MEEs set up by Central and State governments, government should be treated as a promoter. Registered institutes will benefit from the Standing Committee's mentoring

and better funding opportunities apart from other advantages associated with autonomy.

10. Governance

NKC recommends a board of governors for all MEEs, consisting of 50 per cent independent members as there are independent directors under Company Law. The key focus of the governing board should be to continuously improve quality of education and research. For this purpose, they would have to maximise the resource/fund inflows and allocate/spend them purposively and efficiently. The Board should encourage faculty to publish reputed journals and publications, obtain regular feedback from students on teaching-learning process, obtain recruiter feedback for improving quality, institutionalise faculty evaluation and management system and encourage faculty to write India based case studies. The appointment of Directors of public MEEs should be freed from direct or indirect interventions on part of the governments, for these should be based on search processes and peer judgement alone. Likewise, the appointment of directors of private MEEs should be based on a transparent selection process. This would of course

be accompanied by enhanced accountability based on performance indicators and independent external evaluation.

11. Non-traditional Management Education

The need for better management in education, health, local government, co-operatives, and civil society organisations and so on has often been felt. However, the experience of graduates of Institute of Rural Management and Institute of Forestry Management shows that a lack of advancement opportunities in the Government acts as a barrier to the success of such programs. There is a need to establish career opportunities in public management, and systematise recruitment and retention policies. Structure of fees for these courses should be formulated in accordance with earning opportunities. We also need to encourage reputed MEEs to develop specialised courses for agri-business, rural banking, public utilities, regulatory agencies and services sector in the coming years as private players entering this space would create demand for the same. The Standing Committee should undertake a study in this field to institutionalise these programs.

Engineering Education

May 6, 2008

Engineering education is among the key enablers of growth for transforming India's economy. The quality of teaching and research in this sphere will play a critical role in the emergence of our country as a global knowledge leader. It will also provide vital inputs for enhancing productivity across sectors. In the past two decades, we have seen an eight-fold increase in the number of institutions imparting engineering education at the undergraduate level. Yet, there are some fundamental issues that need to be addressed.

A glaring regional imbalance has emerged in the availability of engineering education. Two-thirds of the engineering institutions are located in four southern states, plus Maharashtra, even though they account for less than one-third of the population. There is much less access for the youth in under-provided states, particularly because only 15 per cent of the total seats are available for those who come from outside the state. It would be worthwhile to study whether there are any cultural or region-specific factors that influence the choice of engineering as a career in some states and not elsewhere. This could help make the spread of such colleges more even nationwide.

Several recent studies have flagged the problem of unemployment of engineering graduates, largely because curriculum and syllabi are not quite compatible with industry requirements. Further, the standards of a very large proportion of institutions at the bottom of the pyramid have also been found to be abysmal. Even good institutions are plagued by deficiency of quality students at post-graduate and research level. The problems are complex and deep rooted. The situation calls for a new paradigm in regulation, accreditation, governance and faculty development.

As part of its consultative process, NKC constituted a Working Group of experts from academia and industry under the chairmanship of Prof. M.S. Ananth, Director IIT Chennai. The Group has also considered the inputs provided by the earlier committees on this subject chaired by R.A. Mashelkar (1998), U.R. Rao (2003) and

P. Rama Rao (2004). The study conducted by Professors Banerjee and Muley of IIT Bombay (2007) has also been taken into account. Based on inputs from the Working Group and consultations with other stakeholders, NKC proposes the following set of initiatives:

1. Reforming the Regulatory Framework

As stated in our earlier recommendations relating to Higher Education, there is a need to establish an Independent Regulatory Authority for Higher Education (IRAHE) to cover all streams. The role of the Standing Committee on Engineering Education under IRAHE would be to exercise due diligence at the point it approves entry for an institution to grant degrees/diplomas. The members of the Committee should comprise eminent educationists, education administrators and management specialists drawn from industry. The Committee would follow transparent and uniform processes, under the overall supervision of IRAHE. The Committee shall also determine the criteria and the processes of accreditation and license multiple agencies for the same. A mechanism for ranking of institutions to enable students to take informed decisions at the time of admissions by stipulating grading norms and nominating independent rating agencies also needs to be established. These initiatives will enable the All India Council for Technical Education (AICTE) to focus on important issues such as curriculum development, pedagogy, faculty development etc.

2. Improving Governance of Institutions

In order to encourage greater flexibility and autonomy, there is a need to progressively do away with the system of affiliation of engineering institutions/colleges to universities. Where feasible, they should be given full autonomy. To attain greater transparency and accountability, it should be made compulsory for all engineering institutions to display information about their buildings, labs, faculty, intake of students,

performance of students, recognition status and placements, on their websites. As emphasised by NKC repeatedly, appointments of Heads of Institutions must be made through the process of a Search Committee that has an independent Chair and is at an arm's length from the government. The direct involvement of administrative ministries in the process can result in unfortunate situations.

3. Attracting and Retaining Faculty

The most serious challenge in engineering education is the dearth of well-qualified faculty. Several measures must be undertaken in this direction:

- Institutions should be encouraged to create adjunct positions and invite professionals from industry and research institutions to participate in the teaching process.
- The criterion of holding a Ph.D for teaching undergraduate students may be relaxed to Master's degrees which are specifically designed with more course work in lieu of thesis. Special efforts should be made at the undergraduate level to identify and motivate those who have the potential as well as the inclination towards teaching.
- Incentives like better salary, modern infrastructure, better living and working environment, possibility of secondment to industry during vacations should be made available.
- Shortage of faculty could also be overcome by innovative use of Information & Communication Technology and Open Educational Resources (OERs) by leveraging the content available from the best universities across the world.
- Several initiatives need to be undertaken to improve training and professional development of the faculty. A two-week teacher induction training course should be made compulsory. A one-day regional workshop on teaching/learning processes should be arranged as a part of the academic calendar. Course development should be made an integral part of the training programs conducted by Academic Staff Colleges. Better opportunities may be created for continuing education using the distance mode.

4. Curriculum Reform

The current curriculum should be modified to provide greater flexibility, inter-disciplinary perspective and choice of electives. The focus in the teaching/learning process should be on integrating skills such as problem solving and logical reasoning, process orientation, learning

ability, English communication and programming fundamentals. Industry participation to discuss real life case studies should be encouraged. Laboratory courses must be revamped to develop a healthy attitude towards experimental work. Environment must be created to encourage students to participate in co-curricular activities.

5. Integrating Sciences and Engineering Education

We have entered a period in history where the distinction between sciences and engineering has all but disappeared. Sciences are at the heart of engineering. To that extent there is no distinction between the two. In order to reduce the perceived gap between sciences and engineering, we need to create mechanisms that allow mobility between the two streams. One option could be to start four year undergraduate programs in sciences, initially in institutes of excellence where facilities for science programs already exist. This would enable pursuing doctoral programs in science and technology, without a Master's degree.

6. Encouraging Research

Several initiatives are necessary to promote research in engineering disciplines:

- Vibrant and well funded Ph.D programs with opportunities for international exposure should be rolled out to attract students who currently go abroad for Ph.Ds.
- The new academic and research institutions being established should be so located that they can optimise mutual collaboration. Likewise, existing academic institutions with active research programs should be supported to set up high-tech industrial research parks in the vicinity of their campuses.
- Universities must become the hub of research once again to capture synergies between teaching and research. This will require changes in resource allocation, reward systems and mindsets.

7. Industry-Academia Interaction

In order to attain greater alignment of engineering education with employment opportunities, frequent dialogue with industry and government through seminars and workshops is necessary. To enhance employability, summer internships should be made an integral part of the curriculum. Restrictive provisions and the elaborate regulatory framework of the Apprenticeship

Act 1961 have inhibited industry from adequately using the apprenticeship scheme for honing the skills of engineering graduates. Clauses need to be incorporated in the Act that will enable training in multiple skills (not just a specific trade) and allow entry to and exit from the scheme at different points in the education and career cycle. Likewise, industry needs to encourage continuing education programs for their employees by collaborating with appropriate educational institutes. Academia and industry should engage in joint research to encourage innovation and competitiveness in the global economy.

8. Improve Access

While the government would need to establish new institutions in the under-provided states, it must be emphasised that the recent proliferation of engineering institutions in the southern states is largely the result of private initiatives. A framework for public-private partnerships should therefore be developed in collaboration with the concerned states to establish new quality institutions.

9. Mentoring

Elite institutions should consider some additional responsibilities such as adopting a few engineering institutions of their choice and helping them raise their standards, creating and making available educational resources in the public domain for use of all students and conducting distance education courses, especially for students at the post-graduate level and working professionals. In particular, the existing IITs could mentor the new ones being established. The latter, in due course, could play a similar role vis-à-vis others. Similarly, National Institutes of Technology and Regional Engineering Colleges could play a mentoring role for selected engineering institutions in their respective regions. Mentoring by its definition is a voluntary activity, but if we can create an atmosphere where institutions of distinction feel a sense of calling in the interest of the larger national good, it would transform our education. The changes and reforms proposed above are necessary to bring about a qualitative transformation in engineering education to meet present and future needs.

Open and Distance Education

November 2, 2007

The National Knowledge Commission (NKC) believes that a radical reform of the system of Open and Distance Education (ODE) is imperative to achieve the objectives of expansion, inclusion and excellence in higher education. The significance is obvious. For one, more than one-fifth of the students enrolled in higher education are in the ODE stream. For another, ODE has an enormous potential to spread higher education opportunities beyond the brick and mortar world. But there are reasons for concern. First, the quality of higher education provided in large segments of ODE, particularly in correspondence courses in universities, leaves much to be desired. Second, it is not sufficiently recognised that ODE provides educational opportunities not only to those who discontinue formal education on account of economic or social compulsions, but also to young school leavers who are simply unable to secure admission in the formal stream at universities. It is time to address these problems. There is a clear need to improve the quality of ODE and to make it more appropriate to the needs of society. It is just as important to expand opportunities in higher education through the use of technology in ODE. It would not be possible to attain a gross enrolment ratio of 15 per cent by 2015 without a massive expansion in ODE. In this endeavour, we must not forget that ODE is seen as inferior to conventional classroom learning. This perception, and the reality, both need change. We must realise that ODE is not simply a mode of educational delivery, but an integrated discipline engaged in the creation of knowledge.

In light of the above, NKC constituted a Working Group composed of distinguished experts in this field, chaired by Prof. Ram Takwale, former Vice-Chancellor, IGNOU. Based on inputs provided by the working group and consultations with stakeholders, NKC recommended the following reforms:

1. Create a national ICT infrastructure for networking ODE institutions

A national Information and Communication Technology (ICT) infrastructure must be set up through government

support for networking all ODE institutions. In this regard, we recommend that the digital broadband Knowledge Network proposed by NKC should have provision for interconnecting the major ODE institutions and their study centres in the first phase itself. Eventually, minimum connectivity of 2 Mbps must be extended to the study centres of all ODE institutions. A national ICT backbone would enhance access and e-governance in ODE, and enable the dissemination of knowledge across all modes, that is, print, audio-visual and Internet based multimedia.

2. Set up a National Education Foundation to develop web-based common open resources

A National Educational Foundation with a one-time infusion of adequate funds must be established to develop a web-based repository of high quality educational resources. Open Educational Resources (OER) must be created online through a collaborative process, pooling in the efforts and expertise of all major institutions of higher education. The OER repository would supply pedagogical software for various programs run through ODE and be available for utilisation by all ODE institutions. An enabling legal framework that would allow unrestricted access without compromising intellectual authorship must be devised for this purpose.

3. Establish a Credit Bank to effect transition to a course credit system

Transition to a course credit system must be carried out to enable the learner to undertake programs across all ODE institutions and disciplines. As a part of this process, an autonomous credit bank must be established for storing and filing credits acquired by every learner. In addition, admission criteria and the system of credits should be as flexible and adaptable as possible. Provisions must be made for multiple entry points and exit points, a flexible time-table and assessment mechanisms for supporting life-long learning.

4. Establish a National Education Testing Service for assessing ODE students

An autonomous National Education Testing Service (NETS) must be established through legislation and invested with functional powers and responsibility for assessing all potential graduates in ODE. This unified examination system would test the learners' ability to perform intellectual and practical tasks. All courses, degrees and activities offered through ODE should be certified through this system.

5. Facilitate convergence with conventional universities

The lack of convergence between programs run by open universities and correspondence courses offered by the distance education wings of conventional educational institutions is a cause of great concern. Rather than function as parallel systems at odds with each other, open universities must forge organisational alignments with conventional universities geared towards common goals and strategies. They must engage each other in the collaborative creation of pedagogical resources via OER and its delivery along shared modes. Programs and courses offered by each should be subject to the same stringent norms of quality assurance. This implies that the distance education departments operating within conventional universities must be encouraged to put correspondence courses through the NETS for purposes of assessment. At the same time, universities must also ensure that their distance education programs are not stand-alone, but should benefit from regular interaction with university departments in concerned disciplines. The aim of such convergence is to eventually enable learners to move freely from one system to the other.

6. Set up a research foundation to support research activity in ODE

An autonomous and well-endowed Research Foundation must be established to commission and facilitate multidimensional and multidisciplinary research in ODE. In addition, a favourable environment for research must be created by setting up infrastructure like libraries, digital databases and online journals, holding regular workshops and seminars, granting sabbatical leave for undertaking research, establishing a peer reviewed journal to provide a platform for

publication for scholars, and other such measures. A robust research environment is essential to accord ODE value as a discipline, as opposed to it being consigned to a 'mode'.

7. Overhaul training programs for educators

Training and orientation programs must be conceptualised to enable educators and administrators to effectively utilise technology to cater to diverse learners' interests. The content of the training modules must promote familiarity with the theories and practices of self-learning. Their delivery should take place through several modes, including web-supported, audio-visual and face-to-face interaction on a regular basis with experts, practitioners and peers. Most importantly, these packages must be updated regularly and administered directly. The B.Ed. curriculum must also be revised, updated and made to emphasise theories and practices of self-learning.

8. Increase access for learners with special needs

Special Education Committees must be set up in all ODE institutions to address the needs of learners with disabilities as well as senior citizens. These committees must devise mechanisms to ensure their participation and provide effective mechanisms for monitoring, evaluation of policies, and collection of feedback. Admission criteria and time tables must be flexible enough to provide diverse options for meeting program requirements to differently able learners and senior citizens. Pedagogical tools and components from the open educational resources must be adaptable to alternative formats for special learning needs. This could include, for example, Braille, colour-contrast texts and voice recordings for the visually disabled.

9. Create a new Standing Committee for the regulation of ODE

At present, the Distance Education Council (DEC) under IGNOU arbitrates standards and disburses funds for ODE institutions across the country. NKC believes that this arrangement cannot provide adequate and appropriate regulation. A new regulatory mechanism must be established by appointing a Standing Committee on Open and Distance Education under the Independent Regulatory Authority for Higher Education (IRAHE) proposed by NKC. This statutory

body would be responsible for developing broad criteria for accreditation as well as laying down standards for quality assurance. It would be accountable to stakeholders at all levels and to IRAHE, and have representation from public, private and social institutions involved in the education and development sectors. These include the central open university, state open universities, private open universities, conventional education institutes, as well as chairpersons of the specialised bodies to be set up to look into infrastructural requirements of ODE.

In addition, two specialised bodies should be established under the aegis of the Standing Committee:

- (i) A Technical Advisory Group with representatives from the IT sector, telecom, space and industry should be constituted to provide guidelines, ensure flexibility and track the latest developments in application. The most important function would be to devise common standards for labelling learning content developed by different agencies in order to support indexing, storage, discovery and retrieval of this content by multiple tools across multiple repositories.
- (ii) An Advisory Group on Pedagogical Content Management should be set up to provide guidelines on curricular content and development of repositories, exchange of material, access to students and other such issues.

The Standing Committee on Open and Distance Education would also serve as the nodal agency for the

National Educational Foundation on open educational resources, the National Education Testing Service (NETS) and the Credit Bank.

10. Develop a system for quality assessment

Reliable external assessment is valued by employers, students and other stakeholders in the given context of a market driven economy. In view of this, a rating system to assess the standard of all institutions imparting ODE must be evolved and made publicly available. The Standing Committee would stipulate grading norms and independent rating agencies would be licensed by IRAHE to carry out this function. In addition, it is recommended that every ODE institution has an internal quality assurance cell to ensure that statutory quality compliances are regularly met.

Establishment of the new organisations proposed above, namely, the National Education Testing Service, the Credit Bank, the National Educational Foundation for developing common open resources, the Technical Advisory Group and the Advisory Group on Pedagogical Content Management would initially require financial support from the government. Additional finances for networking ODE institutions and creating access centres, developing training programs for educators and administrators and providing scholarships and services for needy students would also be required.

Open Educational Resources

November 7, 2007

Our success in the knowledge economy hinges to a large extent on upgrading the quality of, and enhancing the access to, education. One of the most effective ways of achieving this would be to stimulate the development and dissemination of quality Open Access (OA) materials and Open Educational Resources (OER) through broadband Internet connectivity. This would facilitate easy and widespread access to high quality educational resources and drastically improve the teaching paradigm for all our students. As a part of its consultative process, NKC constituted a Working Group of experts, including distinguished members from the academia, government, private sector and users to suggest necessary measures to improve the quality of Open Access in India. NKC consultations with stakeholders helped identify a few key reform proposals which are elaborated as follows:

1. Support the production of quality content by a select set of Indian institutions

A set of key institutions should be selected and experts representing diverse knowledge areas like agriculture, engineering, medicine, arts, humanities, science, education etc. should be asked to develop standards-based content, which can be customised to diverse user needs. This should be made available not only to Indian institutions but also for global use. The efforts made through the project of Ministry of Human Resources Development – National Program on Technology Enhanced Learning (NPTEL) for creation of OER in the areas of Engineering and Technology should be applied in other areas of education also. The content in the repositories should be multimedia, interactive and available in different regional languages. These projects should cover a wide range of subjects mentioned above. To speed up the creation, adaptation, and utilisation of OER, it is necessary to launch a ‘National E-content and Curriculum Initiative’.

2. Leverage global open educational resources

Sustainable development of quality content relevant to India is a difficult and expensive proposition, given the diverse needs of various sectors in our emerging knowledge economy. Emerging international and national initiatives are offering quality educational content as open resources. It is vital for India to leverage these initiatives as they are readily available for adoption and adaptation and to serve as a model for further indigenous content production. NKC found that there are already 200-300 free knowledge repositories available across the world. The National Knowledge Commission is separately disseminating this information through its website.

3. Encourage open access

Open Access material stimulates research and helps students, teachers and researchers across the world. Therefore at the policy level, all research articles published by Indian authors receiving substantial government or public funding must be made available under Open Access and should be archived in the standard OA format at least on his/her website. As a next step, a national academic OA portal should be developed. The government should allocate resources to increase the current digitisation efforts of books and periodicals which are outside copyright protection. Separate funding should be allocated to develop a new high quality OCR software package so that new and old fonts in many different Indian languages can be converted into ISCI/ASCII code and OA portals and servers could be upgraded regularly. Appropriate financial resources should be earmarked for these endeavours. This will also facilitate machine translation of these valuable resources.

4. Develop network-enabled delivery infrastructure

Along with the national initiative for content development, we must develop a network-enabled delivery infrastructure with a focus on two primary areas: access and delivery. For access to the network, high bandwidth connections across institutions and a national backbone that provides advanced networking capabilities are major requirements. Additionally, connectivity to global networks is essential. Delivery of the OER content would be done through distributed repositories of educational resources.

5. Create a faculty and institutional development program

Faculty development and teacher training is the primary area that needs to be addressed in order to realise the benefits of extended access and improved quality through OER. The training program must develop domain competencies and teaching skills using new educational technologies. The training will also help developers of new OER and in contextualising existing educational resources. Centres at specific institutions should be identified so that the faculty of these

institutions will eventually own, modify, and expand OER repositories. These must be integrated into university curricula and organisational structures. The availability of learning management systems and other quizzing, authoring and collaborating tools should be increased. The evaluation system should be based on the use of the content and the pedagogy in OER. To implement and monitor the above recommendations urgently and efficiently, the Government of India may designate a suitable organisation or establish a new institution with necessary mandate to achieve the above objectives. This institute may serve the following functions:

- Provide leadership and coordination of network-based open education resources
- Select institutional collaborations for developing content
- Develop adoption support strategies
- Recommend and monitor standards for content development and adoption
- Advise on policy implications vis-à-vis licensing, intellectual property rights etc.
- Identify and set benchmarks based on global best practices
- Establish relationships with global OA and OER initiatives.

More Talented Students in Maths and Science

May 2, 2008

A strong foundation in the pure sciences is essential to transform India into a knowledge superpower. Unfortunately, as the economy grows, fewer students are opting for the pure sciences. This has led to a talent crunch, seriously impeding the development of the future generation of scientists and teachers. We are aware that this is a worldwide phenomenon, but countries like China and South Korea, having invested prudently in science education, are now beginning to reap rich dividends.

In this context, NKC carried out wide consultations with experts through a series of workshops and interviews. A working group of eminent persons was also constituted to consider all aspects of the problem. Based on these inputs, NKC has formulated a set of recommendations to attract and retain talented students in basic sciences which are summarised in the following paragraphs. NKC has chosen to reiterate some of the proposals which overlap with the views of other expert groups. NKC would like to stress that this matter is extremely urgent and a rapid implementation is now crucial to effect a paradigm change in the field of Science education and research in the country.

1. Invest in upgrading and expanding the existing infrastructure and promote sharing of available resources

University departments and leading undergraduate science colleges should be generously funded to upgrade their staff and facilities. To encourage good departments, 'Centres of excellence' should be identified with comprehensive review and evaluation procedures in place. To create a critical mass of scientists in each science stream **undergraduate seats should be increased in good institutes and undergraduate programs should be introduced at institutes where only post graduate teaching is currently undertaken.** Innovative methods for sharing resources and faculty between institutes and universities need to be evolved. At the same time, university management at all levels should be made

more professional and sensitive towards working in an academic and research environment to promote optimal utilisation of resources.

2. Revitalise the teaching profession to attract and retain quality teachers

The working condition of teachers needs to be drastically improved. Rewards and recognition should be publicised and given at all levels. Teachers at the school and college level should be encouraged to develop innovative teaching methods. Research should be promoted in colleges by building linkages between colleges and research institutions. Academic autonomy and flexibility should be encouraged. Further, a mentoring program for young faculty members should be started in universities and colleges. Many reserved faculty posts remain vacant in the absence of innovative or flexible appointment modes to fill these posts, creating enormous practical difficulties in teaching. **There is a need to start a systematic affirmative campaign to rectify this situation.** Young students who can eventually fill these posts could be selected from an early age and nurtured and trained carefully to induct them into a career in teaching.

3. Revamp teacher training at all levels and promote development of teaching aids to retain student attention in classrooms

A systemic change in science pedagogy from primary and high school levels is required. There is a need to launch a large scale in-service training program for all science teachers based on the initiative undertaken by Science academies. At the undergraduate level, the present method of faculty training conducted by Staff Training Institutes/Centres should be reviewed and revamped. In addition, there is a need to provide a platform for life long skill enhancement of teachers. Teacher organisations like the Indian Association of Physics Teachers should be strengthened and financially

supported so that they can become leaders in developing new teaching methodologies and make significant contributions to content and evaluation reforms.

4. Restructure masters and graduate degrees to promote career flexibility after graduation

To bring graduate degrees in science at par with other professional streams, a four year Bachelor in Science (flexible and modular in nature) is proposed. This degree course should be aptly branded and devised so that it is significantly stronger than the regular three year program. It should enable students aspiring for a research career to directly enter a Ph.D program. For others, it should provide them with measurable value additions like interdisciplinary skills, niche skills required in industry, or rigorous training in science education, science communication etc. To ensure the success and acceptability of such programs, the course content must be planned in consultation with diverse expert groups, and implemented at institutions with a proven track record of success. Simultaneously, the existing B.Sc and M.Sc courses should be reformed. The integrated five year M.Sc program should have the provision to be integrated with the Ph.D program so that the total effective time spent for a Ph.D is reduced.

5. Reform the science curriculum content in line with the changing world and increase research component at all levels

There is an urgent need to reduce information load of curriculum at the higher secondary level. Courses should be made engaging and the amount of hands-on work at all levels should be increased. Books should be written by teachers who teach the subject and not by curriculum committees. Pedagogy should be modified to impart creativity and global vision training. Avenues for research should be increased at all levels.

6. Radical changes are required in the evaluation system to encourage scientific thinking and promote better understanding of basic science concepts

The system should move from examination based evaluation to more open assessment mechanisms. Memory, comprehension and creativity should be given equal importance in evaluations. Continuous

assessment at the school level will reduce dependence on year-end examinations. To enable the modifications in the evaluation process, teachers need to be trained in new methods of evaluation.

7. Promote access to quality science educational material at all levels

There is a need to disseminate high quality science educational material and self learning aids in local languages to assist students from non-English medium education background. **One important factor which has to be kept in mind while translating into local languages is that the technical/scientific terms should be retained in English.** This will make it easier to migrate to English medium teaching in sciences at higher level for the students. Special teaching aids need to be developed for tribal children and children from rural backgrounds to attract them towards science. Tribal schools should be equipped with teachers who are trained in pedagogical methods suited to the special needs of tribal children.

8. Re-brand and promote careers in basic sciences

Existing careers in sciences, namely teaching and research, should be made more attractive. There is a need to increase salaries in this field to reflect the shortage of skilled manpower and to attract students towards a career in science. Science colleges should collaborate with research institutes and industry for campus placements. More modules/courses could be designed which prepare students for employment in industry. The four year bachelor's course offered by quality institutes should dispel the myth that science bachelors are in any way less employable than graduates from other professional streams. Research institutes should collaborate with professional streams to pursue and create more opportunities. New institutes will create a demand for quality science Ph.Ds and these career opportunities need to be publicised.

9. Launch a massive science outreach program aimed at students and their parents

A science popularisation program should be launched to effectively cover children across India. This program should bring all popular science activities under one umbrella for rapid implementation and replication of successful initiatives. A large chain of science talent cells should be created and each school should be

funded to open a science club. The effectiveness of mobile labs in reaching the rural students and teachers is very high. Replication of the Agastya International Foundation's mobile lab program, with possible public private partnership mode for implementation, should be considered for various states.

10. Encourage industry participation in promoting sciences at all levels

As research based industries flourish in India, more and more companies will need employees qualified in basic sciences, thus creating other attractive career opportunities in science. Industry should be encouraged to sponsor students for Masters and Ph.Ds in science and also internships of longer duration in industry for post graduate students. Science undergraduates should

be exposed to various applications of science in industry through seminars and popular science lectures by industry leaders. Academic institutions should develop groups at each institute which specialise in developing novel funding mechanisms involving industry and explore other possible modes of industry participation. India has a long and rich history attesting to the high talents of Indians in science. To bring back the glory that the pure sciences once held in the minds of the students, an urgent restructuring of the entire system is needed. These recommendations are just the beginning of a systemic overhaul process, requiring great support from the government and committed individuals. The crucial ingredient for ensuring success would be an effective, mission-oriented platform for delivery. Therefore, a National Science and Mathematics Mission is proposed.

Note on More Talented Students in Maths and Science

Pure sciences form the bedrock of all applied sciences. Advancement in sciences is a necessary condition for future technological revolutions. While innovative science and scientific discoveries have the potential of enabling a quantum leap in human civilisation, pursuit of sciences promotes a culture of open mindedness and rationality. India has a rich heritage in abstract thinking and has contributed to scientific discoveries since ancient times. As India ventures into the 21st century and seeks to establish itself as a knowledge superpower, it is essential that a strong foundation in science is firmly in place. This will help the nation in building excellence in technology, achieving self-reliance and in propelling economic growth and prosperity, consequently raising the living standards of all its citizens. Yet, as the economy progresses, it has become increasingly difficult to ensure a sustained input of fresh young scientists and educationists into the system. This situation has become particularly alarming in the pure sciences. Since developing competence in the basic sciences has a long incubation time, it is important that this problem be addressed with alacrity. Science and Mathematics are living subjects which grow rapidly and give rise to new areas which build on other existing areas. Therefore, they need a constant input of fresh and young talent. It is worthwhile to note that developing countries like China and South Korea have invested massively in science education in the past few decades and are reaping enormous benefits today in terms of economic development and global standing in science.

The Prime Minister has repeatedly stressed the importance of making Science a preferred discipline of study for students and has also pointed out the need for both a qualitative and quantitative expansion in the pool of science students. The strategy for the promotion of science education in the 11th Plan aims at (a) expanding and strengthening the Science & Technology base in our universities, and (b) promoting excellence

through competitively secured funding at centres for advanced research.

In this context, NKC conducted workshops and expert interviews to analyse the issue and recommend steps to attract and retain talented students in basic sciences. A working group of eminent members representing universities, science colleges, research institutes, industry and NGOs was constituted to look into the ideas in greater detail, and this Note is a result of these deliberations. Broadly, the recommendations can be summarised as *better infrastructure and pedagogy, curricular and structural reforms, improved access, re-branding of science careers, massive outreach and greater industry participation*. We are glad to note that some recent UGC initiatives are in line with a few of these recommendations. We are aware that while some of the proposals below are new, various expert groups¹ have previously made proposals which overlap in spirit and content with the others. They are reiterated here because it is felt that these proposals need fast-track implementation for effecting a change in Science Education which is critical and urgent.

Resources

Recommendation 1: Invest in upgrading and expanding the existing infrastructure and promote sharing of available resources

Science is a capital intensive subject and its pursuit requires good infrastructure, adequate resources and regular maintenance of the same. Further, better infrastructure will play a vital role in attracting students towards sciences.

Issues: The condition of basic infrastructure in most science colleges and universities remain largely unattractive and uninspiring to today's high school student who has an array of other attractive options

¹ Higher Education in Science and Research & Development: The Challenges And The Road Ahead, INSA and IAS, 2006; Attracting Young People to Careers in Science, Office of PSA, 2005; Report on University Science Education, IAS, 1994

while choosing his/ her career. Basic infrastructure like classrooms and buildings and essential laboratory equipment deteriorate due to lack of proper maintenance. This creates a grim atmosphere for students and teachers who are interested in pursuing pure sciences.

1.1 Basic infrastructure: The number of seats presently available in good institutes for bachelors or integrated masters in science is limited. There is a need to expand seats at entry level in science disciplines to create a critical mass of scientists in each stream. Substantial expansion of capacity of bachelor's program in all good institutes is required. The starting of IISERs is a step in the right direction and it is crucial that they succeed in setting an example. Care should be taken that while excellence is cultivated in them, it should not lead to their isolation.

A continuum of institutes in quality is needed. While there are IISERs on one end, and government science colleges on the other end, there is a need to start undergraduate courses at universities and other places which currently offer only post graduate education in sciences to complete the continuum of institutes for students with varying abilities. Select universities can offer Bachelor's honours (four year course – detailed later) with an option to directly move to Ph.D program after successful completion of honours.

Independent but standardised accreditation of science departments and regular evaluation of accredited institutions is necessary. Accreditation agencies should be sufficiently supported to carry out regular evaluations. This rating information will help students to take informed decisions when they choose their place of study. This will also serve to direct public funding where it is most optimally utilised.

University departments should be generously funded and upgraded with staff and facilities. To begin with, a few departments could be identified, a plan prepared for their conversion to centres of excellence and then continual monitoring of the progress could be undertaken. This task can be accomplished by either UGC or directly by MHRD. Leading undergraduate science colleges should be chosen to provide them with additional assistance and turn them into centres of excellence. Clusters of undergraduate colleges should make a *centralised request* through university for comprehensive funding.

UGC has a provision to provide grants to the universities for providing financial support to the faculty for travel or to organise seminars. This should

be extended to colleges with a proven track record. In fact, a comprehensive funding mechanism needs to be in place which will cover capital as well as maintenance expenses, work related field trips for students, support to publish articles etc.

1.2 Sharing resources: Many valuable facilities are not optimally shared among research institutes, laboratories and universities. The funding agencies should promote the formation of centres for shared instrumentation, by facilitating a consortium approach. Full-fledged laboratories within the campuses of our universities and other educational institutions can be set up. Greater collaboration should be promoted between research institutes and universities through appropriate incentives. Further, colleges which do not have adequate infrastructure should form clusters with nearby colleges and institutes to share laboratory resources, especially expensive equipment.

1.3 Scholarships: The number of direct scholarships to meritorious students like KVPY (Kishore Vigyanik Protsahan Yojana) should be increased to cover a larger student population. To enlarge the pool of scientific manpower and foster research in the sciences, the Government of India has announced a program entitled "Innovation in Science Pursuit for Inspired Research" (INSPIRE). The INSPIRE program should be launched as soon as possible.

1.4 Autonomy and flexibility: *"A university is about learning that moulds a lifetime, learning that transmits the heritage of the millennia, learning that shapes the future."* While efficient university administration should facilitate this, bureaucratic stranglehold and political interference vitiates the academic environment, creating a war of nerves between academicians and the administrators. Universities have to be financially accountable to the government, but the academic matters should be under the sole purview of the university bodies. At present, even academic matters like starting new innovative courses have to be approved by the state governments. These proposals do not see the light of the day even after several years. Academic autonomy is essential to contemporise syllabus and make it more relevant. The administration at all levels should be made transparent, professional and sensitised towards working in an academic and research environment.

To facilitate teaching in universities by research scientists, supporting infrastructure should be created in universities for visiting professors. Further, *University*

and research institute faculty members should be given the flexibility of taking sabbaticals for teaching in colleges, doing work in educational field and for popularising science among children, teachers and communities in rural and urban areas. Appropriate checks and balances can be put in place to ensure that the organisations where the faculty members choose to work are indeed benefiting from their participation.

There is a horde of grant disbursing government departments and organisations. Researchers seeking funds for their projects have to manoeuvre across all these administrative hassles to get funds. A web portal which brings all relevant funding information together should be launched. Administrative problems and delays created by funding agencies should be done away with. Competitive process for grants should be established. Principles of e-governance should be incorporated to promote transparency in the system.

Recommendation 2: Revitalise the teaching profession to attract and retain quality teachers

The working conditions for science teachers at all levels should be improved. Massive efforts are needed not only to make teaching an attractive profession for young science trained professionals, but also to revive the desire to teach and inspire students in existing teachers.

Issues: The base salary of teachers is low. Further, reward and recognition mechanisms do not exist. Basic infrastructure is inadequate and poorly maintained. In addition, systematic politicisation of universities has contributed to the deteriorating environment. Overall, the morale of the teachers is severely affected. Teaching is taken up by uninspired practitioners who do not communicate the passion for doing science. Shortage of teachers in colleges results in additional burden of teaching load leaving little room for innovation in teaching. The practice of contractual teaching without appropriate remuneration has created its own problems. Access to good libraries, teaching aids etc. is not available. College teachers do not get exposure to newest developments in their fields. Academic freedom and flexibility is lacking in the present rigid system.

2.1 Rewards and recognition: The teaching profession has been severely undermined in recent years and the working conditions of teachers needs to be drastically improved. It is essential that teachers are given due recognition for their contribution to society. Salaries

need to be hiked across the board. Rewards should be instituted for good teaching based on student feedback in colleges. The rewards should be given at all levels and should be organised with sufficient publicity. Innovation in teaching should be encouraged through appropriate incentives. The practice of instituting chairs like National Professors should be extended to school and college teachers too.

2.2 Professional development: School teachers should be provided with avenues to discuss new pedagogical developments. For instance, they should be encouraged to do projects in laboratories in colleges during vacation time. Colleges can be given separate funds to run such programs. School teachers should be sufficiently incentivised to develop new experiments and activities to be used at school level.

Teaching load in colleges should be lightened to provide scope for professional development. There should be a provision of research facilities in all colleges or a system wherein interested college teachers can avail of nearby research facilities. Access to journals and internet based learning must be provided. New faculty members should be given lighter teaching load and a start up grant for research. This will enable them to establish themselves in their chosen research area. There is a need to increase academic freedom at all levels. *Academic autonomy is important in retaining teachers. Teachers should be encouraged and empowered to try new pedagogical tools.* Flexibility is important to contemporise classroom learning and make it more engaging.

2.3 Mentoring: A mentoring program for young faculty members should be started in universities and colleges. Experienced faculty members can mentor junior members on issues related to starting new research projects, grant application writing etc. They can share tips on different aspects of classroom teaching, like syllabus planning, managing the classes etc. Peer evaluation of teaching and exchange of ideas on pedagogy should be encouraged.

Many reserved faculty posts remain vacant in the absence of innovative or flexible appointment modes to fill these posts. This leads to excess strain and teaching load on the existing teachers. In addition, this has contributed to the gradual decay and death of many departments of pure sciences in colleges and universities around the country, which were once famous for their science teaching. *There is a need to start a systematic affirmative campaign to rectify this situation.* Young students who can eventually fill these posts should be selected from an

early age and nurtured carefully to induct them into a career in teaching. Special mentor programs with highly individualised attention should be an in-built part of this program.

Recommendation 3: Revamp teacher training at all levels and promote development of teaching aids to retain student attention in classrooms

A systemic change in science pedagogy from primary and high school levels is required. Teaching should be made more inquiry based. It should raise curiosity, convey the excitement of science and enable understanding of nature through experiments.

Issues: Unimaginative science teaching has promoted rote learning, thereby dousing the very spirit of enquiry that a study of science should nurture in young minds. Teaching is accompanied by a limited number of demonstrations and activities. Science is projected as an abstract difficult subject to its young practitioners. There is no effort on the part of the system to engage students in the process of scientific enquiry. Emphasis is not laid on thorough understanding of fundamental concepts. Instead, students are overloaded with more and more information. This is also encouraged by the current evaluation system and various competitive examination bodies.

3.1 Teacher training: To help teachers keep pace with recent advances in their subjects and new pedagogic tools, there is a need to launch large scale in-service training program for all science teachers. Training teachers is necessary because at the middle school level, they are expected to teach general science courses though they might have received training in only one of the disciplines. The delivery medium should be classroom based, supported by materials based on ICT. Video-conferencing sessions can be very useful. Science academies have launched such a training program, and this can serve as a model for other institutes. The in-service training program for teachers needs to be revamped. The frequency of training should be increased. Teacher training institutes should be measured on their performance based on outcomes. Every training school can be linked to nearby schools for this purpose. The performance of students can be taken as a substitute for measuring the performance of teachers associated with the training school. Apart from fundamental concepts, inquisitiveness, creativity, problem solving and research orientation should be

included in teaching. At the undergraduate level, the present method of faculty training conducted by Staff Training Institutes/Centres should be reviewed and the training system with lectures alone should be done away with. There is a need to revamp the Refresher and Orientation courses conducted under the guidance of UGC. The need is to provide a platform for life long skill enhancement of teachers.

Dedicated training centres can be established at research institutes/universities for advanced level courses. A database of good teachers should be created so that they can be tapped for discussion forums, video-conferencing sessions and for live interactions with trainees. Lectures of good teachers should be recorded and made available in CDs or on internet for easy accessibility. Web enabled discussion forums should be promoted. Teachers should be connected with one another so that in time, teacher organisations can become leaders in developing new teaching methodologies and make significant contributions to content and evaluation reforms. *Well established associations like Indian Association of Physics Teachers and others like the nascent Indian Association of Teachers in Biological Sciences should be strengthened by appropriate financial and other support.*

3.2 Teaching aids: With the advent of new technology, there is a need to develop better teaching aids to make classrooms livelier. There is an array of open source material and ICT aided tools, which can make classroom transactions in math and science more engaging and participatory. At present, it is felt that neither the teachers nor students are fully familiar with these resources. Multimedia should be appropriately used, and easily replicable hands on activities to demonstrate scientific concepts should be made part of regular teaching. The Hoshangabad Science Teaching Program should be emulated by the training schools to enable teachers to use these concepts in their own schools. Virtual laboratories program should be encouraged and scaled up so that schools which are in a position to benefit from such experiments have the opportunity to do so.

3.3 Some external measures to raise quality of science teaching.

- Good teachers can offer common courses in an institute cluster. This will enable access to good teaching for a large number of students and provide them with an option of host of electives.
- Bright young faculty should be attracted with high salaries. This will inject much needed fresh blood in our universities.

- Researchers in India and alumni in research institutes abroad should be encouraged to teach. They are best positioned to convey the excitement of science.
- Schemes that permit utilisation of the skills of talented teachers and scientists, who have reached formal retirement age, will be an important step in maintaining standards in many disciplines, which have been hard hit by declining recruitments over the years.
- Universities should be given financial support to attract good teachers and researchers from institutes in India or abroad (for periods ranging from one semester to an academic year or so) to help introduce teaching in new fields.

II. Science education in schools and colleges

Recommendation 4: Restructure masters and graduate degrees to promote career flexibility after graduation

Structural reforms in courses are needed to streamline available options and present students with multiple options. Preferences of students who intend to pursue a career in research will be different from those who want to work in industry immediately after graduation. Many students may want to pursue a more generalised science course while others may prefer a highly specialised course focused on a particular stream. Issues: The present courses of study available at various colleges and universities involve repetition at each level. This affects students' interest adversely. There is a need to integrate course curriculum from senior secondary level to master level in sciences. Most of the B.Sc courses in the country fail to provide a wider conceptual base in diverse disciplines of Science and thus severely limit "inter-disciplinary" capability of the graduating students. In the absence of extensive laboratory work, the graduates do not know how to actually do an experiment and without any self undertaken exploratory experimental work, they also fail to learn how to ask new questions for research.

4.1 To bring a graduate degree in science at par with other streams, a four year Bachelors in Science course is proposed. This degree course should be aptly branded so that it gains more significance than the regular three year program. To ensure the success and acceptability of this program, the course content must be planned in consultation with diverse expert groups, and

implemented at institutions with a proven track record of success. The first two years of this course would be common for all students. The students may choose their streams based on interest and performance after two years. If the course is offered in an institute/university where engineering courses are also offered there can be a provision of flexibility to move from B.Sc to B.Tech. Further, a student could also choose to take a 4 year integrated B.Sc plus B.Ed. course in colleges where such a facility is available. *A four year B.Sc + B. Ed. Program* is a more effective training program than the current practice of B.Ed. after completing B.Sc. Funding of this program should be given special attention. Universities/ Science colleges must be encouraged to run such programs. If the student does not opt for B.Ed. then s/he can either do a research project in final year or take up employment friendly modules like clinical research, statistics etc.

The exact duration of the course need not be fixed but should be based on credits. Thus, if a bright student completes the requirement of all necessary credits a semester before, s/he could do additional advanced courses in the remaining period. Also if the place s/he is studying offers M.Sc and Ph.D, there should be flexibility to start earning credits for the master's courses such that the total effective time spent in B.Sc + M.Sc is reduced, and the student can directly opt for Ph.D at the end of the course. The government should encourage universities and IITs/IISERs/ research institutes to start a broad based undergraduate degree program in science. Based on the course credits students acquire, the degree can be aptly named like Bachelor in Mathematics and Computer Science, Bachelor in Chemistry and Biology etc. Highly specialised courses like Biotechnology or Bioinformatics at undergraduate level should be avoided. Instead the emphasis should be on broad based knowledge of various science streams.

4.2 The 3 year regular B.Sc course should be reformed. In the first year, the program should include courses in all major disciplines of science, so that all students learn the basics of "physical", "life" and "earth" sciences. These courses should advance the student's understanding beyond the +2 level where the focus is more on information due to limited evaluation methodology. "Deficiency" courses may need to be planned for those who have not studied Mathematics or Biology at the +2 level. In the second year, a student may select three main subjects; however, about 15-20 per cent of credits should be earned through courses from other streams (e.g. a student of "Physics/Maths" stream may take

some courses in Biological/Earth sciences and vice-versa. In the final year, the student may select one subject (Major subject) out of the three studied in the second year. Again, 15-20 per cent credits should be obtained through courses in other streams. These should also include courses designed to improve “skills” like computer programming, statistics, instrumentation (optical/electronic) etc.

All science courses must include 30 to 40 per cent credits in laboratory and field work (where applicable as in Earth sciences and some areas in Biological sciences) and the laboratory exercises should be planned in such a manner that students have opportunities for “hands on” training, and a certain proportion of practicals should be “open-ended” so that students can learn to be innovative/exploratory. The “open-ended” exercises may also be in form of “projects”, which should include, besides the actual study, preparation of a formal report. Care must be exercised to ensure that the practicals do not become “rituals” or “demonstrations”, and project reports do not get replicated from one batch to the next.

It is also desirable that language courses are introduced, at least from the viewpoint of presentation of data etc. in scientific reports/papers. In addition, the students should also be encouraged to take some extra credits in courses in other faculties, like Arts, Social Sciences etc. to develop a more integrative personality. To encourage communication skills, each student should be required to give at least one seminar on a current topic in the final year of B.Sc.

4.3 The integrated M.Sc offered by many institutes should be made more flexible. The program should offer more elective choices for students. The program should be restructured so that the students have the option to pursue a part of their training outside the mother institute. This is being followed successfully in institutes like BITS Pilani. Further, a student should have the flexibility to major in a science stream and obtain a minor in engineering or technology or another science stream. The program should have the provision to be integrated with the Ph.D program offered by the institute so that the effective time spent in B.Sc + M.Sc + Ph.D reduces. Also the integrated M.Sc should have a provision of exit for a student after 3 years with a B.Sc degree. As an integrated M.Sc course by its very nature will have a major interdisciplinary component, it should be run in institutes or universities which have the infrastructure to provide such flexibility. Students should have the option to study a wide variety of subjects

before choosing their thesis topic. A cluster of institutes in the same locality can come together to present and offer such a bouquet of courses.

4.4 Premier engineering institutes should be encouraged to offer a combined master’s degree in technology and sciences to lure some students to sciences. Flexibility to change streams from engineering and medicine to sciences and vice versa should be built in. Masters and doctorates in pure sciences should be open to graduate engineering and medicine students. Remedial courses can be run by premier institutes to bridge the gap in the knowledge of professional degree students. The BITS, Pilani model is worth studying in this context. Frequent interactions with students of engineering and medical streams are important to expose and enable students to contribute to interdisciplinary research. Interactions can be planned in the form of research projects, student seminars and conferences on recent advances in each discipline where participation is open to all.

Recommendation 5: Reform the science curriculum content in line with the changing world and increase research component at all levels

There is a need to change the balance of content in favour of hands-on activities and research at all levels. Increase in experimental learning will increase student interest in science. Content development activities also need to be altered to cater to all segments of student population.

Issues: Firstly, the curriculum load at school level has significantly impacted the understanding of fundamental concepts. Inflexibilities in the course curriculum, lack of application oriented content and poorly designed laboratory courses have made sciences unattractive. Secondly, emerging technology has reshaped and continues to reshape every discipline rapidly. Competitive advantage will rest with those who have life-long self learning skills and humanistic grounding and not with those stuffed with most information. Globalisation demands individuals who can cope with exploding and challenging landscapes of the future world. There is a need to modify the current education system to adapt to changing needs of society.

5.1 Reduction of load: *There is an urgent need to reduce information load of curriculum at higher secondary level. Courses should be made engaging and not very heavy. Fundamentals should be emphasised by providing*

more background and application related problems on each concept.

5.2 Content reforms: *The amount of hands-on work at all levels should be increased.* To make sciences interesting, local environment can be made a part of learning. Students can apply principles of science to solve local problems. This can be coordinated with local science bodies. Group activities, hands-on training, student seminars, project camps in summers should be encouraged at all levels. Laboratory courses should follow a continuum. To aid learning by inquiry, more exploratory methods must be incorporated into the curriculum. A larger number of experiments, kits and multi media teaching aids should be created using, as far as possible, locally available materials with accompanying do-it-yourself books. Most textbooks at school level do not describe the details of experiments and teachers are often not sure how to do the experiments or why their experiments fail – it should be ensured that practical manuals explaining details should be made available. Details about where the requirements /kit items can be available and expected cost should be provided. Students should be encouraged to experiment in a creative, unfettered fashion. This calls for changes in the curriculum, teaching and attitude of school administrators (not viewing labs or instruments or chemicals as prized possessions etc).

Books should be written by teachers who teach the subject and not by curriculum committees. A culture of writing books needs to be developed. Mass collaboration for content development should be encouraged. The government should promote Indian edition of latest books in science.

To be ready for the ever changing scientific world, we should develop and impart creativity training that is the ability to synthesise conceptually. Pedagogy should be modified to entail such training. To empower students to face future challenges imposed by globalisation, global vision training should be imparted to students. Student exchange programs should be increased as international students bring fresh perspective crucial for turning out global citizens.

5.3 Increasing avenues for research: As students advance in their studies, whether undergraduate or graduate, they should be frequently exposed to people who are immersed in solving serious problems in global change, energy and environment, pharmaceuticals, biology and biotechnology, finance, cryptography, and communication — again without dilution of standards.

At the undergrad level, this can be done through popular science lectures. Research institutes and universities should collaborate to launch attractive programs for students. These *specialised courses* will help in channelling student interest towards sciences. Scientists should be incentivised for teaching. If the research institutes have adequate teaching infrastructure, some of them can run six months residential courses at their premises and offer research training in the final semester to post graduate students.

Undergraduate summer fellowships should be popularised and increased in number. The fellowship program currently run by science academies and other research institutes should be integrated and popularised so that students have uniform access to information and opportunity to do a project at a premier institute.

A “University Innovation Fund” can be constituted to promote projects by college/ university researchers showing potential for innovation. The funding system should be intensively peer reviewed. These innovative grants should be closely monitored in terms of performance with a provision for early termination if milestones are not achieved. On the same lines, the *College Science Improvement Program* can be promoted. Teachers should come together to design and fabricate new lab experiments.

Recommendation 6: Radical changes are required in the evaluation system to encourage scientific thinking and promote better understanding of basic science concepts

Issues: The present evaluation system tests memory instead of comprehension. It does not promote creative thinking or problem solving. The selection processes discount originality in thought, innovative ability and passion for hands-on science. These elements are far more important for a career in research. The fun of studying science has been forgotten in the current competitive scenario where science students are focussed at solving problems which appear in various entrance examinations in the shortest possible time.

6.1 Alternative evaluation methodologies: *The system should move from examination based evaluation to more open assessment mechanisms. Memory, comprehension and creativity should be given equal importance in evaluations.* More weightage should be given to round the year hands-on activities and laboratory work. Continuous assessment at school level will reduce

dependence on year end examinations. If we could develop a system where a holistic record of student performance from school to college is maintained, then this can be used as an alternative or additional input to entrance examinations for entry into various institutes after higher secondary level.

At the college level, introduction of semester system will reduce the anxiety related to year end examinations. Internal assessment should be increased and given more weight. Internal assessment should focus on experimental projects which will create demand for laboratories. This in-turn will lead to demand for better laboratory facilities and consequently improved infrastructure in all colleges. Other measures which will encourage students to go beyond rote learning are open ended examinations which test comprehension rather than memory and open book examinations focusing on problem solving and critical thinking. Group testing and field-work based testing should be used extensively.

6.2 Enablers: To enable the modifications of evaluation process, teachers need to be trained in new methods of evaluation. Academic calendar should be strictly adhered to. There is a need to increase the teacher to student ratio to ensure better interaction and assessment. A ratio of 1:40 should be targeted. One can look at a unified National Level testing at mid school level and after school completion to reduce load of competitive exams on students. Another important application of such testing could be to bring forth areas where teachers need to be trained.

Recommendation 7: Promote access to quality science educational material at all levels

To attract more talented students to Maths and Science, it is essential to ensure access to quality science education to all students. There is a need to disseminate high quality educational material in local languages to assist students from non English medium education background. Educational materials should be provided to all at subsidised rates.

Issues: The quality of education in sciences across the country varies widely. Many meritorious students have no access to quality education. There is a large section of student population which receives school education in local languages. These students do wonderfully well in the sciences till graduate level where the medium of instruction remains vernacular. But at post graduate and higher levels because of the monopoly of English language

in science education, they face serious problems. They have to put a lot more effort to understand concepts in the English language at a higher level; often making it difficult to cope with the course work.

7.1 Study material: The current study material available at bachelor's and post graduate courses in science is limited and does not promote or enable self learning for students. Self learning aids will increase access to quality education and hence should be promoted. Internationally available courses in different streams can be adapted for local use. Incentives for people to create such material in academia should be provided so that people are encouraged to take up such work willingly. Further, lectures of teachers reputed for their teaching should be recorded and disseminated all over the country, enabling students and teachers to have access to quality education material.

7.2 Translation: Language should not act as a barrier in science teaching. To bring such students to level playing ground, apart from English language lessons, there is a need to arrange speedy and widespread dissemination of basic science education materials in local languages. These courses should be designed to facilitate understanding of fundamental concepts in the local languages and also provide a bridge towards subsequent studies in the English language. Resources should be provided to translate the best science books in local languages. Internet dissemination of these translated books should be carried out. To aid conceptual understanding, science lectures in local languages can be prepared by good science teachers capable of doing so. These lectures can be recorded and distributed to libraries of all science teaching colleges and universities and made freely available on the internet. As there is an urgent need for this task to be carried, it is important that the right agencies and people be identified and networked to carry out this work in an organised and comprehensive manner. *One important factor which has to be kept in mind while translating into local languages is that the technical terms/ scientific terms should be kept in English.* This will make it easier to migrate to English medium teaching in sciences at higher level for students.

7.3 Special needs of Tribal children: Early childhood education is very important as the brain develops the fastest up till six years of age. In this context, special teaching aids need to be developed for tribal children as they are not exposed to modern technology like rest of the children. Motivation for learning has to be created

by providing exposure to scientific developments. Tribal schools should be equipped with teachers who are trained in pedagogical methods suited to special needs of tribal kids. They should be well versed in local tribal dialect. Science subjects should be taught in local language till mid-school level. However, the teacher should explain fundamental concepts in tribal dialect to ensure sound conceptual understanding. Tribal dialect can be used for evaluation purposes too at lower levels. Nutritional requirements of tribal children should be taken care off. Migration is a major problem which hinders education of tribal children. Hostel facilities should be provided for older students to ensure continuity in learning.

III. Career Opportunities, Outreach and Industry Participation

Recommendation 8: Re-brand and promote careers in basic sciences

The prime reason that students opt for professional courses is the perception that there are no attractive career opportunities in sciences. There is an urgent need on the part of all science teaching colleges, universities and institutes to better brand the careers in science and to spread awareness of increasing career opportunities in basic sciences.

Issues: Financial unattractiveness at all levels is a major reason for the downfall of interest in science. The two main occupations associated with pure sciences are teaching and research. Both careers no longer carry the respect and recognition in society as they used to. The financial attractiveness of jobs in other streams pulls students away from sciences. Parental and peer pressure de-motivates even interested students.

8.1 Current careers: Existing careers in sciences, namely teaching and research, should be made more attractive by providing better emoluments, security of tenure, academic freedom and facilities. Joint appointments within the country and appointment of eminent scientists in such areas from other countries under long term visiting professorships should be looked into. Ph.Ds need to be restructured to ensure better stipends for longer duration and secured post docs. It is vital that all such recommendations of appointments and salary structures have a visible component of accountability in their implementation.

8.2 Some other suggestions to attract students to careers in sciences:

- Information about job opportunities for individuals with a master or doctorate qualification in pure sciences should be made available on a portal. New opportunities in emerging fields like financial mathematics etc. should be appropriately marketed. Companies working in these fields should be invited to deliver talks in science colleges.
- Science colleges should collaborate with research institutes and industry for campus placements. Career cells need to be established. Close interaction with industry and research institutes is needed to project type, expertise level and amount of manpower.
- Additional training at bachelor's level has already been suggested for increased employability. More modules/ courses could be designed which prepare students for employment in industry. Students should have the choice to take such courses while pursuing bachelors. The 4 year bachelor's course offered by good institutes will dispel the myth that science bachelors are in any way less employable than graduates from other professional streams. The ability of life long learning should be instilled in students. This should be marketed well to attract companies to employ science background students.
- New opportunities in science streams need to be developed. Research institutes should collaborate with professional streams to pursue and create more opportunities. Research in emerging areas should be systematically developed. Research activities in research laboratories and universities needs to be massively increased. Government should provide all possible incentives to encourage research and development in every sector of the economy.
- Large research groups should be developed. These groups should focus on taking an idea from basic research to market ready application. Such groups can be partially funded by industry. These groups should look at problems which affect a large section of society and devise plan to come up with solutions. Young researchers should be recruited in such initiatives. These research groups should be headed by a well known scientist who is capable of attracting young doctorates.
- New institutes will create a demand for Ph.Ds. A study on shortage of skilled manpower in science should be commissioned by DST. There is a need to increase salaries in this field to reflect the shortage of skilled manpower. More students will be attracted to pursue basic sciences if they realise that the rewards in scientific profession are not controlled by fixed pay scales but show an upward trend as a reflection of the scarcity of talent in the field.

8.3 Trained technicians: Shortage of trained technicians for science laboratories has resulted in poor maintenance of laboratories across universities, colleges and institutes. Appropriate vocational courses may be designed and introduced in areas that can provide direct employment. This may require a good analysis of local industrial and other requirements. Some general examples are: i) Bio-Medical Laboratory Techniques; ii) Bioinformatics; iii) Computer Applications; iv) Laboratory Techniques (for Physics/Chemistry labs) etc. These courses need to be so designed that the students may be ready for gainful employment. These courses can also be offered to students who are still pursuing their B.Sc as additional courses.

8.4 Mentoring program: A structured program for mentoring students in science should be introduced. It was felt that the students in lower classes in different schools across the country are intimidated by their science and math teachers because of the teacher's attitude towards the students or the teacher's gap in knowledge. As a result, students feel inhibited in asking questions. This in turn, leads to the development of a complex, which is detrimental for academic progress. On the other hand, if good students of higher classes, at least 4 years older, come forward to assist the younger students, the latter would benefit by peer learning as this is associated with a with a sense of ease and freedom. The Young Instructors program of Agastya International Foundation is a model which could be replicated in this context at all levels. This program will instill confidence in senior students and lead to their holistic development too.

The program can be started at first in schools where a few hours every week are kept aside for close contacts like informal tutorials between groups of seniors and juniors. Such a tutorial program should be expanded later to cover students' questions on careers. School teachers can be trained to act as career counselors. Students' doubts regarding uncertainty in pursuing a career in science should be effectively dealt with.

Recommendation 9: Launch a massive science outreach program aimed at students and their parents in particular.

The declining interest in sciences is a wider phenomenon and needs to be addressed comprehensively. Large scale science popularisation programs are needed to reestablish the passion that science once generated. The objectives of science programs should include:

- To spark curiosity and imbibe scientific way of thinking

- To spread awareness about latest discoveries and their impact on society
- To discuss issues related to adverse effects of scientific developments
- To promote science as a medium of socio-economic development
- To glorify careers in science - The media, parents and students should be sensitised to the various career options and job situations available to students coming out of science streams. This would encourage more students to science and reverse the alarming trend of lack of interest in basic sciences.

9.1 A large science popularisation program: A science popularisation program should be launched to cover 250 + million children effectively across India. This program should include all the objectives mentioned above. Apart from money, it will require committed people with vision and capacity towards execution. The importance of this program necessitates consideration of out-of-the box organisation and service delivery alternatives. This program should bring all popular science activities under one umbrella for effective implementation and replication of successful initiatives.

9.2 Science cells, centres and mobile labs: A large chain of science talent cells should be created. Each school should be funded to open a science club. A network of good teachers, laboratory facilities and reading resources connecting like – minded students in every town/city is needed. The school science clubs can be then networked to the local centres of science. The local science centres should have experimental models to demonstrate basic science concepts. The centres would be equipped with personnel to explain and answer questions of students. Provision should be made to facilitate visits to this science centre by connected science cells. The Centre would act as an “anchor” for the rest of the state's science activities and mobile lab programs, which would be dispersed across rural taluks. In general, the various state governments should facilitate building of more engaging and interactive science parks and museums for learning science outdoors.

To tap talent from rural India, special efforts needed. Science programs for rural children should be started – book grants, computer grants etc. can be given apart from direct scholarship. *The effectiveness of mobile science labs in reaching rural students is very high and the program should be replicated across India.* The Agastya International Foundation's mobile lab program should be studied in this regard. A suitable public private

partnership mode can be worked out where a company can sponsor the capital cost of the mobile labs in return for some minimal publicity like logo etc. on the van. The Government under its Sarva Shiksha Abhiyan can sponsor the operating costs of mobile labs to reach rural schools. Such a model is running successfully in many districts of Karnataka. Apart from mobile science labs like in vans, such labs can also be put in coaches of passenger trains run in the interior regions of the country by Indian Railways and in buses of State Transport Corporations.

Mobile science libraries similar to mobile science laboratories can also be promoted. These should have child friendly volumes on interesting topics including science fiction. Alternatively, children's/public libraries should be opened all over the country by the government. These could lend out books to schools and other registered institutions in bulk, say 100 or more books at a time for, say a month – this could be useful since expecting each school to be able to identify and purchase suitable books is unreasonable. Good books could be identified for each state and purchased in bulk for/by the public libraries.

9.3 Local science programs: While we need to build a very strong machinery to promote sciences, science research institutes, science academies and local science organisations and scientists (role models) in their individual capacity should participate in this task of nation building. Science should be used as a means to engage students in a variety of extra curricular activities. Science exhibitions, science competitions and popular science lectures can be organised by local science organisations/ teachers' association/ group of schools to promote application of what students learn in their environment. Different ventures to encourage and popularise science, such as mobile vans, science centres, interactive exhibits, workshops and activity centres for children should be supported financially.

Journals and popular science magazines can play an important role in spreading the scientific temper among citizens must be more aggressively encouraged, especially among college going students. The country needs many more child friendly science magazines, especially in local languages. TV programs like 'Turning Point' and 'Quest' that were hugely popular and provided a platform (turning point) for asking 'scientific questions' for children and adults alike should be promoted.

Science programs focused at non-metro students should be launched. Local languages should be used in science

dissemination. Scientists should communicate more to masses through the media. A national science portal, promoting science contests etc. can be created. The Government can mandate outreach programs as part of grant applications.

The Children Science Congress organised by the Department of Science and Technology is a laudable effort. Its scale should be expanded and more schools should be included. Information should be made available, and should be readily accessible at all high schools and junior colleges about careers in Science, and this should be publicised among the teachers at these levels. Programs like Vigyan Manthan Yatra of the Madhya Pradesh Government, Science centre proposed by Assam Government, Science city concept of Tamil Nadu and Gujarat Government etc. are also good efforts and should be replicated across India wherever possible.

Recommendation 10: Encourage industry participation in promoting sciences at all levels

Industry participation is important in making sciences popular. As research based industries flourish in India, more and more companies will need employees qualified in basic sciences. This will visibly provide more attractive career options.

Issues: The current industry participation in science education is very low. It needs to be increased manifold. Companies need to realise that their investment in science education is a long term investment for their own benefit.

10.1 Select companies, which employ research scientists, can come forward to offer jobs to Ph.D students post completion of their doctoral degree. Ideally this commitment should be made at the time when a prospective Ph.D student is deciding about joining the degree program. Some industries are already doing this in Computer Science. Industry can sponsor Ph.Ds for students after setting some certain minimum criteria or it can hire students at master's level and provide scholarships to pursue Ph.D in chosen fields.

10.2 Industry internships of longer duration for post graduate students should be encouraged for students who intend to pursue a career in industry. This will enable them to learn work place skills as well as expose them to latest technologies and research methodologies. Industry should also devise methods to optimally utilise the student's stay in their workplace.

10.3 At bachelor's level, employable skills like computer training, communication skills etc. should be included in the curriculum. Undergraduates should be exposed to industry problems through seminars and popular science lectures by industry leaders. This will engage students in scientific issues and motivate them to solve some of these problems in the future.

10.4 Teaching aids: Industry can participate in creating study material which can be directly used by students. Self learning should be promoted at all levels. The massive efforts required in translating science study material into local languages can be undertaken by companies which have some expertise in this field.

10.5 Industry sponsorships for science fairs, laboratories, science centres and mobile labs should be sought. A mutually beneficial partnership can be worked out between universities, NGOs and industries to promote science popularisation programs. Industry should be encouraged to invest in basic infrastructure and maintaining them in universities and also in providing scholarships to deserving students. Universities should interact with industry in terms of needs, employability skills etc. In India, a few technology companies have started exploring possible symbiotic relationships with universities in recent years. This needs to be structured and massively encouraged. Further, if the academia

desires industry co-operation, it has to move away from examination orientation. Inter-disciplinary approach is needed to handle partnership projects. This should be facilitated.

10.6 Academic institutions should develop groups at each institute which specialise in developing novel funding mechanisms involving industry. The academia on its part should run courses to train industry personnel. It should take up industry sponsored projects for effective interaction. Academic institutes should invite industry to visit institutes and demonstrate facilities to create confidence in the industry people. Universities can create interface bodies for effective research work. Such collaborative work will generate funds for universities too.

In short, restructuring of the entire system is needed to bring back the glory that the basic sciences once held in the minds of the students. Many of our recommendations on infrastructure, autonomy, access, evaluation and pedagogy have synergies with NKC recommendations on higher education, school education, libraries, translation and open educational resources. We have highlighted the most important things which have to be in place to work the system around. We believe that the implementation of all these recommendations in a coordinated fashion will charge the system to act as a magnet to attract students towards basic sciences.

More Quality Ph.Ds

November 6, 2008

It is widely recognised that a nation's transformation to a Knowledge and Skills Economy is critically dependent on the original research and development taking place within the country. If India is to make the transition to a Knowledge economy, it is therefore vital that research and development within the country be dramatically improved. There is ample evidence that India is not well-placed for this future transformation. For example, in many disciplines, there is already a severe shortage of well-trained young doctorates to fill in existing posts in research institutes and universities. This problem is likely to be even more acute in the envisaged elite new universities. The growth in the number of doctorates has only been 20 per cent in India in the period 1991-2001 compared to 85 per cent in China¹. Not more than 1 per cent of those completing undergraduate degrees currently opt for doctoral studies in India, and a substantial number of students prefer to go abroad. To address these problems, there is a pressing need for urgent government policy interventions, including high priority initiatives to attract, nurture, and retain the country's best young minds in academia and research.

With this objective, the NKC conducted a wide-spread investigative survey across the country and abroad. Workshops and consultations were also held with other stakeholders from industry, research institutes and universities. The attached note on 'More Quality Ph.Ds', identifies the critical issues and discusses the remedial steps in detail. NKC recommends the following to improve the quality and quantity of Ph.D students in the country.

1. Launch a national publicity campaign to attract the best young minds for careers in teaching at all levels, and also academic research

One of the casualties of the expanding market economy has been the devaluation of the academic profession as a

whole, and this is now seriously affecting the desirability of this profession. Specific measures for addressing this problem include:-

- Enhancing the prestige, social-standing and remuneration of people in the academic profession
- Systematic and targeted initiatives to unleash the potential of gifted students outside the urban population centres
- Utilisation of current technology to provide greater access to quality learning at all levels, and bridging the language gap
- Increased coverage in the media of different facets of teaching, research and academic achievements, both nationally and internationally

2. Initiate major academic reforms in universities

Throughout the world, universities are the natural home for the interface between teaching and research. But this is far from reality in the vast majority of Indian universities. In fact, the overall current situation in Indian universities is dismal largely due to the lack of quality infrastructure and the inability to recruit good young faculty and gifted students. Some concrete interventions for improving the situation include:

- Urgent Regulatory reforms in Higher Education, reducing regulation while improving governance; the details have been articulated by NKC in its earlier recommendations on Higher Education
- Greater autonomy for departments within universities to introduce new relevant courses, along with encouragement and rewards for innovation in teaching and research
- Identifying and supporting university departments as Centres of Excellence
- Greater flexibility and increased funding for university departments to recruit and retain good faculty from across the world

¹ "Measures of Progress of Science in India", Report by NISTADS 2006

- Periodic peer reviews of departments in the universities
- Encouraging recruitment of capable and talented younger faculty

3. Implement administrative reforms in universities

It is equally important that reforms in the administration of universities accompany academic reforms. This will ensure professional administration of universities, and help in attracting students and good faculty. These reforms should include the following:

- Ensuring a capable administration headed by an able Vice Chancellor and Registrar; these appointments should be based on academic and administrative credentials
- Increasing efficiency and transparency in university administration at all levels
- De-politicisation of appointments and more administrative autonomy
- Better systems for monitoring and maintaining the physical infrastructure, especially buildings
- Sensitising the administration towards academic freedom and the academic needs for a good research environment

4. Enable research environments in universities

Academic reforms and better infrastructure should go hand in hand with nurturing and sustaining a research environment. Some key enablers for this are:

- Mechanisms for greater academic co-operation between universities and research institutions; in particular embedding research institutes (granting sufficient autonomy) within university campuses
- Providing access to digital media in universities, in parallel with funds for better libraries and laboratories
- Focused engagement towards making universities a natural home for research as well as teaching

5. Set up more quality undergraduate teaching institutions across disciplines

Dedicated researchers involved in direct training of the students at the undergraduate level create a greater impact. Most of the universities or elite institutions in the country are currently involved in training for

the Masters or Ph.D degrees. However, it is now widely recognised that the students emerging from the undergraduate programs are ill-prepared for a research career. The following steps are proposed to address this:

- Introduction of well-planned four-year courses to enable direct entry into Ph.D programs
- Encouragement of various measures to ensure multiple sources of input of talented people into the academic profession
- Credit portability across a network of institutions

6. Increase funding for education at all levels and for R&D

Even in the developed countries, it is fully accepted that long-term investment in education and increased spending on R&D is necessary to maintain the lead in cutting-edge research. This is even more relevant in India today. NKC proposes the following measures:-

- Strengthening of education at the school level, with particular focus on teacher training
- Creation of effective monitoring and assessment mechanisms, nimble enough to measure outcomes and adopt new strategies
- Consulting stakeholders in making policy decisions

7. Rejuvenate doctoral programs across disciplines

While the above recommendations are aimed at attracting potential doctoral students and enabling a research environment, it is vital that prospective doctoral students are chosen with sufficient care. The following measures are proposed with this objective in mind:-

- A review of the whole selection procedure and monitoring process for graduate students
- Multiple pathways for entry to a Ph.D program while maintaining entry standards
- Support for quality research in Arts, Humanities and other areas
- Support and promotion of cross-disciplinary teaching and research programs
- Greater exposure of undergraduate and postgraduate students to cutting edge research

8. Ensure quality of doctoral work and academic research in institutions

At the same time as striving for greater influx of people towards research careers, institutions must ensure that the research undertaken matches global quality in the

relevant field. In addition, the graduate programs should be continually reviewed so as to make them vibrant, challenging and internationally relevant. Here are some steps to be taken in this regard:

- A preliminary vetting of the synopses of the theses followed by rigorous external examination of doctoral theses
- Broad funding for the organisation of and participation in workshops, seminars and symposia, in India and overseas
- Encouraging doctoral students to teach, with remuneration provided via Teaching Assistantships
- Wider dissemination of research work, especially through current digital media in universities and research institutions

9. Enable vigorous industry-academia interaction

In the modern context, there is a crying need for a healthy and enlightened co-operation between private industry and academia, which replaces the existing feelings of doubt and mistrust. While industry should recognise that support for education is beneficial, universities should take cognizance of the changing needs of private enterprise in planning new courses. This could be achieved by the following measures:

- A policy framework for meaningful Public Private Partnership in universities, and concerted efforts to nurture Industry-Academia interactions
- Encouraging private investment in education, research and innovation, backed by appropriate taxation measures
- Promoting collaboration between research and development units within industry and universities

10. Foster a global outlook in research

Research is increasingly becoming a collective global endeavour. It is thus necessary to harness global talent and expertise to develop capacity within the country. This is also essential if the nation is to remain a participant in global cutting edge research. With this in view, the following is recommended:

- Encouraging NRI/PIO Scientists to establish meaningful links with Indian institutions, and participate in the academic development of the nation
- Creating joint Ph.D programs between universities both within and outside of the country
- Financial and administrative support for international research collaborations
- Identifying important areas of research where national expertise needs to be developed and initiating steps for funding and capacity building by way of collaborations, guest faculty, pro-active hiring etc.

In conclusion, it must be recognised that investment in education and research produces a broad range of dividends, both tangible and intangible. Our existing base in research needs to be urgently strengthened to arrest any further erosion. While the NKC welcomes the augmented allocation for education in the Eleventh-Five Year Plan, it is important that these funds are effectively utilised to make a visible difference in our academic landscape. As a first step, we urge the government to set itself a target of tripling the existing research base within the next dozen years, and meaningfully work towards it. NKC strongly feels that a mission oriented approach is necessary for creating the required research ecosystem in the country. Hence, a National Research Mission which can be spearheaded by National Science and Engineering Research Board, proposed in the current Five Year Plan is recommended.

Note on More Quality Ph.Ds

Research is an activity based on intellectual investigation and has the purpose of discovering, interpreting, and revising human knowledge and experience on various aspects of life. It is crucial for the overall development of human society. As the economic paradigm undergoes a change in the globalised world, future economic progress will increasingly be a function of the intellectual capital that a nation can create. This in turn depends crucially on the quality of academic research that is done in the nation. Thus, if India is to play a key role in the envisaged knowledge economy of the world, a significant investment in research, accompanied by sustained vision and policy is vital to achieve a long term competitive advantage. While the importance of research and development in science and technology is increasingly recognised, basic research in many other areas like economics, management, social sciences, arts etc. play an equally important role in the overall development and well-being of a nation.

Historically, India has had an enviable standing in the world of research. However, the current situation is unsatisfactory across multiple dimensions, and the reasons for this are manifold. An important factor which impacts the quality and quantum of research is the scarcity of talented and dedicated manpower engaged in research. We need qualified doctorates for our research laboratories, to teach and engage in research in our universities and to work for research and development in all sectors of the industry. The number of researchers in India was 112 per million inhabitants compared to 633 in China and 4374 in USA in 2002. The growth in the number of doctorates has been only a modest 20 per cent in India from 1991-2001 compared to 85 per cent in China during the same period.¹ The current state of affairs thus requires urgent policy intervention.

Research in any area requires continuous intellectual engagement along with a passion for ideas and creative thinking. We thus need to create a system where these qualities are nurtured and encouraged, thereby

providing a pool of students wishing to pursue doctoral studies. Simultaneously, it must be ensured that once they acquire a Ph.D, further employment opportunities are attractive. This is essential to justify the amount of time and effort invested in doctoral research, even more so in today's modern world where there are many other seemingly easier and more lucrative career options. While achieving a critical mass of researchers in the country is important, it is necessary to ensure that quality standards are maintained at the same time.

With this objective, NKC initially conducted a wide spread survey across the country and abroad. A detailed questionnaire was sent to all the universities, academic and research institutions, government agencies, and other stakeholders. More than 250 people responded to the survey. A one day workshop was also held where prominent members from diverse industries, academic and research institutions and universities deliberated on these issues. This note captures the main suggestions that evolved from these consultations. Some of the recommendations below have systemic linkages to the previous NKC recommendations in the areas of education, entrepreneurship, intellectual property rights, knowledge network and attracting talented students to Maths and Science.

Part A: Attracting potential doctoral students

In order to sustain research in the long term and for it to flourish, creating a critical mass of researchers and academics is of the foremost importance. Serious policy interventions are required to ensure that this is achieved within a specified time frame in the country.

Recommendation 1: Create greater awareness and acceptance towards pursuing teaching and research as a career, by communicating the opportunities and excitement at a broader level

¹ "Measures of Progress of Science in India", Report by NISTADS 2006

Issues: The Indian society at large, especially the younger generation is not well-informed of the career opportunities, excitement and freedom that a research career offers. Consequently, the acceptance level for embarking on such careers is rather low.

Societal pressure affects career choices significantly. A multi pronged approach needs to be adopted to bring about a change in the national mindset towards recognition and acceptance of a career in research. For long term wealth creation, it is important that the nation trains academics, scientists and teachers, rather than bankers.

Awareness

Media: The media has an important role to play in bringing about a fundamental change in attitude and in the nation's consciousness on this issue.

- Short and engaging television or radio programs related to research can be aired at prime time.
- News channels should highlight and publicise various achievements of academics and other scientists.
- Print and electronic media should be encouraged and incentivised towards promotion and engagement of the intellect.

There are various other means to increase the awareness of society at large:

- Annual R&D shows can be held, where leading research institutes and companies interact with the public, thereby providing a wider exposure.
- Museums, exhibitions and popular lectures are other avenues through which public attention can be engaged. These should be encouraged at as many places as possible. For this purpose, the resources and infrastructure of various educational institutions throughout the country should be used.
- Academic societies should be generously funded and members should be encouraged to participate in the outreach programs.
- In schools and colleges, career awareness workshops and seminars highlighting research careers should be held regularly.
- Important academic events and visits of reputed academics to India should be publicised and shared with the entire educational community through the use of various channels. This will help create enthusiasm in teachers, students and also acquaint society with academia.
- Talent residing in rural areas remains completely untapped because of various reasons. Basic

education and learning resource materials should be made available to all. At the same time, it is important that targeted initiatives be undertaken to identify talented students and to provide them with opportunities for greater exposure, learning and bridging language gaps.

- Women and especially their parents must be made aware of the possibilities and flexibilities that a research career offers, and should be encouraged through targeted initiatives towards such a career path.

Acceptance

- Nobel Prize winners, reputed academics and other scientists should communicate and publicise the joy and opportunities in a research career.
- School teachers play a very important role in orienting students as well as their parents. Hence teachers should be trained and engaged in this endeavour. Parent-Teacher Associations provide a platform where role models can interact with both parents and teachers at the same time and increase their acceptance towards research.
- Open competitions and projects at different levels should be conceptualised, encouraged and widely publicised. Industry can be involved in such activities.
- Recognising good research work is important for two reasons. It gives a sense of pride to the researcher as well as encourages others to do research. Hence, various means of recognition such as awards, felicitations, publicity etc. should be taken up at all levels.
- Higher learning, along with research and innovation, plays an important role in development of knowledge areas. Its impact on society needs to be publicised widely.
- Both the monetary and non-monetary aspects of a research career, especially the accompanying academic freedom and the international nature of research, should be communicated to students.

Recommendation 2: Expose undergraduate and post graduate students to cutting edge research and engage them in serious research wherever possible

Issues: The major decision points where a student decides to pursue doctoral studies are towards the final year of either an undergraduate or a master's program. These students are often not well exposed to various research opportunities and hence remain untargeted.

2.1 Undergraduate Research: A good undergraduate teaching program is vital for grooming prospective students towards research. Currently, our education system remains largely unimaginative and monotonous with a stress on rote learning and with problems handed down to students. Wide-ranging reforms that encompass pedagogy of teaching, curriculum and evaluation are a pre-requisite to nurture and encourage interested students towards a research path².

- Relevance and application play an important role in attracting applied researchers, while general abstraction and challenge attract theoretical researchers. Taking this into account, a judicious mix of projects and courses may be designed, of which one kind offers an exposure to real life problems from the industry, economy etc. and another imparts foundational training in theoretical aspects of the subject.
- Courses that orient students towards research need to be specifically designed and made part of the curriculum. An important component of these courses should impart knowledge on identifying and defining problems, various research methodologies, analytic methods and presentation. Team projects comprising of different disciplines can be introduced as an optional course for students. This could be combined with changes in syllabus that allow one research-based course even at undergraduate level.
- Summer internships, summer schools, workshops, competitions should all be encouraged. Exciting undergraduate research projects that can involve larger number of students should be rolled out. The vacation period should be utilised to provide undergraduate students with a comprehensive training comprising of exposure to problems in rural areas, industrial training, research project in academic or research institutions and an exposure to foreign universities through various means such as exchange programs. DST, ICSSR and other organisations can fund a program of small research projects to be undertaken at undergraduate level, which would introduce students to the actual practice of research.
- Teachers need to be trained to promote research and should be incentivised to create innovative projects where undergrads can participate.
- Exposure to and acquaintance with frontier research should be facilitated.

Overall, undergraduate education needs to be strengthened in the country. Creativity should be

encouraged at all levels. A continuum of quality institutions from the undergraduate level in all disciplines is required. Residential undergraduate programs should be increased.

2.2 Post graduate research and training: To encourage research and innovation at post graduate level, several measures can be undertaken.

- Post graduate students should be given the opportunity of spending a semester at research labs or other Indian or foreign universities, outside their own university to broaden exposure. The home universities should facilitate such exposure by entering into alliances with other well established places of research. The BITS Pilani program is an excellent example of such an initiative.
- Research projects which have the potential to be extended as doctoral projects need to be encouraged at the post graduate level. Projects should be offered in emerging areas to retain student interest. Faculty must regularly update themselves to be in a position to guide students. Group research projects among post graduate students will create more interest and add enthusiasm towards research.
- Reduction of course load with a corresponding increase in the research component for students who show deep interest and commitment to research would incite potential doctoral students.
- Post-graduate courses in Social Sciences and Humanities should have a component (perhaps a full course or paper) that requires either desk-based or field research, which could be an optional choice.
- All post-graduate departments should organise and hold regular research seminars, and students should be encouraged to attend these. Programs that facilitate establishing links between interested post graduate students and their prospective guides should be encouraged.

2.3 Integrated doctoral programs: There should be flexibility of moving from undergraduate degree to a Ph.D degree when substantial interest and aptitude for research has been shown at the undergraduate level by the student. S.N. Bose Centre for Basic Sciences runs such a program. An integrated program covering bachelors, masters and doctorate degrees with various exit points has multiple advantages. It will establish a vital link between students at all levels. Networking among students at different levels will give rise to new ideas. It will bring

² See National Knowledge Commission's recommendations on Higher Education, <http://www.knowledgecommission.gov.in/recommendations/higher.asp>

much needed fresh energy into research by exposure and induction to research at an early stage.

However, many precautions need to be taken while designing the integrated course, for instance

- Curriculum must be planned well and subject to periodic reviews. It should have a provision for multiple exchange semesters which will enable wider exposure, interaction and exchange of ideas.
- Selection procedure should take research aptitude into consideration.
- The program however should have multiple exit and placement opportunities. There should be enough flexibility provided to students so that while opting for an integrated course, a student should not feel that they are bonded by it for seven to eight years.

In view of all these requirements, it is suggested that a restricted pilot be launched at select institutions. This program is especially directed towards science streams.

2.4 Linking researchers at all levels: Within an institution, relations among different levels of students (e.g. undergraduate, postgraduate and Ph.D) should be fostered. This could be achieved by judiciously mixing students in projects. Apart from facilitating peer learning, it provides a learning platform for potential doctoral students.

A comprehensive National Projects and Research portal is highly recommended. This is essential for connecting students and researchers at all levels, facilitating formation of virtual peer groups, disseminating information related to various projects and schemes, and providing information of various positions for doctorates etc.

Recommendation 3: Restructure incentives for doctoral degree students to attract and retain them in research

Issues: The gamut of opportunities available to graduate and post graduate students today has made research in India an obvious secondary choice. Apart from financial unattractiveness and substantial investment of the prime years in their lives, there is a perceived lack of challenge as well as future career opportunities.

3.1 Remuneration: It is generally true that interested and talented people choose to pursue doctoral studies. They could have easily opted for better paying career options. Also, there are many more students whom the system fails to attract on account of remuneration issues.

Thus it is important that while deciding remunerations, opportunity costs are factored in.

- There should be a regular upgradation of the amount of fellowships offered for Ph.Ds, and in general for the entire academic profession.
- Various forms of additional compensation should be explored.
- Teaching assistantship to bright Ph.D students should be provided to add to their earnings. This would also have the additional benefit of training and preparing them for a career in academics and teaching. This is vital considering the current serious shortage of competent faculty being faced by our institutions of learning.
- Other possible methods could include summer projects, summer internships in industry and involvement in organisational work as part of academics.
- Subsidised health insurance, home loans etc. could be looked at.
- Generous travel grants should be ensured.

A good placement office for Ph.Ds should be given priority in all universities and institutions. They should have tie-ups with various universities, research institutions, industries at the regional, national and international level.

3.2 Entrepreneurship: More students can be attracted to doctoral studies by providing a platform where they can convert their ideas or research into reality. To foster such an environment,

- Incubation centres must be facilitated and promoted in academic institutions.
- Universities can offer courses on Entrepreneurship.
- Mechanisms should be framed to support start-ups.

While application-oriented research is important, care should however be taken to ensure that

- Traditional base of academic research is not eroded.
- Intellectual property of the university is well protected.
- Core values and requirements of research are not diluted.

3.3 Joint Ph.D programs with industry: To address the needs of people from industry interested in doing a Ph.D, academic institutes should focus on networking with industry and work out joint programs with interested companies. This will create a talent pool of researchers in industry. Consequently, research in private sector will get a boost, thereby creating attractive job opportunities for researchers which, in turn, might

entice many students to enrol in a doctorate program. Thus, a virtual circle can be created.

The opportunity cost of pursuing a Ph.D is very significant for this target group. Hence, a favourable proposal needs to be designed which not only allows but also encourages employees to go for a Ph.D. There should be Memorandum of Understanding (MoU) between the partnering institution and the industry. The MoU could include the clause that the company pays their salary during the period of Ph.D. The Reliance Life Sciences (RLS) model is noteworthy in this aspect. RLS has a mechanism whereby its employees may pursue a doctorate degree at Mumbai University. BITS Pilani also runs a doctorate program for professionals. The program has in-built flexibilities which attracts people from industry and simultaneously has a very strong scrutiny system to ensure quality Ph.Ds.

One important factor that should be kept in mind is that academic freedom is maintained and an enabling environment is created wherein prospective guides and doctoral students from industry can interact.

This will also potentially attract those bright students who chose to work in industry because of attractive financial packages.

Recommendation 4: Create attractive post doctoral opportunities to provide fresh doctorates with a valuable cross disciplinary research and teaching experience

Issues: Post doctoral opportunities in India and abroad are limited. The opportunities existing in India right now do not stand any appeal against post doctoral offers from abroad. The brightest go abroad and tend to prolong their stay as far as possible. Simultaneously, there is a lack of synergy between research and teaching experience.

This is an important stage where effective intervention should be made to broaden our academic and research base. Therefore, it is vital to create

- Dedicated central fund for Post Doctoral Fellows (PDFs) so that senior researchers can employ post docs for their research projects.
- More flexible positions for researchers with various institutions, centres of excellence, advanced research labs and industry.
- A large pool of post doctoral fellows. Projects of national importance, faculty for teaching institutions as well as private companies can choose new doctorates

for temporary, yet financially very attractive positions from such a pool. Such centralisation of resources will lead to better information dissemination and effective resource sharing.

Longer term offers could be made to PDFs by including teaching as a vital component. In many universities, a purely post doc research position is not recognised as teaching experience while making faculty appointments.

- Effective utilisation of the PDFs in universities should be facilitated by flexible and innovative appointment modes. This can provide a means of upgrading university departments in general, and also addressing the faculty shortage. Teaching experience will also increase opportunities of employment in universities after post doctoral work.
- Mobility across organisations should be facilitated during post-doc tenure. A group of five to six universities can be formed with an understanding that a Ph.D of one university can do a post doc at another. International peer review mechanisms can be established for PDFs. Overall, this calls for greater coordination among universities and research institutes, better sharing of resources, and for convergence of teaching and research experience.

Part B: Quality

A quality degree which is universally recognised as such, and which is acquired after consistent hard work and application of mind both acts as a magnet to attract talented students and inspires awe in the minds of the general public. It is therefore essential that doctoral programs in the country aspire to attain the highest standards of excellence. At present, the quality of research output in the country is completely uneven across institutions. While, it is necessary to maintain the high quality standards in elite institutions, it is simultaneously imperative to encourage the transition to cutting-edge research in others. It is also crucial that quality in the output of academic research is ensured by a variety of metrics like publications in peer-reviewed journals with good impact factor, academic activities like workshops and conferences, patents, technology transfer activities etc.

Recommendation 5: Rejuvenate the Ph.D program and adhere to quality standards to attract talented students

Issues: Other than the financial benefits, a key deciding factor in making a career choice in academics is the intellectual satisfaction that one expects. The quality of

research undertaken at a majority of institutions in the country is however so low that it deters potential students.

5.1 Entry level screening: Usually, an entry level examination is conducted to ensure good quality of the intake of doctoral students. A prospective doctoral student's aptitude and attitude towards research should also be considered along with other qualifications. At all times, adherence to good standards at the entry level is essential.

- Multiple pathways should be used to fill research positions.
 - Flexibility should be given to universities for conducting their own entrance examinations.
 - A demonstrated research potential should be given due consideration. If an applicant has published a good quality research paper, filed a patent etc, his/ her application should be accordingly considered.
 - For working professionals, who may find it difficult to pass an entry level test, other flexible methods of assessment should be put in place.
 - Online testing of students should also be worked out. This is particularly important to attract potential students from abroad.
- Examinations
 - Testing aptitude for research should be made an integral part of the selection process. Apart from a written examination, a personal interview will be greatly useful.
 - Syllabus and quality of the current NET examination needs to be massively reformed.
 - Unlimited attempts should be allowed to pass the qualifying examination.
 - As the borders between disciplines are getting increasingly blurred, it is important to examine the entry requirements for lateral entry across disciplines.
- Adequate care should be taken to ensure that screening methods are transparent and objective.

5.2 Pre-Ph.D courses: It is important to identify and bridge the gaps between the present and the required knowledge of a doctoral student. National Pre-Ph.D program: In order to utilise the limited pool of talented faculty, a national Pre-Ph.D program of suitable duration, run by major national institutions can be launched. The program would help in broadening the perspective of a future doctoral student and also increase networking within the research community. The necessary infrastructure for such an initiative needs to be created.

- It should involve qualified researchers who should be sufficiently incentivised to teach in the training

programs. Other distinguished speakers can also be invited for delivering lectures.

- Qualified applicants with a Pre-Ph.D degree can return to their respective home institutions once their training is over.
- The program should be tailored to cater to different disciplines and should include a study of latest trends in particular streams. It should also train students in analytical skills, research methodology, instrument use, dissertation writing etc.

For students registering for a Ph.D directly after a bachelor's degree, the importance of a Pre-Ph.D program increases. It would not only impart students with necessary background training but also examine their research aptitude. In an integrated doctorate program, Pre-Ph.D can serve as one of the exit points. The Pre-Ph.D degree could be recognised as a qualification to teach undergraduate courses.

R&D laboratories can prepare teaching material for Pre-Ph.D courses. Lecture notes should be made available on the internet, thereby ensuring wider accessibility. This will also contribute towards greater access to quality educational material among students and faculty. At the individual level, the guides must give sufficient self-study coursework to students.

Recommendation 6: Create effective monitoring and assessment mechanisms during the course of doctoral research and encourage broader engagement with research

Issues: Research in India is carried out solely on the basis of internal motivation. Effective external mechanisms which ensure good quality of research largely do not exist. At the same time, there are no sufficient mechanisms to guarantee broader engagement with research.

To ensure effective monitoring and assessment mechanisms:

- Students must be continuously monitored and mentored to ensure that the research output is of requisite quality. Regular seminars by students will ensure that the students adhere to their research work plan and show progress. Regular reporting in lab meetings could be used for informal feedback.
- Experimental projects should be monitored through a well maintained log book. The guide should insist and regularly check whether log books are maintained.
- Independent committees can also be set up before which the students make regular presentations.

Any such committee should provide feedback and counsel the doctoral students. External co-guides from industry/other institutes could facilitate a way to ensure better monitoring.

- Any mechanism used for monitoring should check for possibilities of plagiarism. Further, to enable an overall healthy research environment, Ph.D students should be taught ethics and standards of academic research as part of curriculum.

Before designing any new monitoring and assessment mechanisms, it is important to identify why the existing ones have failed and the lessons learnt should be taken into account.

To promote broader engagement with research:

- Regular interaction among the researchers should be facilitated through group meetings, research seminars etc. At some places, lab group meetings are held every week in which each student presents and discusses his/her work with the entire group.
- Wider exposure to research in the form of participation in international conferences, workshops, seminars etc. will strengthen the student's research base and should be encouraged.
- Journal clubs where students discuss articles other than those in their own areas of research provide a means to broaden the academic horizon of students.
- Mentoring doctoral students for meaningful participation by means of poster presentations (individually or in groups), group discussions would provide further impetus in helping the students towards gaining confidence about their research. It will also lead to a larger networking among peers and established researchers from around the world.

Recommendation 7: Comprehensive assessment of doctoral thesis and wider dissemination of research work

Issues: Often there is no objective assessment of doctoral thesis, thus leading to theses of poor quality. The evaluation committee does not subject the thesis to a strict scrutiny. There is a huge problem of uneven quality across institutions, and this is particularly marked in the Social Sciences and Humanities, even to the point where Ph.Ds can be “purchased” on the basis of minimal work in some places.

One of the fundamental requirements for running a quality doctoral program is to have a strong faculty involved in front-line exciting research. It is equally

important that reputed examiners are appointed to validate the quality of output of research thesis.

- A combination of internal and external examiners should be used to make the system more robust. The names of members of the respective evaluation committee should be attached to each approved thesis. It is important to bring transparency in the system and attention to quality.
- Open defence of thesis could be mandated. If a student fails to defend his/her work suitably, a second defence can be planned after six months. Honourable exit options should be provided for doctoral students.
- Publications in quality research journals should be encouraged. Open peer review of publications should be aimed at.
- Ph.D thesis should be uploaded on the internet, preferably on the proposed National Research Portal. In any event, open and free access to research output in archives and other digital media resources should be made mandatory.

Alternative systems to grant a Ph.D can be explored. As practised these days in Germany, five published papers in peer reviewed journals should be deemed sufficient to acquire a Ph.D. This does not stipulate registration, time limit or supervision. Such students should publish in reputed and internationally recognised journals, and these papers may be reviewed collectively by a panel of examiners (at least two from developed countries and two from India). If a minimum of three pass the standards test, Ph.D degree may be awarded to the student and should be recognised in the existing system. Such innovative and alternative systems need to be explored and put into practice.

Part C: Nurturing a research environment

In order for research to flourish, it is vital that the entire academic system be made more conducive and vibrant. Universities are the natural homes for academic research the world over, and it is vital that research culture be brought back to our universities. Other stakeholders like industry and government can play an important role in this endeavour.

Recommendation 8: Enable university environment to produce quality Ph.Ds

Issues: Various compulsions in early policy making in the post-independent era led to a large number of

stand-alone research institutes. It is now increasingly being recognised that separation of research and teaching has been at the cost of creating a good research environment in the universities. We have already lost a couple of generations of talent because of the resulting breakdown in the university system. The present academic environment in many universities remains largely unattractive for researchers.

8.1 Facilitating research opportunities in university environment: University reforms are urgently needed and an integral part of this should be aimed at enabling a research culture in universities. A vibrant research atmosphere in the universities will definitely attract more students towards research. The most essential enablers for such an environment include the presence of a facilitating administration, talented faculty and the availability of adequate research facilities.

Conducive administration: Often university administration itself militates against creating conditions conducive to research. This is largely because of the centralisation of decision-making, restrictions on faculty autonomy and imposition of rigid financial rules that makes “managing” projects very demanding. Administration should be sensitive to academic needs and should aim to encourage and help faculty to deliver better results. In order to enable a favourable administrative environment, it is essential to

- Ensure a capable administration headed by an able Vice Chancellor and Registrar.
- Grant autonomy in making recruitments to achieve higher standards.
- Undertake steps to completely eradicate politics and inbreeding in the system.
- Simplify bureaucratic procedures to make the system more responsive, transparent and efficient.
- Provide technical help or guidance to potential university researchers for writing grant applications.

Collaboration for sharing resources and expertise: It is vital to provide researchers with the required infrastructure to carry out their research work. Universities should be given adequate funds for upgrading infrastructure. Often, the lack of funds acts as a hurdle in building and maintaining capital-intensive infrastructure. Hence, sharing of infrastructure with joint responsibility of maintenance among institutes should be greatly encouraged. For better, meaningful sharing of physical as well as intellectual infrastructure among institutions,

- Collaboration should be formalised by entering into alliances, signing MoUs etc.
- New research and academic institutions should be co-located as much as possible.
- Library facilities, access to journals electronically etc. should be provided freely. The upcoming National Knowledge Network should be leveraged for this purpose.
- Top down systemic linkages from elite institutions to universities and to colleges should be established and encouraged to ensure capacity building.
- Joint doctoral research where students are allowed to select guide and co-guides from across academic and research institutions should be undertaken.
- Research institutes can allocate sub-projects to universities to begin with.
- Inter-disciplinary projects involving multiple agencies should be explored.
- UGC should promote conferences with industry and research institutes to enable conversion of ideas into research to be implemented at universities.

Revamp of Laboratories: An inseparable part of research and teaching in Science and Technology is the laboratory. Laboratories play an important role in creating research attitudes, arousing interest and curiosity. They help in gaining experience in scientific methods and learning the process of scientific enquiry. Given the current state of affairs, there is an urgent need to begin an intervention aimed at addressing the quality issue in laboratory training. It is important that even schools are provided with good laboratories and specific attention should be paid to lab training at the undergraduate level.

A major problem with all laboratory experiments is that they do not attempt to challenge the student sufficiently and the whole exercise is conducted at a very rudimentary level. Vital aspects of experiments are not highlighted for the students. The student is typically not involved in important areas of the experiment such as designing or selecting the apparatus, deciding what measurements need to be taken, or what variables need to be controlled. Students are given no opportunity to think for themselves. Laboratory courses thus need a complete revamp.

- There is a need to redefine the objectives with which experiments in a lab are performed, so as to make the laboratory training more concept based rather than ‘result based’.
- It should lay emphasis on a student’s contribution to planning, execution and analysis of the experiment.

- Error analysis, up to and including calculation of error bars should be essential requirement for each experiment.
- Training should include maintaining lab journals and technical communication skills.

This will help in guiding the talent towards hard-core experimental sciences.

8.2 Changes in the university system to encourage research and good teaching: Both teaching and research should be promoted by creating mechanisms which provide freedom, encourage innovation, and recognise and reward good work. Good teaching plays an important role in encouraging students to pursue an academic career and this aspect is often unrecognised.

- Faculty should have sufficient resources to carry out research as well as teaching activities. Teachers should be especially encouraged to create innovative teaching material and for providing wide-spread access.
- Good working conditions are absolutely essential in creating a vibrant academic environment.
- Free flow of researchers between industry and academia should be initiated. Sabbaticals to work in industry for academicians and vice versa for industry employees should be instituted. Sufficient provisions should be made for granting sabbaticals to faculty for undertaking research.
- Liberal rules should be looked into for providing faculty members with the flexibility to hold dual appointments between R&D institutions and universities.
- Flexibility in extramurally funded projects to university based investigators should be given so that they can travel and participate in international meetings/workshops.
- There should be provisions for mentoring of young faculty by established scientists which involves spending brief period at the mentor's laboratory/institute.
- To incentivise research, performance appraisal for promotions should give a higher weightage to research.
- A component of funding should be used for rewarding good teachers and researchers.
- Separate research wing in universities could be developed with as few bureaucratic hurdles as possible. Group recruitment with a specific mandate of developing frontier areas in research should be explored.

Flexibility should be accompanied with a component of accountability, the norms of which should be periodically reviewed.

8.3 Reduction of teaching load: There is a serious shortage of faculty across institutions. Further, with a large number of teaching posts in colleges and universities remaining vacant, there is severe stress on the existing faculty. Also, in the current system, the whole profession of teaching has been severely undermined with contract teaching in colleges becoming more and more acceptable. Teachers have no time or inclination to participate in anything innovative which has led to a lack of involvement and enthusiasm in the whole system, thereby leading to gradual decay and degradation. It is crucial that these issues are addressed and acted upon with the utmost sense of urgency.

Some steps that could be undertaken to reduce teaching load are:

- Duplicity of courses should be avoided. This calls for greater interdepartmental collaboration at the level of individual institution. Inter-institutional collaboration to offer common courses can also be worked out by means of sharing credit.
- Lectures can be delivered to a large class combined with tutorial sessions in smaller batches of students.
- Positions of Adjunct Faculty must be created and strengthened. People from research institutes, industry, abroad etc. should be invited to teach few courses every semester. Services of retired professors can also be used. This will also bring in much needed fresh inputs from outside into the university.
- PDFs and Ph.D students should be effectively utilised in teaching or teaching assistantships. Specially, bright students should be allowed as well as encouraged to teach junior classes.
- ICT should be used extensively for teaching wherever appropriate. This will give access to quality educational material to a larger section of the student community.
- Issues regarding new recruitment should be sorted out and new appointments should be made as soon as possible. Adequate facilities for research, seed money, housing and incentives for sponsored research should be offered to attract new faculty.

8.4 Data collection, organisation and access: While there are numerous agencies involved in data collection related to different aspects of Higher Education and

Research, the organisation of, and access to these data remain largely nebulous and inaccessible. This should be rectified. It is important to recognise that such data can play a vital role in policy issues, funding, reforms etc. Data collected should be cogently organised, analysed and made accessible to a wide section of stakeholders. We also emphasise that there should be strong, vibrant and systematic linkages in place between institutions like NISTADS, NUEPA and the actual stakeholders in the system that these institutions are supposed to address. Just as the modern knowledge system necessitates continuous knowledge upgradation of the academic and scientific personnel, it also necessitates that the university administration be continually exposed to best management and administration practices in the university systems around the world. It is thus essential to create a vibrant and pro-active platform for the skill and human resource upgradation of the administration personnel.

Recommendation 9: Foster inter-disciplinary research, translational research and basic research in social sciences, arts and humanities

Issues: New interdisciplinary areas of research are emerging rapidly in the global context and these are not adequately represented in the country. Almost in all important professional streams like medicine, engineering, management, law etc, actual practice is divorced from research. Despite the tremendous diversity, rich history and cultural heritage, credible basic research in the social sciences is conspicuous by its absence in most universities.

The face of sciences, or for that matter, every discipline today, is changing rapidly. Conventional boundaries between different streams are fast disappearing. Interdisciplinary projects and doctoral programs in interdisciplinary areas need to be encouraged to propel research in emerging areas. To facilitate this, interdisciplinary faculty options may be created. Interdisciplinary guide and co-guide combinations should be permitted for guidance towards a doctoral thesis. Generous funding should be provided to encourage research in new areas. Appropriate modification of entry barriers to such doctoral programs should be looked into.

Translational research, especially in the area of medicine and engineering is largely absent in the academic landscape. As a specific example, Medical Education

and Research lack in innovation due to the present lacunae in the education system. This field is largely service oriented with less or no emphasis on research, reasoning and rigour. In order to drive innovation, it is imperative that a medical education straddling programs from diverse disciplines such as clinical, epidemiological, laboratory, pure sciences (physics, statistics, optics, medical chemistry, organic chemistry, cell biology, biochemistry) be rolled out in front-ranking institutions. An option of having a component of clinical research in Ph.D programs in the natural sciences should be introduced. This will require co-mentoring of students by faculty drawn both from a surgical/clinical/para-clinical pool and basic biology/physical/engineering sciences. In general, translational research linking practice, field and lab work should be generously funded and encouraged. The existing regulatory structures make this highly difficult and this needs serious intervention.

The training in the humanities has to be reformulated so as to provide a sound, but preliminary, theoretical classical foundation which is in the end solidly geared towards training the student to understand social life as it actually is. It should equip him/her to tackle its vast range of problems in their full magnitude, reinforced by solid and practical training in the field. Integrated courses which allow for a creative and imaginative choice of subjects should be designed. There could also be a component of Management Education within the Humanities stream. Integrated Masters programs in the Humanities that initiate a congruence of many components ranging from communication skills, traditional knowledge systems and practices, disaster management, community life, local government, international diplomacy, governance and conflict, public administration and beyond should be designed. These courses could also be made open to international students, especially from the developing world. The courses should relentlessly focus on the centrality of human living, and represent a thorough amalgam of its constituents, with the first two years devoted to theoretical foundations, the next two years to applied aspects, and the final year to practical field work. Such programs would also improve the quality of work at the doctoral level.

Industries probably do not have a tangible stake in funding basic research in social sciences. Hence public funding is vital to ensure research and progress in these areas. It should be recognised that knowledge in these areas contributes directly to the wellbeing of society and also in nurturing a sense of pride about our cultural heritage.

Overall, undergraduate and postgraduate courses should offer a wider bouquet of subjects within a credit and semester system.

Recommendation 10: Promote excellence at research institutes and universities

Issues: Research institutions have maintained a lead in research activities in the country. However, they need to play a larger role in academic activities by means of linkages with universities etc.

10.1 Research Institutes: To promote better managed institutions, it is essential to groom leaders who can take the institutions forward. Governance of the institution should be based on democratic principles. Wider feedback from scientists at all levels should be taken. An independent Board of Governors with respectable members from academia and civil society should be constituted for each institution. Transparency in recruitment of faculty members is necessary and promotions based on appraisals should be encouraged. An efficient administration totally devoid of corruption should be put in place.

The research institute should be nimble and dynamic in developing new areas of research. Industrial consultancy group should be developed in application research based institutes. This will bring in funds, ideas and much needed efficiency in the system. Better managed institutes should be encouraged to lead and mentor others. Research institutes should be encouraged to work with universities.

The interaction between research laboratories and universities should be institutionalised. It is important to work towards aggregating research institutes and universities rather than creating new stand-alone research institutes. Possible ways of doing this are to convert research institutes into small-sized research universities, aggregating various CSIR research labs under a common university system whose strengths are interdisciplinary teaching and research, co-location of teaching institutions and research institutions, as between IISER and NCL in Pune. Some research institutes which have outlived their utility can be absorbed in regular universities. This will also give much needed access to quality research personnel at universities.

10.2 Periodical reviews: A good periodical review system of departments to support centres of excellence can be undertaken through independent accreditation, out of turn rewards, and conditional grants. Advisory committee of Alumni can be constituted for internal review of the departments.

Ph.D thesis, publications, patents, commercialisation of research and peer review can be included as measures of performance review. Quality of faculty should be strictly monitored.

Recommendation 11: Establish more centres of excellence for research and teaching from the undergraduate level for different disciplines across the country

Issues: There is a serious shortage of institutions which provide both good undergraduate training and research environment. Currently, in most of the existing centres of excellence where doctoral studies are undertaken, the focus is largely on the Ph.D and/or Masters program.

Sound training at the undergraduate level is vital for students wishing to embark on an academic career. Often, students entering a doctoral program at elite institutions are found to have an inadequate background for research even after having completed a Master's degree. A high quality four year program should be rolled out in select institutions³ which will enable direct entry to a Ph.D program, thereby effectively reducing the total time spent on doctoral study. A new system of research based universities starting at the undergraduate level focusing both on teaching and research is essential to create the right environment needed to nurture research. Existing universities or research institutes may be transformed into a smaller research based universities. Smaller universities ease administrative hurdles. Universities without attached colleges have a higher chance of developing a good research culture. Excellent resources and infrastructure should be created. Also, adequate communication channels should be established with existing universities to provide holistic (broad based) education. The Government has taken a step in the right direction by starting Indian Institutions of Science Education and Research (IISERs) in the field of sciences. Corporate houses could be involved in starting some of these new universities. Research universities for thrust areas can be created in public-private partnership mode.

³ See NKC's Publication on "Attracting More Talented Students to Maths and Science", Pages 9 and 22, http://www.knowledgecommission.gov.in/downloads/documents/nkc_maths.pdf

However, some caution needs to be observed while setting up new research universities.

- An able director is essential for developing a new institute.
- These universities should not become isolated islands of excellence.
- Faculty will remain the most serious issue in expansion and appropriate steps should be taken in this direction.
- Serious investigations into the existing system should be undertaken in order to identify the gaps and to ensure that mistakes are not repeated.

Simultaneously, a comprehensive process of repair and reforms within the existing system should be initiated. This can take the initial form of identifying select departments/colleges/universities with a potential for substantial improvement. Funds should be invested in upgrading and monitoring the progress of these. Vital components of this exercise are transparency, academic autonomy and establishment of systematic linkages.

Colleges within universities which are engaged in quality teaching and research projects should be encouraged and supported with free access to funds, investment of infrastructure, more academic and administrative autonomy. A useful metric for evaluation of colleges could be the placement of its students at research and academic institutions within and outside of the country. On the whole, there should be an overall empowerment of colleges providing quality undergraduate education.

Recommendation 12: Augment available sources of funding, optimise allocation and provide greater flexibility towards utilisation

Issues: Funding remains a key issue in facilitating quality research in most universities. The low quantum of funds, the cumbersome process of acquiring them and the lack of fund raising capabilities in the university/faculty members have severely hampered growth of research.

Concerted efforts are needed in funding research. Various sources of funding should thus be explored.

- Large scale public funding is necessary for nationally relevant research projects.
- Recruiting companies should contribute towards university research funds. Industries should be encouraged to sponsor and collaborate on research projects. Laboratories named after sponsoring companies can be established. Also, Sponsored Chairs by industry can increase the number of

faculty and researchers without any additional cost to the university.

- Universities should formulate strategies to convert research findings into commercial applications, thus generating funds. Alternate means like consultancy, online courses etc. should be explored. Universities should also establish and leverage alumni network.
- Government funding agencies should proactively encourage and guide faculty members from universities to submit research proposals. A system of open competition for research grants should be developed.
- Collaborative funding between countries and universities should be encouraged.

To increase research funding in the longer term, alumni/corporate fellowships should be looked at. For instance, NASSCOM has developed a Public Private Partnership framework under which fellowships could be provided to students. Collaboration with foreign universities in which students and co-guides get a chance to attend foreign universities has been worked out as part of the initiative. Academia should evolve strategies to increase such funding avenues substantially. Such initiatives also have the merit of wider industry academia interaction.

Primarily however, professional financial management is needed at universities. There should be in-built flexibility and lenient guidelines for utilisation of funds. It is also important that faculty in research institutes and universities are trained in the utilisation of funds.

Recommendation 13: Encourage private participation in research activities by fostering industry-academia interaction

Issues: The two worlds, academy and industry, are viewed as divergent, because of perceived vested interests, which often leads to mistrust.

It is important that there is a change in this mindset and that new ways of establishing and institutionalising permanent linkages are explored. The value of domain knowledge expertise is bound to increase as the economy matures and knowledge gets integrated as an important component of the economy. Industry should take cognizance of this and should support doctoral programs in both basic and applied research disciplines. Further, social sciences can contribute to innovation in business processes, and in the overall understanding and progress of the society. Industry can participate in academic research activities by:

- Investing in infrastructure building.
- Inviting students to spend a semester in industry.
- Allowing people from industry to take special lectures in universities.
- Getting involved in monitoring and updating curriculum.
- Offering research projects to people in academia either alone or by collaborating with other industries.
- Conducting or participating in science fairs, seminars, workshops and popularisation programs etc.
- Sponsoring research in universities directly. As an example, TCS sponsors research projects in various colleges instead of giving one time infrastructure grant. This ensures more than just monetary support and leads to healthier interaction.

At the same time, academia should open its doors to industry. Lateral entry provision should be facilitated for those interested in academics with a background in industry. It should also facilitate continuing education of industry employees by designing and delivering short courses. Appropriate methodologies should be developed to carry out all collaborative efforts. It is essential to clarify issues such as sharing of intellectual property rights. Industry associations must facilitate interaction and collaborations between industry and academia.

A culture of research in the private sector is essential to develop more prospects for doctorates and increase efficiency and diversity in the system. To encourage Indian as well as foreign industries to carry out research activities in the country,

- Industry should be incentivised to use indigenous technology.
- New science and technology parks in the private sector should provide research and development facilities at subsidised rates for all companies.
- Knowledge hubs should be created in each state, which should provide space and other facilities like patent cell, entrepreneurship cell. Multinational companies which aim at creating large research centres in India can pilot launch their operations in the knowledge hubs. Knowledge hubs will facilitate market driven research and product development.

Part D: Fostering a global outlook in research

Research as an activity requires exchange of ideas and sharing of knowledge at a broader level. In today's globalising world, there is a pressing need for India to

provide its students and faculty with international and multi-cultural exposure.

Recommendation 14: Attract NRI/PIO Scientists by providing attractive opportunities in the country

Issues: Researchers often leave India for a better environment that offers variety of choices, opportunities and intellectual freedom. Such researchers find it difficult to return back because of the absence of an enabling and nurturing system in the country.

Provide flexibility in the system: Currently, the rigidity of entry in the university system repels the scientists who might otherwise consider coming back to India.

- The system should be made more flexible to encourage talent at all levels. Respect for talent rather than "seniority" should be built into the system. To attract the best people, it becomes important to offer them positions that are professionally better than what they currently have in their country of residence.
- Positions of Research Professors with advancement capability based on research excellence and not age should be created. Young scientists should get equal independence as their senior counterparts.
- Adjunct positions in industry and research laboratories should be created for inviting NRIs.
- Institutional mechanisms should be created to allow scholars to go back and forth and to freely invite other researchers and collaborators. In case, the scientist returns back, he/she should be encouraged to continue to maintain contact with the researchers in the lab and guide them.
- The system should also enable appointment at the level of Director, Dean, Vice-Chancellors, and Technical/Scientific advisors to Union and/or State Government. At the same time, there should be effective monitoring mechanisms to ensure accountability and to prevent misuse of such positions.

Offer more resources and create nurturing environment: Creating a challenging and excellence-oriented environment with appropriate resources is vital.

- Substantial amounts of "start-up funds" for setting up labs and hiring post doctoral students should be made available to the researchers. The researchers should also be given freedom to generate their own funds.
- A congenial environment to foster independent thinking and working is a must. This requires

providing facilitating administration as well as maintaining best standards in research.

Recommendation 15: Formalise collaboration with foreign institutions and researchers

Issues: Failure to attract foreign students and collaborate with foreign universities and researchers has led to an absence of multi-cultural and international exposure for both Indian students and faculty.

Collaborative programs with foreign universities and research institutions will encourage faculty and students to learn and exchange ideas and practices on latest developments.

- Indian scientists should be given generous travel grants to attend international conferences. Further, they should be given adequate and comprehensive support to organise international meetings.
- Visa procedures for research exchanges should be simplified. Just as credible business travellers are granted multiple entry visas valid over a longer period, similar facilities for scientific visas can be looked into. The post of Academic Attachés in various consulates should be created and filled. They can play an important role in facilitating scientific exchanges between countries. In addition, this will also provide an alternative employment avenue for people with a research background. Multiple entry provision for foreign researchers would also benefit frequent collaboration by considerable reduction in the hassles of obtaining visas.
- Joint supervision of doctoral thesis is one area where co-operation should be promoted. Length and type of exchange programs should be so designed that our faculty as well as research students gain adequate benefits.
- Other forms of collaboration which could be looked at are joint degree programs with foreign universities.
- Initiatives should be taken to invite faculty from abroad to not only give special guest lectures but also teach partial or full courses.
- A public/private non-profit corporation like Carnegie, Ford and Rhodes Scholarships of high brand value can be created to pay for faculty exchanges from both industry and research institutes. Individuals who are capable of mobilising funding

for such corporations could be chosen to head such institutions.

- Indian Institutions should tap the benefits of multi-institution networks by participating in the good ones that already exist or by creating such platforms themselves. The McDonnell International Scholars Academy and McDonnell Academy Global Energy and Environmental Partnership at Washington University in St. Louis are examples of such networks. The two academies collaborate with select universities from across the world. They provide opportunities to the partners to interact, discuss, and learn from each other by working on collaborative projects.

Many funding agencies from the developed countries are conscious of the demographic advantage that India has and are keen to participate in joint initiatives in research, training etc. Funding and collaborative opportunities for the younger people should be widely publicised and national funding agencies should play a pro-active role in directly linking up scientists and such diverse international funding agencies. Collaborations should be based on win-win models and should facilitate a need-based, two way flow of knowledge. One must also ensure the following:

- Intellectual property is well-protected.
- Collaborations are based on synergy and not brand name alone.
- Students are not just made to do repetitive work without any meaningful exchange of knowledge.
- Students spend considerable amount of time in the home institutions.

To conclude, excellent infrastructure, favourable research environment, reforms in Higher Education - especially university reforms - and increased funding with sustained investment are all needed to attract students to doctoral programs. In this context, there is an urgent need to give special attention to the dire situation of the lack of qualified faculty, and to overall spark national interest and attention towards academics. Any initiative or investment in this direction may not produce tangible results in the short term. However, given the enormity of the problem, further procrastination will only lead to greater damage of the system which will render future repairs vastly more expensive, both financially and academically. Hence it is imperative that the Government acts with a sense of urgency and embarks on the remedial path immediately.

Creation of Knowledge

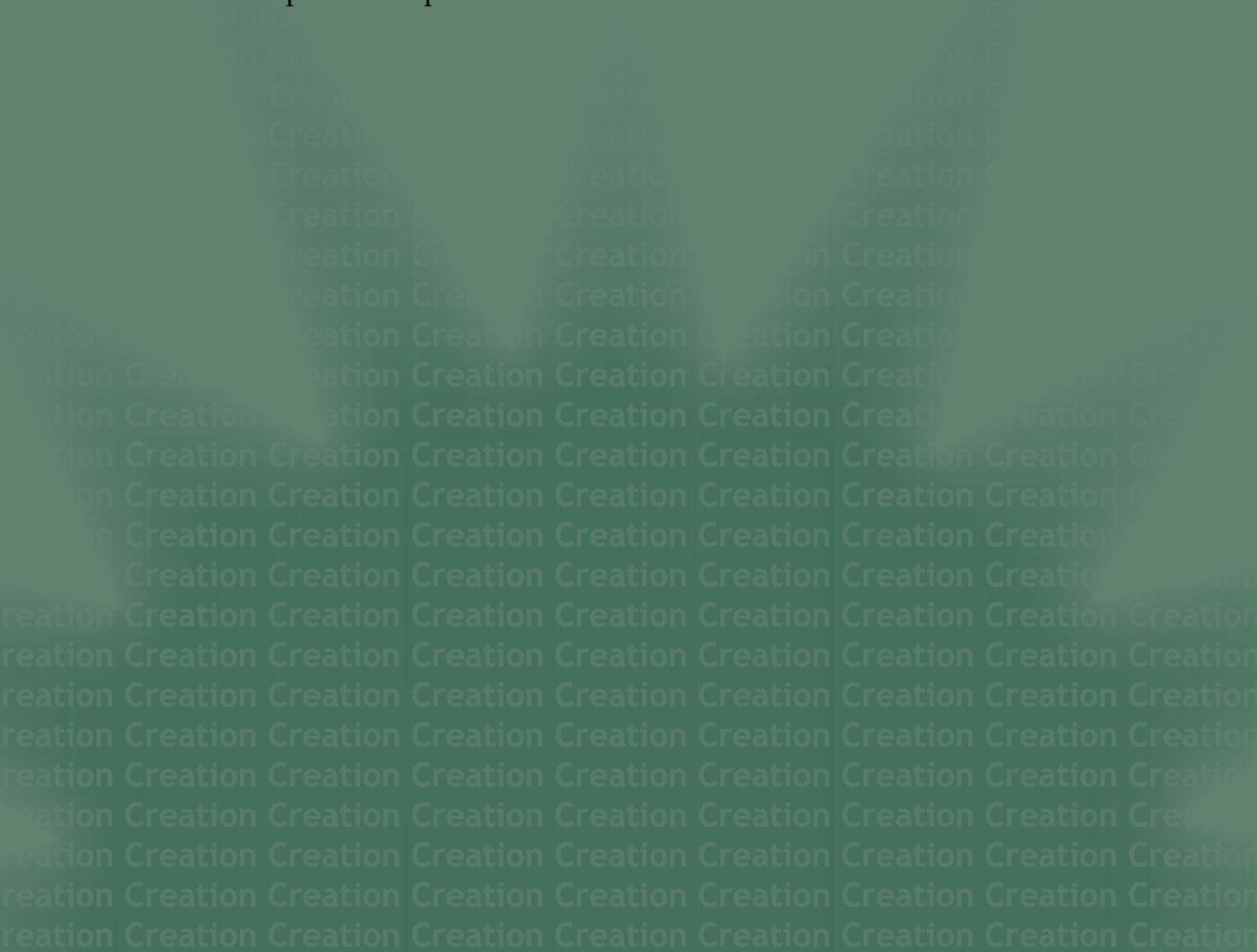
National Science and Social Science Foundation

Legal Framework for Public Funded Research

Intellectual Property Rights (IPR)

Innovation

Entrepreneurship



National Science and Social Science Foundation

November 28, 2006

Indian scientists made significant contributions to the advancement of science and technology in the 1950s and 60s. This was possible because of the support successive governments extended to science education and research. Numerous research and development institutions were established across the country. However, over the years, in spite of continuing government support, both the quality and quantity of the research output from India has been on the decline. It is necessary to examine the reasons for this decline and implement remedial measures.

One widening realisation of the last few decades has been that knowledge is a continuum and the boundaries between disciplines are increasingly becoming blurred, tenuous and indefinable.

The following major causes for the current crisis in Indian research deserve attention:

- **Lack of interaction:** There is very rigid compartmentalisation of natural and social sciences; as a result, there is little or no interaction between researchers in natural sciences and social sciences.
- **Lack of long-term vision:** Research topics of long term relevance and importance are not taken up as support tends to be for the duration of three to five years because of our planning process.
- **Lack of differential remuneration:** The principle of differential remuneration based on performance and output is not followed to reward those who perform well and chastise those who do not.
- **Lack of scientific methods:** Current teaching methodologies at school, college and university levels do not inculcate a scientific temper in the students.

NKC is aware that the Science Advisory Council has recently suggested the establishment of a National Science Foundation to address some of these and other issues confronting research. It supports this suggestion, with some modifications that will make the solution more comprehensive and practicable.

NKC feels that in view of the disappearing boundaries between various disciplines of knowledge and knowledge

emerging as a continuum, India should set up a National Science and Social Science Foundation (NSSSF) which will look at all knowledge as one seamless entity. We will be the first country to set up such an avant garde organisation – and rightfully so, given our 5,000 year-old tradition of broad-based knowledge.

The objectives of the proposed NSSSF will be to:

- a) Suggest policy initiatives to make India a leader in the creation and use of new knowledge in all areas of natural, physical, agricultural, health, and social sciences, with emphasis on those areas which cut across traditional disciplines;
- b) Ensure that science and technology are maximally used for betterment of the lives of our people;
- c) Develop a scientific temper

The Governing Board of the Foundation should have a Chairman, a Vice-Chairman and 8-10 members. The Chairmanship and Vice-Chairmanship of the NSSSF should rotate between the sciences and the social sciences, ensuring that if the Chairperson is a scientist, the Vice-Chairperson should be a social scientist, and vice-versa.

The Chairman, Vice-Chairman and members of the Governing Board should be appointed by the Prime Minister and should satisfy the following criteria:

- High level of professional competence.
- High national and international reputation.
- Professional and personal integrity and honesty that are beyond reproach.
- Evidence of absence of any bias or prejudice.
- A strong social commitment, loyalty to the country, and concern for others.
- Commitment to social, professional and financial accountability.
- Someone who combines erudition with articulation.
- Courage of convictions.
- Ability to listen to other people's views and modify one's own if reason demands that.

The budget of the NSSSF should be Rs 1,250 crores a year; which will allow it to fund between 200 and 400

outstanding, long-term (5-10 years), extremely carefully selected projects that have the potential of making India a leader. We should expect at least a 20 per cent success rate. The NSSF should work towards having at least three to four Indian scientists and/or social scientists produce work in six years which should be worthy of a Nobel Prize. The NSSF will set up a worldwide review system involving some of the best known scholars around the world for approval of the projects that it supports. The project-funding activity will, however, be only one (though a major one) of the activities of the NSSF.

Some of the major activities and responsibilities of the NSSF will be to:

- Identify major unsolved problems in various areas of science and social sciences and individuals, groups and/or institutions who can work on them to provide India leadership.
- Identify and set up studies on (a) relationships of science with other areas of human concern such as economics, sociology, politics, art and literature, and vice versa, and (b) social, economic, political, legal, moral and ethical implications of advances in science and technology.
- Identify and set up studies on futuristic interdisciplinary areas in real time.
- Recommend steps that would help inculcate a scientific temper amongst the people of the country as envisioned in the constitution.
- Help the Government to set up systems that would remove bureaucratic hurdles, increase professional, social and financial accountability; and recognise that creativity in science and social sciences like in all creative endeavors is non-hierarchical.
- Identify and set up studies to find solutions to the problems of the poor and the underprivileged by translating the advances in science and technology.
- Recommend strategies (scientific, technological and social) that would provide additional employment in the rural sector and help set up mechanisms for their implementation with the co-operation of Government, industry and NGOs.
- Recommend steps for optimising the use of our natural resources (including marine resources).
- Help set up systems for documentation, standardisation where necessary, validation and use of our traditional knowledge. Ensure that the custodians and providers of such knowledge and wisdom are identified, are involved in the process, and share benefits accruing from the use of such knowledge.
- Set up policies for international co-operation in science and social sciences.
- Serve as a platform for the coming together of various departments, organisations and agencies of the Government that are concerned with scientific and social science research and related developmental work, to optimally utilise their collective knowledge and capabilities.
- Set up a mechanism for close interaction between state-funded scientific and social science organisations, private sector and responsible and effective NGOs.
- Set up a system that would ensure that appropriate credit comes to India, the Indian institutions and the Indian scientists and social scientists for their work, and that their work is duly publicised in and outside India (e.g. through our embassies and missions).
- Formulate ethical guidelines for administration of science, doing science, communicating science, and using science; and a system of punishment when those guidelines are compromised. Set up similar guidelines for social sciences.
- Recommend setting up of new organisations or institutions that would help advance these objectives and close down existing institutions which have outlived their utility or are not functioning satisfactorily.
- Prepare and present to the Government of India, periodic reports on the state of science and social sciences in India in the global context, and suggest steps that may be taken to improve it.

Legal Framework for Public Funded Research

January 16, 2007

The National Knowledge Commission while deliberating on issues related to the creation and application of knowledge recognises the need to provide impetus to government funded research and to translate this knowledge into relevant and useful applications to benefit the widest cross-section of people. NKC's consultation with diverse stakeholders has revealed that there is a need to provide incentives to increase innovations, collaborations, licensing and commercialisation.

It is therefore recommended to enact legislation that creates a uniform legal framework for the government funded research and gives universities and research institutions ownership and patent rights. This will create an enabling environment for them to commercialise such inventions through licensing arrangements where inventors would also be allowed to receive a share of the royalty. Conferring ownership rights on universities and linking such ownership with the patent system and the market, will make research more attractive and in the process bring about a radical change in the research landscape in India. The proposed enactment could also incorporate important safeguards for exceptional circumstances where the government could be given 'march in rights' to protect the public good.

Uniformity of policy for inventions generated out of government-funded research will provide incentives to various stakeholders as follows:

- **Government:** The government could retain the right to a non-exclusive, non-transferable, irrevocable paid up license to practice the invention throughout the world. It could also have the responsibility and power to monitor the implementation of the act by a provision that requires concerned parties to report to the government on an annual basis on matters pertaining to utilisation of the invention. Since the patent applications would be filed and owned by the relevant institutions, the government would be spared from bearing the costs of filing applications. The government could also be given the right to own the invention where the party decides not

to retain title or fails to file the requisite patent application. Finally, 'march in rights' accorded to the government in certain situations involving the public good as well as exceptions for circumstances involving, *inter alia*, national security and defence imperatives would help assuage fears on the same.

- **Universities/R&D:** For universities and research institutions, revenue generating incentives lie in ownership and control over the fruits of research generated out of government funds. This should encourage filing patents in their own name and entering into commercialisation processes with industry. Further, the inventor, through profit sharing of royalties from licenses, would also get rewarded accordingly. The proposed enactment could also provide that the balance of any royalties or income earned after payment of expenses, be ploughed back for scientific research and education.
- **Industry:** A higher degree of industry participation in university research will result due to clear legal title, a uniform legal regime for all government funded research, commercial gain through collaborative arrangements, opportunities to obtain exclusive licenses and new businesses opportunities for the new inventions.
- **People:** Finally, the taxpayer, whose resources are used in government funding of research, will also get the benefit of inventions, in the form of products and services once they are commercialised and made available in the market.

Issues that need special attention in drafting the proposed legislation are:

- Calculating exact ratios in which revenues will be divided and the percentage made available to various stakeholders including the actual inventor
- Understanding national security implications where they arise and carving out exceptions in such situations
- Identifying specific guidelines, rules and existing provisions of laws that need to be overridden to bring a uniform legislation in place for inventions arising out of government funded research

- Establishing the precise nature of various licensing arrangements as well as conditions governing the grant of exclusive licenses where applicable
- Clarifying situations requiring the invocation of 'march in rights' for government intervention and clarification of exceptional situations to the general right of ownership
- Determining whether plant varieties come under the scope of 'inventions' in light of India's own patent and plant varieties, legislation and analysing the relationships between the proposed act and India's own patent and plant varieties acts

There are precedents for such legislation such as the American enactment entitled the Patent and Trademark Law Amendments Act, enacted in 1980 and commonly known as the Bayh-Dole Act. It is perhaps significant to note that in the United States, before the Bayh-Dole Act was enacted, the country's federal agencies owned about 28,000 patents, out

of which only 5 per cent were licensed to industry to develop commercial products. Subsequent to the enactment of the said act, there has been a massive rise in the number of patents filed by and granted to universities, the number of universities involved in patenting and licensing of inventions and in the number of new companies that have been set up on the basis of new inventions licensed by universities. There have also been innovative breakthroughs in the form of inventions, technologies and processes, arising from university research. Economic activity of a scale running into billions of dollars has been generated, further creating new jobs in the economy.

In NKC's view, introduction of legislation generally along the lines of the Bayh-Dole Act, while keeping in mind India's specific interests, is necessary to help scientific research develop far reaching innovations, generate employment and function as a vehicle of significant economic growth.

Intellectual Property Rights

October 15, 2007

A nation's future and its ability to compete in the global market depend greatly on how it generates new ideas and innovates in science and technology. Intellectual Property creation and protection are critical issues in global knowledge based competition. Countries like China, Japan and Korea have improved their respective IPR systems through intense capacity building efforts, with a view to achieving greater innovation. It has become imperative for India to scale up efforts to build a world class IPR infrastructure and ensure that IPR is used in the best national interest for more extensive innovative research, technology transfer, wealth creation and overall benefit of society. NKC's consultations with various stakeholders have helped to identify some key areas that will facilitate such systemic reform. Some of these areas involve the granting of product and process patents, in which both the configuration of the state mechanism for patent examination and the systematisation of a substantive perspective of patent examination keeping both treaty obligations and national interests in mind are crucial issues. Other critical areas involve alternative non-patent modalities for the creation and sharing of knowledge and inventions. Below, one area, namely, the configuration of the patent examination mechanisms, is discussed, with some reference to allied issues in patent utilisation.

1. Modernisation of IP Offices

1.1 The processes in the IP offices need to become more accessible and user friendly and therefore, the ultimate objective of all efforts to modernise the patent offices must be to facilitate more transparency and procedural ease for the inventor as well as the common man. NKC is aware of the initiatives proposed by the Ministry of Commerce and Industry in this regard, especially those pertaining to modernisation of infrastructure, computerisation, digitisation, e-filing, re-engineering of procedures with information technology integration, human resource development, efficiency, transparency of procedures and creation of an operational

environment of global standards. The need to be sensitive to the needs of the everyday citizen is crucial if the IP offices have to transform themselves into service providers delivering solutions with the greatest efficiency and highest quality standards. In this respect, some suggestions are as follows:

- The patent offices must be adequately e-enabled in real time with adequate search facilities so that all its transactions are transparent and publicly accessible.
- The examination procedures, practices and decisions in the IP offices should be streamlined and consistent
- A new detailed and clear manual of the examination procedure and practice, accompanied by full text versions of all the relevant IP laws of the country, should be created, periodically updated and made available to the public, in soft and hard copy. Interested stakeholders, particularly including civil society as the major stakeholder, must be involved in its preparation. This is particularly important since new Indian patent examination procedures will need to be devised keeping both treaty obligations and national interests in mind, and the creation of an adversarial process of patent examination will be crucial in these procedures.
- There must be an educational section for public awareness on IP (including the current status of IP law on various topics) made available in the public domain in all official languages of the country.
- The patent granting procedure must involve adequate web based notification of an application with complete details to give sufficient opportunity for any pre-grant objections to be filed. It is particularly essential to provide e-access in real time to all steps of a patent application, from the detailed patent description, examination reports at each stage and all amendments introduced at various points, in order to maintain complete transparency.
- There is urgent need to develop a comprehensive patent database that provides the latest information on patents, including patent applications and decisions of patent offices. At the same time,

the patent offices must have access to relevant international databases and search engines, including databases with prior art literature.

- To achieve the best global standards in quality and access, the IP offices should aim to become International Search Authority (ISA) and International Preliminary Examination Authority (IPEA) under the PCT and to this end, aim to conform to the PCT standards in respect of possession or access to minimum documentation, number of administrative and technically qualified staff and IT support systems.
- Efforts should also be made to develop quantifiable indices for measuring, monitoring and managing quality and efficiency.
- To ensure that the services of the IP offices reach the common people engaged in rural technologies, artisanry, crafts and traditional knowledge, there should be special schemes and establishments in the patent offices to deal with claims involving the creation and protection of traditional knowledge in its various forms. Since ensuring effective and competent legal representation is a critical problem for such groups, mechanisms should be evolved that incentivise such representation by the best patent lawyers in the country.
- For each sector of highly technical patents, it may be necessary to constitute specific empowered committees of experts as part of the patent evaluation process in the patent office to decide on the suitability of granting a patent, in accordance with the provisions of the law. These committees must adhere to strict time bound procedures of examination and sufficient safeguards must also be maintained to ensure confidentiality and prevent any subversion of the process.

2. Incentive Mechanisms to Attract and Retain Quality Talent

2.1 An incentive driven system of human resources management, including fast track career structures for deserving staff should be developed within the IP offices to attract and retain competent personnel. As the IP Offices will be competing with the private industry to attract qualified scientists and engineers, they will need to reach out proactively to institutions of eminence. Candidates applying for the post of a patent examiner must be tested on a combination of skills, such as scientific/technical knowledge, practical experience of such knowledge, critical analysis, written and oral communication

skills and problem solving. Further, to ensure the availability of trained personnel in all technology sectors, the appointment of such personnel should be done periodically in a manner that ensures adequate proportional representation of each sector, by considering as an illustrative benchmark, the volume of applications and grants in the sector.

2.2 In order to deal with the existing problem of attrition of trained examiners to scientific/technical institutions and the private sector, Flexible Complementing Scheme which has been applied to scientific and technical group “A” posts should also be implemented for the technical staff of the IP Offices. Furthermore, pay scales of patent examiners should be increased for those who successfully undergo IPR training. Additionally, a fast track career should be provided to examiners who consistently perform exceptionally better than average. To this end, a transparent annual confidential reporting system should be introduced. In this context, it is important that performance in IP offices must be measured on the basis of turnaround time for applications and decisions as well as the sustainability and tenability of the decisions made, and not on the basis of the rate of rejection/acceptance of applications.

3. Training and Human Resources Development for IP Offices

3.1 There is need to intensify IPR training efforts in the IP Offices and Intellectual Property Training Institute (IPTI), including induction sessions for new staff, mid career courses and regular exposure to global best practices in IPR, wherever available, keeping in mind the best national interest. At the same time, there must be relevant safeguard procedures in place to avoid potential conflict of interest issues between trainer and trainee. The overriding aim of IPR training is to ensure legal and technological competence consistent with the best international standards. For training of IP Office personnel, an in-house Professional Development Committee (PDC) should also be formed. The PDC should identify training requirements of the IP Offices and collaborate with IPTI to impart up-to-date IP training. Steps could also be taken to invite Indian scientists located in India and abroad who have experience in patent examination processes to participate in training initiatives with Indian patent examiners. However, in-country expertise must be urgently developed for training and sensitising

IP regulatory staff in the new India-specific treaty-compliant patent examination procedures that will be required for the new IP offices.

- 3.2 The IPTI should, with active involvement from stakeholders, prepare a comprehensive induction-training course for new patent examiners on various IP topics such as patent searches (including international databases), substantive requirements for patentability of an application, examination procedure as well as drafting of objections to the grant of a patent, where a list of standard clauses of objections could be developed. Such a course could be of duration of three/six months. The course material should be standardised and could be made available on the Intranet. Once again, procedures for maintaining the adversarial nature of the new India-specific treaty-compliant patent examination process must form a major component of these programs.

After the completion of the induction-training program, a senior patent examiner could be assigned to each examiner as a training officer who would act as a mentor by supervising work, providing further training on a case-by-case basis and eventually reporting on the work of the examiner. Such training could last for a period of about six months. The IPTI should also provide advanced level courses in examination and international IPR issues after about a year to eighteen months, including courses on pre-grant and post-grant opposition procedures.

The IPTI should also collaborate with legal associations and organisations to set up specialised certificate and diploma courses in IPR and hold qualifying examinations for a patent attorney to act before the IP Offices. This would ensure that highest professional standards are maintained. Appropriate public private partnerships (PPPs) could also be evolved for this purpose.

4. IPR Education and Development of IPR Cells

- 4.1 Educational efforts on IPR must go beyond the IP offices and reach out to scientists and engineers working in national research institutes, universities, industry, the Bar, as well as to researchers and students, not just in the metropolitan areas but also in the smaller towns and rural areas of the country. Law schools throughout the country must also design specialised up-to-date courses and programs on IPR and the process of creating faculty chairs

on the subject must also be intensified through better incentives for academia. Business schools also need to incorporate IPR dimensions in their curricula.

- 4.2 There is also an urgent need to set up IPR Cells in major scientific and educational institutions in the country with trained staff, competent in the law and technical aspects of relevant disciplines.

5. Establishment of A New Institution for Cutting Edge Policy Expertise

- 5.1 The sheer complexity and scale of IPR capacity building for the 21st century require an independent world-class institute exclusively devoted to the field of IP. Once established, a National Institute of Intellectual Property Management (NIIPM), located in New Delhi, would be responsible for imparting training on a regular basis to various stakeholders, conducting cutting edge research, serving as a think tank to advise the government on IPR issues as well as conducting public awareness on IPR. Crucial parameters to set up the NIIPM include the establishment of an infrastructure of international standards, development of human resource expertise and aspects relating to finance. Initially, the NIIPM could be funded by the central government. Gradually through public private partnerships and other innovative financial mechanisms, the revenue generated from training programs would aim at ensuring self-sufficiency in the long run. The mandate of such an institution must involve policy research on the procedures to be adopted for patent examination so as to yield crucial input for periodic revision of these procedures. Also, this mandate must transcend the limited purview of the patent-oriented process for intellectual property management and must address itself innovatively to systematic exploration of other modalities for social utilisation of knowledge and inventions through structures such as copyrights and commons.

6. IPR Tribunal, Special Rules of Procedure and Judicial Training

- 6.1 Efficient enforcement is an indispensable facet of a strong IPR regime. IPR has emerged as a specialised area within law with urgent demands for speedy and efficient disposal of cases. It has become necessary to create a separate tribunal with jurisdiction

over disputes in all aspects of IPR and develop a pool of competent judges who are trained in the legal as well as the technical aspects of IPR. The IPR Tribunal should be designed to deal with the appeals arising from the decisions of IP offices. In case of appeals where issues to be decided involve technical considerations, the tribunal should consist of three judges having considerable experience in law, where at least two of them also have technical qualifications.

- 6.2 To avoid undue delays and legal uncertainties, detailed and streamlined procedures with fixed time limits should be chalked out for the IPR Tribunal after consultations with stakeholders, including civil society. There should be a strict adherence to these procedures.
- 6.3 Training of the judiciary in IPR needs to be viewed as an essential IPR enforcement issue. The National Judicial Academy is already engaged in training judges on a variety of areas, including IPR. Such training efforts have to be intensified and the establishment of the NIIPM would be a significant step in this regard.

7. Protection of Traditional Knowledge (TK) through Traditional Knowledge Digital Library (TKDL) and Promoting Incentives for Wealth Creation from TK

- 7.1 The creation of the TKDL database is a significant effort to codify and classify traditional knowledge of the country. While there is increasing recognition of the important role of the TKDL to prevent misappropriation and grant of 'wrong patents' as well as to provide incentives for innovation and wealth creation, the key challenge here is to ensure its effective utilisation to achieve these objectives.
- 7.2 The Government of India has also already taken steps to allow access of the TKDL database to some international patent offices under non-disclosure agreements for the purpose of search and examination. Steps need to be taken for the use and incorporation of TKDL into the minimum search documentation lists of International Search Authorities and other patent offices,

while processing patent applications. Further, to prevent misappropriation and to facilitate more transparency, it is also necessary to disclose and declare all pertinent sources of information relating to TK in patent applications.

- 7.3 To create incentives for commercialisation of TK, companies should be able to access the TKDL upon payment of adequate user fees and subject to the condition that inventions arising out of the TKDL would require royalty sharing with the government. The government should also take active steps to encourage investments in TK through collaborative efforts with industry and civil society. Innovative financial mechanisms should be evolved so that the revenue generated by the government from commercialisation of TKDL and other commercially synergistic initiatives is used to create a TK Development Fund. The proceeds of the fund would be used to conserve TK generally, conduct research on TK, expand the TKDL and benefit communities that have contributed to the creation of TK.

8. IP and Small and Medium Enterprises (SMEs)

- 8.1 It is crucial at the governmental level to invest in the IP needs of SMEs. There is need to facilitate better awareness on the strategic aspects of creating, managing, protecting and leveraging IP as a tool to further business opportunities and enable wealth creation. SMEs are emerging as crucial players in the global knowledge economy and unlike larger firms, they may not have the necessary resources to make the best use of IP. In this context, it is essential for special awareness campaigns for SMEs so that they are made fully aware of the various implications of IP and optimally translates such understandings into their everyday business practices.

9. Global Technology Acquisition Fund

- 9.1 The strategic positioning of India as a technology superpower will depend not just on development indigenous technological expertise, but also on the ability to make crucial technology acquisitions in the global market. Countries like Japan and Korea have successfully used such acquisitions to expand their IP portfolio and some Indian companies, especially

in the pharmaceuticals and biotech sectors, have already been engaged in such acquisitions. However, such examples are sporadic and there is need for a national strategy on technology acquisition, with the aim of leapfrogging our expertise in key areas. A Global Technology Acquisition Fund, created by the central government, could be a significant step forward in facilitating such acquisitions, especially for the SMEs. The funds could be parked with a financial institution or a special purpose vehicle (SPV) could be created to manage the fund, with members of industry and S&T invited as board members. Relevant financial instruments, including support in the form of loans and equity, could be evolved, for such technology intensive acquisition.

10. IPR and New Technologies

10.1 It has become imperative for technical institutions, scientists, examiners and other relevant stakeholders to be fully aware of the IPR dimensions of new and rapidly changing technologies, especially in ICT, biotechnology, nano-technology, electronics, engineering, bio-informatics etc. There is therefore, need for high powered expert bodies that can help identify IPR issues arising out of each of such areas, with a view to evolving necessary IPR policies that would optimally foster greater global competitiveness for Indian industry as well as ensure faster innovation, wealth creation and overall development.

Innovation

July 4, 2007

The National Knowledge Commission identified the role of innovation as one of the key factors in India's economic growth. Innovation is a process to achieve measurable value enhancement in any commercial activity, through introduction of new or improved goods, services, operational and organisational processes. It is a significant factor in facilitating competitiveness, improvement in market share and quality as well as reduction in costs.

NKC conducted a nationwide survey among large firms, as well as small and medium enterprises to explore the role being played by innovation in fuelling India's economic growth. The NKC Survey¹ reveals that Innovation Intensity (i.e. the percentage of revenue derived from products/services which are less than 3 years old) has increased for large firms as well as small and medium enterprises. The strategic prioritisation of innovation as a factor critical to growth and competitiveness has also achieved significant prominence since the start of economic liberalisation in India. The NKC Survey further highlights crucial parameters at the firm level that have enabled some firms to be more innovative than others, including the role of

structural frameworks and processes. It is expected that dissemination of the survey results across India's industrial spectrum will highlight best practices in industry and thereby also generate catalytic impact on a wider scale.

However, it is pertinent to point out that the most critical external barrier for both large firms and small and medium enterprises is skill shortage arising out of lack of emphasis on industrial innovation, problem-solving, design, experimentation etc. in the education curricula. There is also need for more effective collaboration between industry, universities and R&D institutions. Systematic reform of the higher education system (including skill based marketable vocational education) in India is essential to develop the required intellectual capital as well as generate effective synergies among industry, government, the educational system, the R&D environment and the consumer. Innovation is a complex activity that requires widespread interaction across the entire economy, from the grassroots to the large firm level. NKC recommends a comprehensive campaign to address these issues and to spur efforts to make India a global leader in innovation.

¹ For details, see http://knowledgecommission.gov.in/downloads/documents/NKC_Innovation.pdf

Entrepreneurship

June 5, 2008

The National Knowledge Commission recognises the growing significance and visible impact of Entrepreneurship on wealth-creation and employment-generation in India. Considering its importance, NKC has undertaken a study on Entrepreneurship to explore factors that have promoted Entrepreneurship in India as well as others which could further encourage and facilitate even greater growth of Entrepreneurship in the country. This report compliments earlier NKC studies and recommendations on Innovation and Vocational Education and Training. The NKC study has found that Entrepreneurship flourishes as a result of a combined input of some key 'triggers', such as a helpful business environment, access to early-stage finance, education, individual motivation and some socio-cultural factors. To accelerate the growth of Entrepreneurship in the country would require the support of multiple stakeholders such as the government, the financial institutions, educational institutions, incubator providers, chambers of commerce, entrepreneurial networks and associations as well as family and the larger community.

Based on the NKC study, some policy recommendations to further enhance Entrepreneurship are as follows:

1. Supportive Business Environment

Make it easier to conduct business by consolidating and simplifying processes, improving delivery time and curbing corrupt practices. In particular, prioritise the MCA-21 project and ensure the following:

- Make Single Window Clearance meaningful.
- Introduce a Single Composite Application Form for all clearances.
- Introduce a Single Unique Company Number for company, tax and social security registrations.

2. New Institutional Mechanisms

- Set up commercial courts to deal with commercial disputes and to speed up contract enforcement.
- Introduce Limited Liability Partnerships (LLPs) in order to ensure flexibility and low cost of

operation while limiting personal liability.

- Establish a Global Technology Acquisition Fund for Intellectual Property (IP).

3. Facilitate Information Flows

- Create 'one stop shops', web based portals and information handbooks for entrepreneurs. (NKC proposes to set up an all encompassing website on Entrepreneurship as a one-stop portal.)
- Widely publicise risk management tools such as the SME Rating Agency (SMERA), Credit Appraisal and Rating Tool (CART), Risk Assessment Model (RAM) and improving information flows through the Credit Information Bureau India Limited (CIBIL).
- Increase awareness of the Credit Guarantee Fund Trust Scheme (CGTSI). Ensure visibility and access of the 'Central Plan Scheme Monitoring System' (CPSMS), which has been proposed in the annual budget for the year 2008-09.

4. Access to Early Stage Finance

Banks, Venture Capitalists, Angel Investors etc. need to be more proactive in assessing the business opportunities generated by Indian entrepreneurs.

5. Incentives for Seed Capital Funding

- Establish a secondary market for smaller companies, which provides exit options to the seed stage investor and value addition for the entrepreneur.
- Create new instruments and institutions for start-up funding, involving multiple stakeholders (public and private).

6. Business Incubation for Entrepreneurs (BIE)

Develop and put in place a comprehensive BIE policy to increase quantity, enhance quality and increase access to financing.

7. Industry-Academia Synergies

- Enact a uniform legislation for publicly funded research which would grant IP rights for successful results of research to universities/research centres and also entitle the inventor to a share of the royalties from commercialisation.
- Enable Ph.Ds/researchers to set up commercial entities while engaged in universities or professional employment, as well as encourage universities/research organisations to establish commercial enterprises based on their new inventions.

8. Entrepreneurship Education

Make Entrepreneurship a core subject in business schools and explore possibilities of setting up specialised entrepreneurship schools at the under-graduate and post-graduate levels.

9. Vocational Education and Training (VET)/Skill Development

Modernise VET by formalising:

- Performance based training and assessment
- Innovative delivery models

- Incentives to states
- Skills in spoken and written English as a priority
- A transparent industry based certification system
- A transparent rating system for VET institutions

10. Promoting Entrepreneurial Culture

- Reward and recognise successful entrepreneurs ranging from the local to the national level and formally recognise entrepreneurial networks and associations.

The Report on Entrepreneurship has concluded that the aforesaid recommendations are critical to significantly enhance Entrepreneurship in the country and the NKC looks forward to being involved in their implementation, as may be appropriate.

Knowledge Applications

Traditional Health Systems

Agriculture

Enhancing Quality of Life



Traditional Health Systems

December 12, 2007

The current global health sector trends suggest that medical pluralism, to which Indian traditional medical systems can contribute critical components, will shape the future of healthcare. This shift from singularity to plurality is taking place because it is becoming increasingly evident that no single source of health science has the capacity to contribute solutions to all of society's health needs. India has a comparative advantage and can be a world leader in the era of medical pluralism because it has strong foundations in evidence-based biomedical sciences as well as an immensely rich and complex indigenous medical heritage of its own. The Government has already undertaken and encouraged several initiatives in the area of traditional medicine within the country including establishment of the Department of AYUSH in the Ministry of Health and creating support programs in S&T agencies like CSIR, ICMR, DBT & DST. To accelerate this momentum, the National Knowledge Commission consulted extensively with diverse stakeholders within the related fields and also constituted a Working Group of researchers, private sector representatives and policy-makers. NKC recommendations on strategies to promote the knowledge systems of traditional medicine are as follows:

1. Transform Traditional Medicine Education

The quality of and access to education in traditional medicine in the country needs urgent improvement. There are currently 450 poorly endowed colleges (undergraduate and post-graduate) admitting around 25,000 students in the country. These colleges are not training students to play leadership roles in the emerging era of medical pluralism. The major reason for this lacuna is that education in traditional medicine fails to provide the transformational catalysis necessary to link traditional medical system sources to evidence-based approaches. This has led to isolation of such education and lack of

its pluralistic integration into mainstream evidence-based medicine education, which is essential if India's traditional medical heritage is to find its rightful place in global medical pluralism.

It is recommended that efforts be made to introduce evidence-based approaches into the current educational framework, possibly through institutions of the standard of IISc, IITs and AIIMS with commensurate financial outlays.

2. Strengthen Research on Traditional Health Systems

Investments in research and development of traditional medicine have been sub-critical and fragmented resulting in scarcity of evidence about the efficacy of Traditional Health System (THS). In addition, these efforts have also been frequently characterised by a lack of rigorous evidence-based approaches. There has also been little appreciation of the role that social science research must play in comprehending the variety of societal perceptions and responses so critical to ideas of medical pluralism. There is a need to urgently establish a network of world-class research programs in different parts of the country to address these lacunae, with appropriate institutional and incentive structures. It is essential for India to make original, rigorously evidence-based contributions to the world of medicine in fields such as pharmacogenomics, immunology, drug discovery and cardiology via imaginative examination of traditional ideas such as prakriti, rasayana or rasa.

3. Strengthen Pharmacopoeial Standards

Despite extensive documentation of medicinal plants, there is a strong need for creating internationally acceptable pharmacopoeias for herbal medications, as well as eco-system specific, regional pharmacopoeias for various bio-geographic regions of India.

4. Increase Quality and Quantity of Clinical Trials & Certification

Promotion of traditional medicine goes hand-in-hand with increase in the quality of rigorous, yet sensitively designed clinical trials to support or refute traditional medical claims of efficacy. Also, lack of information on toxicological data/safety studies makes it difficult to evaluate the risk profile of traditional medications. There is a need for greater institutional enabling of such evaluations and trials. These should be accompanied by a world-class certification process, which will assist the achievement of internationally acceptable standards for good manufacturing, laboratory, clinical, agricultural and collection practices. The pre-clinical and clinical efficacy validation and standardisation of ten best THS products for global market should be supported as a flagship project. Similarly technological up-gradation of the manufacturing units involved in manufacture of these successful products to international standards must be carried out.

5. Digitise Traditional Knowledge

The work underway for creating a comprehensive Traditional Knowledge Digital Library (TKDL) should be diversified and expanded. A major program should be established for digitisation of India's medical manuscripts (located both within India and abroad) and for making this digital library accessible to teaching and research institutions in India. To modernise data-mining from the vast corpus of traditional medical literature, an all-India coordinated, "Traditional Knowledge Informatics Program" should be constructed to create a comprehensive list of available plant material-medicina (2,000 species), their products (40,000 formulations) and clinical applications (5,000 conditions).

6. Create Suitable Framework of Intellectual Property Rights

Emphasis should be put on creating suitable Intellectual Property Rights framework in the country for protection of the sources of traditional medical knowledge. At the same time sufficient incentives should be created for commercialisation of traditional medications. Steps should be taken for the use and incorporation of TKDL, with all pertinent sources of information, into the minimum search documentation lists of International Search Authorities and other patent offices while processing patent applications. Lack of clarity regarding the 'ownership' issue for traditional knowledge must

be addressed in the TKDL. This is especially pressing since underprivileged communities are commonly the primary sources of such knowledge. The need is to create IPR systems that ensure that such knowledge remains in the public domain and is "protected" for the communities of origin through mechanisms such as Geographical Indicators (GIs).

An approach to the commercial dissemination of traditional medications will be to allow companies to access TKDL upon payment of adequate user fees and subject to the condition that invention arising out of the TKDL would require royalty sharing. Both user fees and royalty must be shared between government and the communities identified as the sources of the knowledge, and innovative modalities will need to be found to administer such distribution. The revenue generated by the government from commercialisation of TKDL and other commercially synergistic initiatives should be used to create a 'Traditional Knowledge Development Fund' and its proceeds should be used for conservation, evidence-based analysis and research on traditional knowledge and for the benefit of communities that have contributed to the creation of traditional knowledge.

7. Establish Goals for Conservation of Natural Resources

Natural populations of around 12 per cent of the 6000 species of potentially medicinal plants are currently estimated to be under threat due to degradation and loss of habitats alongside unsustainable ways of harvesting and lack of cultivation. The problem of growing scarcity also leads to the danger of more counterfeit material being marketed. It is therefore necessary to support conservation and sustainable harvesting efforts in the forestry sector and cultivation in the agricultural sector. Direct support for conservation and cultivation as well as indirect methods through incentive policies should be pursued for nurturing these plant resources. The wild gene pool of India's medicinal plants should be secured, via establishment of a nation wide network of 300 "Forest Gene Banks" across the 10 bio-geographic regions of the country.

8. Support Non-government and Corporate Initiatives for Promotion of THS

The non-government and private sector have played an important role in building the public image of traditional health sciences. Non-governmental research

and education institutions, NGOs and corporates with a global vision must be strategically supported in the interest of enhancing national and international awareness of India's rich health system heritage.

9. Promote International Co-operation

International co-operation in exploration of traditional health systems must be given a big boost through substantial initiatives like strategic research collaborations with reputed research centres and establishing wellness centres in countries that offer promising market opportunities. EXIM bank of India must be supported to work with industry to open world markets for these products and services.

10. Support Primary Healthcare in Rural Areas

With 70 per cent of Indian population relying on traditional medicine for primary health care in the absence of adequate state primary health care, it becomes necessary to establish evidence-based guidelines for this informal-sector usage. A nation-wide network of Home Herbal Garden and Community Herbal Gardens (CHG) can be created to support the primary health care needs of rural communities for those plants and medications established as efficacious by evidence-based research.

11. Create A Major Re-branding Exercise of Indian Traditional Medicine

Better branding of Indian traditional medicines proven to be effective in well-designed clinical trials can increase safe and effective healthcare options. Such proven medications should be integrated with the national healthcare system. Such evidence-based, well-validated and uniquely Indian holistic healthcare system combinations must be marketed extensively globally.

In order to achieve these goals as rapidly and efficiently as possible, the Government of India may consider establishing a National Mission on Traditional Health Knowledge (NMTHK), which would take up these tasks in an organised way. It should be a relatively small body in terms of its own infrastructure with powers to enable it to recommend targeted funding in identified areas. It should support initiatives at many different levels, including state and local levels, and coordinate with Ministries of Health, Science & Technology, Forestry, Agriculture and Commerce as well as with the NGOs and private sector. The Mission leader must be a person with high public credibility, have extensive knowledge and experience in the field with established managerial capabilities and experience of dealing with all the concerned stakeholders.

The National Knowledge Commission is seriously concerned about deep crisis in Indian agriculture which has been in the making for some time. There are several dimensions of this problem. The proportion of the population employed in agriculture is as much as 52 per cent, yet agriculture contributes just 18.5 per cent to the national GDP. Thus per capita GDP and average living standards in agriculture are significantly lower than in the non-agriculture sector. Growth in terms of yield per hectare and employment creation has also slowed down in the sector and per capita availability of food grains has shown no discernible increase for more than three decades. The recent suicides of farmers are symptoms of a much deeper malaise. Thus, in order to transform India into a knowledge economy, it is imperative that we focus on agriculture on a priority basis. In this regard NKC believes that appropriate application of knowledge in agriculture can play a major role in boosting the agrarian economy and giving the Indian farmer a competitive edge in the global market.

We note that various Commissions and Working Groups set up by the Government of India at different times have made a number of important and extremely useful recommendations. Yet it is a matter of concern that most of these recommendations have not been implemented. We urge you to consider these recommendations for speedy implementation. In addition, we would like to make some further recommendations, based on discussions with a variety of stakeholders and the Report of a Working Group representing agricultural scientists, managers of extension services, independent analysts and representatives of farmers' organisations and of companies linked with commercial farming. We recommend the following concrete steps for the revitalisation of knowledge generation and application in agriculture:

A. Knowledge Generation

1. Modernise and stimulate agricultural research institutions, co-ordinate research and make research support more flexible

- Each State Agricultural University (SAU) and Indian Council of Agricultural Research (ICAR) institute should create a research policy unit comprising core faculty and also including other issue-based stakeholders.
- Based on the research policy and programs, expected research output and linkages to extension and other stakeholders, each SAU and ICAR institute must put forward a set of valuation indicators, to be used for periodic assessment and public scrutiny.
- Both the ICAR and SAUs should assign about 50 per cent of their total research resources (largely Plan funds) to support a competitive grants system, with its deployment focused on priority multi-disciplinary and regional research areas.
- Priority problem oriented research in a competitive funding mode should be promoted, for example by identifying a group of scientists reputed for excellence in an area and encouraging them to form a coalition to work on specific problems in mission mode, with required funding support.
- Regional Coordination Units should be initiated under the umbrella of the SAUs, and should include representatives of ICAR, relevant line departments, Agricultural Technology Management Agency (ATMA), rural credit agencies, cooperatives, private sector, farmers' organisations and key civil society organisations falling within the particular region.
- Decentralisation of research management and authority and distribution of accountability at different levels in the ICAR and SAUs are

required. Scientists and research teams should be empowered to function in this decentralised system, with administrative and financial support. This will require the amendment of the Model Act (1966) and University Acts binding all SAUs, and a change in the legal status of the ICAR to grant full administrative and financial autonomy with enhanced funding.

- There should be emphasis on ensuring research relevant to farmers' needs, by encouraging and institutionalising greater interaction between research and extension personnel and providing feedback mechanisms for farmers.

2. Improve the organisation of agricultural research

- The Research Project File (RPF) system in ICAR institutes has fossilised and does not assist the conduct or management of relevant research. The lab/project file must be made mandatory in SAUs and ICAR institutes and computerised on a priority basis, preferably by 2009-2010. This will enable the creation of a research database within the organisation and at the national level.
- Based on this lab/project file system, there should be an annual scientific audit of each program/project.

3. Direct more research to neglected areas

- Much more research activity is required for enhancing productivity in rain-fed agriculture and the cultivation of traditional staples.
- Research into improvements in post-harvest technology and storage patterns should be promoted with special funds allocation.
- The possibilities and problems associated with 'jhum' cultivation must be addressed.
- Agriculture and rural livelihoods in the North Eastern region deserve very special attention, including with the establishment of a sub-cadre of agricultural graduates well trained to meet local R&D needs.
- While water management has been and remains a major area of agricultural research, there is need for more locally specific result-oriented research to develop techniques that can be easily applied by farmers.
- More research is also required to address the mitigation of, and adaptation to, climate change.

4. Provide more effective incentives for researchers

- Agricultural research should be made attractive as a career option for young scientists through appropriate recruitment and personnel policies, incorporating a flexible system of incentives in career advancement and remuneration.
- The ICAR and SAUs should promote and recognise quality and relevant scientific output by promoting research publication, establishment and working of patents, technology development and transfer. These should be accompanied by strong disincentives for unethical and fraudulent professional practices.
- In order to promote team-based research, a system of equitable incentives for the leader and the members of the team should be devised.
- As in the ICAR, the SAUs should introduce sabbatical leave, giving scientists the freedom to choose any laboratory or relevant institution within or outside the country for advanced studies during the sabbatical period with full pay. In addition, leave may be given to those scientists who have developed a technology area (including a patent) with high public interest value, to work on such development in their own capacity, in case the technology is not being developed by other parties.

5. Change the curricula in agricultural universities to ensure greater relevance

- Curricula should be changed with a bottom-up approach to prepare students for careers in agri-businesses and agri-clinics, and to give them new skills in entrepreneurship development, communication skills, computer knowledge, agribusiness, environment science and biotechnology. This requires both the introduction of new courses and major reforms in the examination system.
- With the increasing feminisation of agriculture, it is very important that agricultural curriculum should be engendered by introducing basic courses on Gender Concerns in Agricultural Development.
- The system should be able to provide periodic (and more frequent) refresher training for extension workers to upgrade their technical efficiency.
- Non-formal education programs should be initiated in need-based vocational modules to generate para-professionals for technological and economic empowerment of the rural youth.

6. Exploit the opportunities and meet the challenges of Intellectual Property Rights

- Any licensing of IPR enabled technology by public research must be done without in any manner excluding its access by resource-poor farmers.
- As the holder of thousands of farmers' varieties of plants and animal genetic stocks, the ICAR must immediately enunciate the policy and guidelines on the access to these materials by the private sector and the IPR related regulations applicable on the genetic material being accessed by these parties.
- There should be total transparency on all transfer or exchange of genetic material, and clear regulation to prevent private appropriation of farmers' varieties and animal stocks by misusing IPRs within or outside country.
- The ICAR and SAUs must lay down clear guidelines to ensure benefit sharing with farmers who have preserved genetic resources, with respect to themselves and also other commercial parties.

7. Encourage and regulate private agricultural research

- While private sector presence is rapidly increasing in biotechnology, critical input services and related areas, the thrust of private activity is on market-driven knowledge and services. Public-private partnerships should be leveraged to benefit resource poor farmers, who tend to have less access and to ensure that private research meets social needs.
- In the case of biotechnology and its application to crop plants and animals, particularly those in the food and feed chain, research on bio-safety aspects and processes leading to the release of such plant varieties in the environment should assume the highest priority, with transparency and civil society participation.
- Systems need to be developed to monitor the results of private research so as to avoid the problems associated with conflict of interest.

B. Knowledge Application

The current system of agricultural extension in the country is based on a linear transfer of technology model, which needs to be made more responsive to local situations and community needs. To improve the scope and efficiency of extension, the focus should shift to providing an integrated range of services, making grass root workers devote more time to location-specific problems and be more accountable to the community.

8. Make knowledge applications in agriculture community-driven and farmer-led

- Both panchayats and community-based organisations should be treated as platforms for delivery of an integrated range of services from production to post-harvest storage to marketing.
- New methods of collaboration between scientists and farmers must be institutionalised in order to identify their needs, set priorities in work programs, test and refine the technologies and evaluate the final results.

9. Redesign the existing support systems

- Support systems should move from input-centric model to output-centric models. This requires redesigning the support systems and incentives in the existing centrally sponsored schemes like Rashtriya Krishi Vikas Yojana (RKVY), National Rural Employment Guarantee Scheme (NREGS), National Horticulture Mission, National Food Security Mission, and National Watershed Program.
- The scope of the NREGS should be expanded to support small and marginal farmers in the production of food crops like traditional staples such as millets, organic soil management, Natural Pest Management, System of Rice Intensification (SRI) etc.

10. Document and disseminate successful experiences and good practices

- The current extension system is based on technologies generated in the formal research institutions. This completely ignores the successful technologies generated by farmers and civil society organisations, which are based on local knowledge and may be more locally adaptable and with stronger ecological principles.
- Therefore special initiatives are required to find and document the successful experiences of farmers in particular areas and encourage their dissemination by the formal institutions and support systems.

11. Improve the capacities and expertise of extension workers

- Extension workers must be provided with the necessary resources and facilities to carry out their work effectively, including transport and

communication facilities such as two-wheelers and mobile phones where necessary.

- The present extension staff must be retrained to be able to provide information and assistance not only for agriculture and animal husbandry, fisheries and horticulture, but also with respect to methods of storage, transport, market access, value addition, credit etc.
- The syllabi in agricultural colleges and agricultural polytechnics must be restructured to prepare a cadre of extension workers who can broaden extension delivery.
- Institutional arrangements need to be developed to ensure continuing education of those involved in agricultural extension, whether in public institutions or in private capacity.

12. Restructure Agricultural Technology Management Agency (ATMA) to make it more decentralised, participatory and locally responsive

- The staff of the various line departments connected with agricultural development (agriculture, horticulture, animal husbandry, dairying, fisheries) should be placed under the control of ATMA at the district level, with technical support, monitoring and quality control provided by the respective departments at the State level.
- This calls for restructuring the line departments at various levels and the recruitment of a competent and experienced Project Director in each district, with the exclusive function of management of the ATMA.
- The district level agricultural sector management programs and plans for ATMA need to be prepared with a bottom-up participatory approach emphasising convergence and based on consultations with all stakeholders at the village level, which can then be consolidated at block and district level.
- The Department of Marketing, Department of Credit, Agricultural Universities, KVKs, NGOs etc. should be partners in the planning process and provide support to the ATMA, in addition to implementing collaborative activities and programs. The District Collector as the chairperson of the governing board of ATMA can play an important role in ensuring the participation of these partners.
- The implementation of the district level plans should be through Result Oriented Management (ROM) rather than the target-oriented management

approach which is followed at present in ATMA. This process requires that short term management training be provided to all categories of staff and stakeholders engaged in implementation issues.

13. Enhance and regulate the role of private players in agricultural extension delivery

- The already large involvement of private agencies in agricultural extension should be recognised and encouraged, and most importantly, integrated with the public provision through some institutionalised mechanisms.
- At the same time, problems of conflict of interest in private provision must be minimised by appropriate regulation, with broad guidelines and a clear code of conduct.
- The existing multi-agency and multi-media extension strategies need to be co-ordinated, with some integration and interaction on content between various extension providers such as farm schools, information kiosks, web-based providers, kisan call centres, agri-clinics, mass media etc.
- Contract farming has the potential to benefit small farmers when practiced appropriately, by providing larger scales of operation and assured market and price for the produce. To ensure the positive effects while preventing exploitation of farmers, legislative benchmarking of minimal standards in the conduct and practices of such contracts should be defined by the Central government, leaving flexibility to states for enacting state-specific laws, which could be either *at par* or above the central benchmark.

14. Create a web-enabled knowledge bank on all aspects of agriculture

- Such a knowledge bank should strive to include all traditional knowledge that is credible *prima facie* or validated, all modern knowledge generated by research over the years with location-specific features highlighted, and appropriate information on post harvest and value addition aspects.
- It must also include dynamic data on marketing and market price movements, seasonal agricultural advisories, regional meteorological information etc.

We believe that these changes are both necessary and desirable in order to encourage the creation and dissemination of useful and relevant knowledge in agriculture.

Enhancing Quality of Life

Setting up Panchayat Gyan Kendras

March 2, 2009

The National Knowledge Commission considers it imperative to ensure that the applications of knowledge are used for the well-being of common people, especially in rural areas. Our consultations with a working group of experts involved with grassroots organisations helped identify some workable ideas and existing projects that have potential for scaling up. One of the projects identified for implementation after discussions focused on the need to set up Panchayat Gyan Kendras (PGKs) throughout the country. The findings from this project form the basis for our policy suggestions in this letter.

We believe that it is essential to build capacity in Panchayats to ensure participatory decision making and a healthier democracy. Building a system that can tap and develop locally available knowledge resources through Panchayats is crucial for the efficient implementation of initiatives such as NREGA. Such a system also provides creative outlets for harnessing local knowledge to meet a variety of needs in diverse areas such as health, education, agriculture, forestry, water etc. On a short term basis, NKC, along with the Mazdoor Kisan Shakti Sangathan (MKSS) and the School for Democracy, Rajasthan, helped set up a PGK in Rajsamand district in Rajasthan to efficiently implement the NREGA and use the systems developed to create a more participatory, transparent and accountable Gram Panchayat. We believe that eventually, if a network of such PGKs is set up across the country, it will help identify, harness and replicate the tremendous human resource and knowledge pool that exists, to improve the quality of life of India's people.

Panchayat Gyan Kendra in Every Block

We recommend that every block in the country should have at least one PGK. The PGK can become a resource centre to demonstrate best practices, evolve local solutions and serve as a training institution. It can also offer an opportunity to bring together elected representatives (including Panchayat representatives)

policy makers and civil society in a creative endeavour of local self government for efficient delivery of basic services. This system of PGKs can be initiated through the broader platform of a Panchayat Knowledge Mission, for maximum scale, commitment and effect. While it is envisaged that the PGK will eventually develop into a comprehensive resource, it could initially concentrate on areas related to the NREGA. As such, the PGK can immediately address the following issues in the NREGA by building demonstrable systems of people-based implementation:

- 1. Peoples planning:** Institutionalisation of proper planning mechanisms requires area-specific processes, evolved after concentrated effort at the local level. The PGK could be required to carry out:
 - An initial review of existing plans and initiation of the peoples planning process
 - A tentative revised plan for the first year of NREGA works to be prepared in 3 months
 - Institutionalising a long term planning process in a year's time
- 2. Worksite management:** The NREGA can work well if there is decentralised accountability at every one of the hundreds of work sites in each district. An efficient worksite management system will change the work culture, involve a new set of educated unemployed youth and bring about skill upgradation in an organised manner. The PGK can serve as the platform for implementation of the following:
 - Initial training of NREGA worksite managers ('upgraded mates') in 3 months
 - Facilitating adequate training and competencies of all worksite managers in the block in one year
 - Institutionalising worksite management systems including systems for training women masons, appropriate worksite facilities, improved tools and certified worksite managers. This would require a period of two years

3. **Computerisation of the Panchayat Office:** To address efficiency and accountability issues, the PGK can assist in computerising the Panchayat office. This would involve:
 - Computerisation of NREGA documents in 6 months
 - A fully computerised and organised Panchayat office in 12 months
 - Institutionalising this process with innovations such as information kiosks at the Panchayat level, over a period of two years
4. **Use of ICT:** Use of ICT innovations for better governance would involve proper record maintenance, enhanced transparency and proactive disclosure, efficient and timely wage payments and facilities for financial inclusion at the Gram Panchayat level. This could also include innovations to reduce the digital gap by making the PGK a public internet point of the Panchayat. To ensure transparency, ICT should also be employed in bank transactions for wages as well as to create bank accounts for NREGA workers. This would provide an important system of checks and balances.

One such initiative is a live pilot jointly launched by NIC and India Post in the state of Orissa in December 2008. In this pilot, postal agents in villages have been equipped with mobile phones enhanced with unique secure transaction technology, and supported by smart card readers and finger-print sensors, to interact with NREGA workers and securely deliver payments. Near real-time data entry from these terminals to the block level system using mobile data connection ensures minimal latency and enhanced transparency in servicing worker requests. While the first phase of the live pilot is focused on secure delivery of payments to the workers, the larger goal of this exercise is to create “pseudo-bank accounts” for all the participants, which will be hosted by India Post (and any other treasury authorised by the Government of India). A similar pilot project for enabling wage payments through ICT is also under consideration in Rajsamand district in Rajasthan.

5. **Disclosure processes:** To ensure transparency in Panchayats, due mechanisms need to be incorporated including an open office, open inspection and an institutionalised system of proactive disclosure for NREGA, as well as

other Panchayat programs and functions. For all Panchayat offices, this would require a year.

6. **Social audit:** To further ensure a system of accountability and monitoring, a full social audit of all NREGA works in the Panchayat needs to be conducted twice a year. This would aim to cover neighbouring Panchayats and eventually the block within one year.
7. **Programs for skill upgradation:** Such programs for NREGA workers in the Gram Panchayat could be evolved based on local skills and local employment opportunities. These could then be institutionalised in a phased manner in the block and district. Locally appropriate and useful labour intensive works could be proposed and tried out, so that they can be included in the list of permissible works under NREGA.
8. **Effective local designs for labour intensive works to build rural infrastructure:** The NREGA is an employment generation program which requires the use of labour resources on a priority basis. NREGA allows various types of labour intensive works to be carried out – such as water harvesting structures, forestry, roads etc. To increase efficiency and reduce drudgery, relevant designs have to take into account locally available material, geo-climatic conditions and social factors, including the need to optimally use human resources of the area. This task requires a local centre for innovation and design, which could be facilitated by the PGK. Further, the productive value of these works could be enhanced with appropriate scientific and technical inputs. In a related letter, we have discussed the need for ergonomic tools, especially among workers involved in manual labour tasks.
9. **Design of appropriate worksite facilities:** The NREGA mandates that all workers be provided with clean drinking water, shade, crèche facilities for small children, and first aid facilities at the work site. This is crucial to ensure dignity of labour and to make the worksite a safe working environment. This task also requires an appropriate set of local designs for management as well as the means of delivering these facilities.
10. **Convergence of different social sector programs:** Finally, the NREGA offers huge potential for facilitating convergence of different social sector

programs as it brings together rural labour at one place. This can enable a number of empowerment and awareness generating efforts in health, education, workers rights and understanding of democratic processes. The PGK could function as a platform for organising melas, workshops and training, which not only deal with the NREGA, but also enhance participatory processes in all social sector programs in the Panchayat. The PGK could thus play a critical role in creating a well-informed citizenry.

11. Establishing a Panchayat Knowledge Mission:

The knowledge gathered and generated, and the lessons learnt in different parts of the country in the PGKs need to be brought together on one

platform so that a cross fertilisation of ideas can take place. Also, there is a need for national resource centres, to provide technical and appropriate support to help PGKs carry out their objectives and overcome challenges through creativity and innovation. Such an effort would require flexibility and support best provided through a mission approach. The Panchayat Knowledge Mission and its special resource units can enlist technical help and expertise to meet demands for such support from any part of the country.

We believe that building a network of PGKs, backed by ICT and transparency mechanisms will create a wealth of innovative, scalable best practices and qualitatively improve democratic governance in the country.

Enhancing Quality of Life

Designing Ergonomic Tools

March 2, 2009

The National Knowledge Commission considers it imperative to ensure that the applications of knowledge are used for the well-being of common people, especially in rural areas. Our consultations with a working group of experts involved with grassroots organisations helped identify some workable ideas and existing projects that have potential for scaling up. One of the pilot projects selected for implementation after discussions focused on the urgent requirement for ergonomic tools, especially among NREGA workers. This project recognises the enormous skills involved in manual work and aims to give workers tools that will help them carry out their task in a more specific and less physically taxing manner. The findings from this project form the basis for our policy suggestions. In this letter, key issues discussed pertain to designing ergonomic tools as a means of improving dignity of labour, encouraging energy efficiency, reducing workloads for women, reducing drudgery, increasing skillful engagement and improving productivity.

MAEER MIT Institute of Design (MITID), Pune in collaboration with Mazdoor Kisan Shakti Sangathan (MKSS), Rajasthan were identified by NKC as 'host institutions' to conceptualise fresh perspectives in tool design. Based on consultations and feedback received, we suggest the following steps to enable a qualitative improvement in general working conditions in occupations involving manual labour:

1. Improve Dignity of Labour

Creating a people-based development process is essential to improve working conditions and ensure dignity of labour. Large-scale government schemes which generate employment opportunities for those involved in manual labour should incorporate necessary processes and incentives for providing appropriate work environment, facilities and ergonomic tools to workers. Dignity of labour will be enhanced if basic facilities for water, shade, first-aid and child-care are also provided at the work site. Also pertinent here is the need to

define appropriate work hours, productivity norms and mechanisms for grievance redressal to address issues of harassment and exploitation.

2. Modernise Tools and Technology

Redesigning low-cost tools for greater efficiency and modernising tool kits needs to take into account India-specific factors such as the geographical and cultural diversity of the country. These factors include land, terrain, clothing, social conditions, traditional practices in tool-use and significantly, specific problems faced by women workers. There is also an urgent need to recognise that the tools currently used are of a very basic nature and involve low appropriate technology, minimum production complexity and local production. Also, these tools are often multi-purpose in nature and therefore unable to deliver efficiency in specialised tasks. For example, it is recognised that digging trenches for irrigation and digging for road development have become very specialised tasks, requiring special energy efficient tools. While traditionally single tools have served the purpose of multiple tasks, there is increasing realisation now on the need to design a variety of specialised tools. The following suggestions will help address such issues:

- Explore co-creation and a participatory design approach and process
- Involve the beneficiaries during testing and validation
- Engage social mobilisation mechanisms extensively
- Carry out strategic grouping of tools based on functionality and tasks
- Articulate strategies and norms for maintenance and up-keep of tools
- Identify and analyse areas of mechanised and semi-mechanised tools/equipment, keeping in mind efficiency and employment opportunities
- Identify and partner with manufacturing clusters and manufacturers, including small and medium enterprises
- Alter the weight of tools keeping needs of women workers in mind. Weight reduction of tools makes the task easier and less intense

- To optimise the weight of the tool, bring about changes in the profile as well as the angle of the blade used, specific to the type of operation (e.g. ‘angular digging edge’ to dig better, ‘multiple digging edge’, ‘dimensioned digging edge’ etc)
- By optimising on materials (eg. use of medium carbon steel) weight can be reduced while keeping the digging quality unchanged
- Use mechanical traction devices to enable load carrying from one point to the other (both vertically and horizontally) to overcome drudgery and ensure dignity of labour
- Provide necessary tools in the form of a ‘tool kit’ to the beneficiaries as another means of upgrading skills. The tool kits must be available at work sites and carrying them from home to the work place should be discouraged. Such modern tool kits must be evolved for not just field labour but other works such as plumbing, masonry, carpentry and electrification
- Aid heavy labour intensive tasks by semi-mechanised or mechanical traction devices to overcome drudgery and increase efficiency. This would also ensure that labour displacing machines do not take away the livelihood of workers.

3. Funding Mechanisms for Development of Toolkits and Provisions for Loans

To ensure financial and operational sustainability as well as to achieve scale, it is necessary to create appropriate funding mechanisms that catalyse the task of creating relevant R&D. This will also encourage various industrial, academic and research institutions and engage young minds in a critical, if often overlooked part of the development process. From the point of view of the beneficiaries, the incorporation of redesigned tools and related R&D within the structure of an employment scheme (such as NREGA), would facilitate easy access and also encourage R&D providers. Within a program like the NREGA, there is a need for appropriate designs of tools for women, as well as for those who are physically weak and caught in a vicious

cycle of low nutrition and reduced physical efficiency. The proposed Skill Development Mission could also create mechanisms to encourage the redesigning of such tools. Further, in this respect, it is necessary to incentivise private sector producers and importers of low-cost cutting-edge, human dignity-enhancing tools and implements. Incentives such as tax and duty policies favourable to local production as well as low-cost loans for buying such tools should also be considered.

4. Training and Upskilling Manpower

In order to harness the true potential of India’s demographic dividend, we have highlighted the urgent need to produce skilled manpower and upgrade human resources. In this respect, as a means of encouraging the use of ergonomic tools and skill development, schemes for lifelong skill upgradation through training programs must also be available for workers engaged in manual labour. Further, such training must be available locally to enhance access, taking into account context-based technical and planning specifics.

5. Portals and Guilds for Workers

Creating portals and guilds for workers will enable easy access of information on the availability of jobs and also facilitate transactions such as purchase of relevant material and ergonomic tools. In this respect, a key objective of the proposed Skill Development Mission is to develop employment exchanges as outreach points for storing and providing information on employment and skill development as well as enabling them to function as career counselling centres. At the local level, institutions such as the Panchayats should be involved to manage such portals or kiosks.

We believe that implementation of these suggestions will better the working conditions of people engaged in manual and other tasks in the country. This will also help in heralding a change in mind sets, which is essential to improve human capital and dignity.

E-governance

January 26, 2006

After a series of discussions and reviews of various E-governance efforts at the Centre and State levels, NKC formed a special group, under the chairmanship of Nandan Nilekani, to study E-governance. The report of this group was discussed at the Planning Commission and presented to the Minister for Communications and Information Technology. Thereafter, several discussions were held with other stakeholders including the Administrative Reforms Commission. Based on these discussions, NKC is convinced that E-governance is more about an opportunity for administrative reforms than merely about electronics and information technology and infrastructure. NKC's recommendations on E-governance which broadly relate to Processes & Standards, Infrastructure and Organisation are as follows:

1. Government Process Re-engineering Before Any Computerisation

At present the E-governance efforts are primarily based on computerising age-old processes left behind by British Raj and compounded by a plethora of new layers and silos by Indian bureaucracy, each working within departmental boundaries and pet-priorities. As a result we are computerising cumbersome processes and hence not commensurately benefiting from it. Simply digitising the existing government processes merely adds an additional layer of expense, complexity, delay and confusion. NKC feels that there is now a unique opportunity in the history of India to leave behind the British Raj and re-engineer and modernise government processes to build a new India of the 21st century. Hence it is essential to first redesign the government processes keeping the citizen at the centre, providing for the enablement of citizens, businesses, producers and consumers, replacing the old mistrust and control regime of the colonial past. This redesigning of government processes will drastically reduce the numbers and duration of successive steps required to obtain services. It will also provide traceable records, enable enforcement of individual performance,

accountability, efficiency and productivity, as well as transparency of policies and processes.

2. Ten to Twenty Important Processes and Services

To make an immediate impact on citizens it is critical to identify and simplify important processes and services, say 10 to 20 to begin with, which are currently cumbersome, bureaucratic and prone to unnecessary delays and even corruption. These processes can be simplified and made available as web-based services. Initially, these services could include birth certificate, death certificate, proof of residence, and ration/ID cards. Other processes can be added over a period of time. This approach will require each state to implement these processes in concert and learn from each other.

3. Common Standards

At present, various State Governments are choosing their own ways of selectively computerising their processes and provide E-governance. Many of these programs are vendor-driven and not scalable. It is critical to develop and enforce citizen/business entitlement standards uniformly over all states and central ministries and functions, spanning from voting, taxes, certificates, financial products, law-enforcement and welfare for individuals, properties of land, institutions, businesses etc. These standards should not be hardware-centric and vendor dependent but should enable easy participation by any State, Panchayat Institution, business, NGO or citizen, whenever they decide. These standards, templates and data formats must be designed carefully by teams of experts drawn from government, IT companies, academia, R&D institutions and users or stakeholders who understand latest trends, technology, software, user interfaces and interoperability requirements. NKC recommends that all State Governments follow these standards. At the same time, it is also conscious of the need to incorporate some of the standards followed by State Governments.

4. Best Practices and Lessons from the Past

A great deal of work has already been done in various central ministries and in State Governments. The key is to learn from these and design best practices that are affordable and applicable nationwide to ensure ease of use and interoperability. NKC notes that the Government's own offices, laboratories, and directorates have an immense amount of useful and relevant data [e.g. the seven centres of the National Bureau of Soil Science and Land Use Planning (NBSSLUP)], which needs to be digitised and made publicly accessible for use and analysis. Data collected by one agency should be made available across all agencies as well as to the public, subject to national security considerations.

5. National Infrastructure

It is important to provide secure broadband infrastructure and associated hardware, software and hosting facilities nationwide with easy access at all levels. This infrastructure should be based on a 'user pays' principle and public-private partnership in investments and mutual accountability and efficiency. This infrastructure creation should be led by the Central Government to enforce a high level of security, uniformity and standards at every interface, regardless of state language, culture, legacy and financial health.

6. Web-based Services

To enforce standards and to keep the governance uniformly responsive and transparent, it is recommended that State Governments use templates created by the Central Government to offer localised data and services in Indian languages. In this model, the private sector can invest in creation of access-infrastructure and building relevant business models for user-fee collection and its sharing across all stakeholders, to ensure sustainability and adaptation for future needs. This also implies that all public institutions will make sure that all public data is available on the web.

7. Open Source Software

Because of the enormous size and scope of the E-governance effort in India and because of the availability of globally recognised software talent of Indians, we must actively encourage open source software implementations and open standards wherever possible.

This will allow us to have cost-effective solutions and help develop open software products and standards. It will also help improve scaling up and minimise delays caused by repeat tendering.

8. Specialist CITO (Chief Information Technology Officer)

Each State and major Central Government departments must create an empowered chief information technology officer, with relevant expertise and skills in the domain subject and IT usage. These posts must be filled on open recruitment and draw the best and the brightest from India's technologically qualified talent. These officers should be paid market salaries and have a three-year contract with the Government, which can be renewed depending on performance.

9. New National Programs

As government plans to spend hundreds of thousands of crores on Bharat Nirman, Rural Employment Guarantee Scheme, and urban development initiatives, it is recommended that we mandate that each of these programs begin with well engineered E-governance implementation and web-interface that ensures speedy delivery, productivity and efficiency. It is recommended to invest one to two per cent of the national program budget in establishing new processes and associated E-governance infrastructure to improve delivery and reduce leakages.

10. Focused Organisation

For national E-governance to succeed, it is critical to create an appropriate central organisation with structures that can operate in a mission mode, with full autonomy and accountability. NKC recommends creation of an organisation with a Chief Executive Officer (CEO), with board members drawn from the IT industry and government to redesign processes and procedures, to represent a multiplicity of stakeholders and diversity in domain expertise, and to drive the national E-governance plan with facilitation from the CIT Ministry.

The task of this organisation shall include but not be limited to:

- a) administrative reforms related to process re-engineering
- b) providing and maintaining common national ICT infrastructure for E-governance

- c) providing leadership and framework for implementation, with immediate focus on selected mission mode projects ; and
- d) providing a neutral consulting framework and standards for E-governance with the help of CITO's

There is a need to re-engineer our processes first to change our basic governance pattern for simplicity, transparency, productivity and efficiency, to select 10 to 20 important services that make a critical difference, to offer web-based services, develop common standards

and deploy a common platform or infrastructure for E-governance to make it citizen-centric.

As a next step, NKC recommends focusing on the organisational issues related to re-engineering government processes with strong committed leadership, autonomy, flexibility, clarity of purpose, predefined deliverables, measurable milestones and periodic monitoring in order to implement the national E-governance program within three to five years.

NKC: Impact

Knowledge Initiatives in the Eleventh Five Year Plan

In view of the critical role that knowledge institutions would play in making India a global leader in the 21st Century and in meeting the growing aspirations of the large component of the young in India's population, there was little doubt that education and related sectors would merit large infusion of resources in the XI Plan. It was also apparent that institutional reform would need to supplement this infusion. NKC was envisaged by the Government as one of the key concurrent processes for the XI Plan: 2007-12. Recommendations of NKC have been key inputs in formulating broad contours of the XI Plan. Some of these are highlighted below.

XI Plan 2007-2012

The XI Plan, approved at the meeting of the National Development Council on 19 December 2007, places the highest priority on education as a central instrument for achieving rapid and inclusive growth. This is reflected in the four fold increase in resources allocation. At Rs. 2.70 lakh crore, it constitutes 20 per cent of the Plan, representing a credible progress towards the target of 6 per cent of GDP. The following paragraphs summarise the major components of the XI Plan relating to the recommendations made by NKC. They appear in the same order as in the Plan.

E-governance for better service delivery (Volume I: Inclusive Growth)

- Process re-engineering to be the most crucial element of the agenda to make delivery of services citizen centric.
- Creation of a common service delivery platform including State Wide Networks, Common Service Centres and Last Mile Connectivity.
- A body with PM as Chair to prescribe deliverables and milestones for the National e-Governance Plan.
- Make use of e-governance in implementation of all major flagship programs.

Vocational training & skill development (Volume I: Inclusive Growth)

Launch a National Skill Development Mission with an outlay of Rs 31,200 crore to increase capacity from 2.5 million to 10 million per annum. The National Skill Development Mission would:

- Encourage Ministries to expand existing public sector skill development infrastructure and its utilisation by five fold.
- Modernise existing public sector infrastructure to get into PPP mode with functional and governance autonomy, establish a credible accreditation system and a guidance framework for all accrediting agencies, encourage agencies to rate institutions on standardised outcomes, and establish a "National Skill Inventory" and a "National Database for Skill Deficiency Mapping" on a national web portal.
- Set up a National Qualifications Framework, which establishes equivalence and provides horizontal mobility between various Vocational, Technical and Academic streams at more than one career points and a Trainee Placement and Tracking System for effective evaluation and future policy planning.
- Enlarge the coverage of skill spectrum to 1000 trades, with relevance to our emerging needs while making a distinction between structural, interventional and last mile unemployment and correspondingly set up programs for 24 months, 12 months and 6 months duration. "Finishing Schools" will be encouraged to take care of last mile unemployment.
- Create a "National Skill Development Fund" imposing a universal skill development obligation on industry to invest in skill development of SCs/STs/OBCs/Minorities/other candidates from BPL families – as their contribution to affirmative action combined with matching government contribution.

- Facilitate repositioning of employment exchanges as outreach points of the Mission for storing and providing information on employment and skill development and to function as career counselling centres.
- Enlarge the 50,000 Skill Development Centres program eventually into a “Virtual Skill Development Resource Network’ for web based learning.

Innovation (Volume I: Inclusive Growth)

- Put in place a National Innovation Policy which encourages competition among enterprises, greater diffusion of knowledge and increased support to early stage technology development initiatives and grassroot level innovators.
- Foster increased collaboration among the R&D institutes, Universities and private sector enterprises and leverage upon their cumulative strengths in designing and implementing various innovation programs.
- Create new interface structures to forge partnerships between academia and industry.

School education (Volume II: Social Sector)

- Reorient Sarva Shiksha Abhiyan bringing in a strong rights focus to make Right to Education a reality: ensure basic learning conditions, special focus on Math, Science & English, common syllabi and curriculum and pedagogy.
- Gradually reduce Central Government’s funding over the Plan period rather than move immediately to 50:50.
- Ensure minimum standards and norms for public and private schools and address systemic issues of accountability and decentralisation of decision making, teacher recruitment, teacher training, learning outcome measurement, teacher motivation.
- Recognise and encourage the role of private providers.
- Special focus on disadvantaged groups and educationally backward areas.
- Scheme for Universal Access and Quality at the Secondary Stage; set up 6000 Model Schools one in each Block, upgrade 15000 primary schools to secondary level, additional infrastructure and additional teachers, hundred per cent trained teachers.
- Use ICT based pedagogy and learning aids, provide

broadband connectivity to all the Government and Government aided secondary schools.

- Strengthen teacher training and professional development.

Higher & technical education (Volume II: Social Sector)

- Expansion, inclusion and rapid movement in quality by enhancing public spending, encouraging private initiatives and initiating the long overdue major institutional and policy reforms, will form the core of the XI Plan effort.
- Improve quality: work on a detailed reforms agenda including: a) admission, curriculum and assessment; b) accreditation & ratings; c) teachers competence and motivation; and d) restructure affiliated colleges and research for policy formulation.
- An apex Independent regulatory mechanism accompanied by greater autonomy and internal accountability; establish a high level committee to suggest specific reforms
- Quantitative expansion through establishment of new government and private funded institutions and increased intake in existing institutions.
- Reduce disparities based on gender, caste, region etc. through differential support.
- Establish 30 new Central Universities, 16 in States where they do not exist and 14 as World Class Universities (all India admissions, course credits, regular syllabi revision, incentives for faculty, strong linkage with industry and research institutions, no affiliated colleges, outsource non teaching functions).
- Establish 8 new IITs, 7 new IIMs, 10 new NITs, 3 IISERs, 20 IIITs and 2 new SPAs.
- Provide flexibility to universities to raise fees accompanied by scholarships, fellowships and student loans.
- Establish a National Science & Engineering Research Board for rejuvenation of research in Universities.
- Launch a national Mission in education through ICT coverage in all the Universities and colleges; broadband connectivity through National Knowledge Network and requisite nodes within institutions; to be implemented through an Empowered Committee.
- Revitalise and reform polytechnics through industry linkage and teacher development, establish 210 community colleges and 700 polytechnics.
- Strengthen Open Universities and reform statutory

bodies, scale up SAKSHAT as the education portal for 50 crore people.

Libraries (Volume II: Social Sector)

- Develop Public Libraries including Rural Public Libraries.
- Special collections and technological support for visually challenged and hearing impaired.

Translation (Volume II: Social Sector)

- A National Translation Mission for promoting Translator education including specialised courses in translation technology.
- Translate at least five good literary works in every language into all other major languages.

Legislative framework for public funded research (Volume II: Social Sector)

There is a need for an appropriate legislative framework for incentivising innovators and commercialisation of public funded R&D where the Government, the recipients of funds, the inventor as well as the public benefit from the protection and commercialisation of IP.

Traditional health systems (Volume II: Social Sector)

The Plan recognises that no single system of health care has the capacity to solve all of the society's health needs. It lays special thrust on strengthening professional education, strategic research programs, promotion of best clinical practices, technology upgradation in industry, setting internationally acceptable pharmacopeial standards, conserving medicinal flora, fauna, metals and minerals, utilising human resources of AYUSH in the National health programs and strengthening IPRs with the ultimate aim of enhancing the outreach of AYUSH health care in an accessible, acceptable, affordable and qualitative manner.

Intellectual property rights (Volume III: Economic Sector)

- Undertake the second phase of modernisation of IP offices to address the needs of human resources development, training and awareness and also infrastructure besides regular updating of the IT facilities.
- Indian IPO would be made an International Searching Authority and an International Preliminary Examining Authority under the Patent Co-operation Treaty of WIPO.

Follow Up on NKC Recommendations

Highlights

The Government has been committed to implementing the Commission's recommendations. The action taken includes:

Right to education

- The Right of Children to Free and Compulsory Education Bill, 2008 has been introduced in the Parliament.

School education

- Under the Scheme for Universal Access and Quality at the Secondary Stage, 6000 high quality Model Schools are being set up, with at least one school in each Block. The first stream will consist of 2500 public funded schools (2000 in KVs and 500 in NVs template) in the Educationally Backward Blocks which have a significant SC, ST, OBC and minority population. The second stream of about 2500 schools would be set up through Public Private Partnership in other Blocks with emphasis on geographical, demographic, gender and social equity. Modalities for the remaining 1000 schools have yet not been finalised.

English language teaching

- Twenty five states have already introduced English as a subject from Class I. With the help of NCERT and CIEFL, the MHRD is guiding English Teaching in schools in the states/UTs by developing appropriate curriculum, materials and training of teachers with skills in English.

Vocational Education and Training (VET)

- For expansion, redesign and quality enhancement of VET in the country a three tier structure has been constituted in July 2008 under the **National Skill Development Mission (NSDM)** consisting of:

a) **National Council on Skill Development:** The functions of the Council under the Prime Minister would be to lay down policy objectives, strategies, financing and a governance model to promote skill development.

b) **National Skill Development Coordination Board:** The Board will enumerate strategies to implement decisions of the Prime Minister's National Council on Skill Development. It would develop operational guidelines and instructions for meeting larger objectives of skill development needs of the country and also make appropriate practical solutions and strategies to be adopted by the Union and State Governments.

c) **National Skill Development Corporation:** It will develop a system of institutionalising measures to this end.

Higher and technical education

- To expand capacity and improve quality of higher education, the Government has sanctioned the setting up of 15 new Central Universities and 14 new Universities based on world-class standards.
- The Government is in the process of setting up eight Indian Institutes of Technology (IITs), 10 National Institutes of Technology (NIT), 20 Indian Institutes of Information Technology (IIITs) as far as possible in the Public-Private Partnership mode, three Indian Institutes of Science Education and Research (IISERs), seven Indian Institutes of Management (IIMs) and two Schools of Planning and Architecture (SPA).
- The Committee for Rejuvenation and Renovation of Higher Education, set up for the review of UGC/AICTE has submitted its report.
- The Science and Engineering Research Board Bill 2008 has been introduced in the Parliament.
- The National Mission on Education through Information and Communication Technology (ICT) has been launched to leverage the potential of ICT in the teaching learning process with an aim to enhance the GER in Higher Education

by 5 percentage points by the end of the XI Plan. Under this Mission 20,000 institutions of Higher Education and nearly 10,000 University Departments will be provided connectivity, beginning with a minimum of 5 Mbps for each one of them. The Central Government will bear 75 per cent of the connectivity charges for 5 years, even for institutions not belonging to it. The estimated cost of the Mission is Rs. 4612 crore.

Integrated National Knowledge Network

- During 2008-09 Rs. 100 crore has been allocated for the National Knowledge Network (NKN) which proposes interconnecting all knowledge institutions in the country with gigabit capabilities, for sharing resources and research. A high level committee (HLC) constituted by the Department of Information and Technology (DIT), under the chairmanship of the Principal Scientific Adviser, was set up to operationalise the network. The design of NKN was prepared by a Technical Advisory Committee set up by the HLC, and the initial implementation is being managed by NIC (under DIT).
- The network is ready for roll out and is awaiting a formal launch. The network would be operationalised in two phases. The core and distribution network covering 1000 nodes with gigabit capacity would be set up in the first phase and this process has already started. The network is scalable and coverage can grow up to 10,000 nodes/institutions.

Translation

- The Government has approved the setting up of a National Translation Mission (NTM) with an outlay of Rs. 75 crore. The CIIL, Mysore is the nodal agency implementing the Mission.

Libraries

- Based on the recommendations of NKC, the Department of Culture (DoC) proposed setting up a National Mission for Libraries (NML) in the XI Plan as a Central Sector Scheme. The EFC memo is under revision by the DoC and is being restricted to Rs. 180 crore earmarked for the same during the XI Plan. The NML will cover libraries under the DoC and the activities under it will include: National Census of Libraries; Modernisation including networking of Libraries under DoC; establishing Knowledge Centres and Digital Libraries.

E-governance

- The XI Plan envisages the creation of core infrastructure such as SWAN (State Wide Area Network), Common Service Centres (CSCs) and State Data Centres (SDCs) for creation of a common service delivery platform
- SWAN has been implemented in 6 states/UTs till date and in 18 states implementation is in process.
- Till date SDCs have been approved for 26 states by the Government.
- Under the approved CSC scheme which envisages establishing over 100000 CSCs across India, 20,558 CSCs have been rolled out. The process for roll out for another 250968 CSCs has also been initiated.

Legal framework for public funded research

- The Protection and Utilisation of Public Funded Intellectual Property Bill 2008 has been introduced in the Parliament

Legal education

- Ministry of Law and Justice has conveyed in-principle approval for new Standing Committee on legal education under IRAHE and consequent changes in the role of BCI, curriculum development, developing research tradition in law schools/ universities.
- Proposal for setting up Centre for Advanced Legal Studies and Research (CALSAAR) for the northern region at Manesar (Gurgaon) was submitted by the Department of Legal Affairs to Planning Commission. The Department has been advised to make budget provisions for the scheme of CALSAARs in the XI Plan by the Planning Commission.

Intellectual Property Rights

- The IP Office has put the relevant acts, rules, manuals on its website and there is no restriction on access to these materials.
- Digitisation of all patent records is underway. Forty-five thousand patent records are already on the website.
- National Institute of Intellectual Property Management (NIIPM) to be set up at Nagpur.
- An IP Appellate Board has been set up for trademarks, geographical indications and patents.
- DIIPP is examining the issue of sui-generic legislation for protection of traditional knowledge.

NKC: State Level Initiatives

Many of the subjects on which the National Knowledge Commission has submitted recommendations fall within the purview of the State Governments. Implementation of most of the recommendations, be it reform of existing Universities, revitalising libraries in the region, introduction of English in schools, are all initiatives that need to be undertaken at the state and district level. In light of this, NKC has successfully engaged with several State Governments to formulate knowledge initiatives at the state level. It is working with 26 States and 3 Union Territories for implementation of its recommendations. Key highlights include:

- All States have appointed nodal officers and departments for implementation of NKC recommendations.
- Many State Governments are preparing blueprints for reform based on NKC recommendations. These include Rajasthan, Orissa and Andhra Pradesh. The Delhi Government has already approved an action plan for implementation of NKC's recommendations.
- Several states are evaluating setting up a State Board of Undergraduate Education to reduce the burden of affiliating colleges on Universities. These Boards would aim to separate the academic functions from the administrative functions and provide quality benchmark.
- Karnataka has started a Knowledge Commission to lay the groundwork for reforms in the knowledge sector in the state. Rajasthan has set up a Rajasthan Knowledge Corporation Limited for promoting IT education and application of IT systems for process improvement and knowledge delivery.
- As part of the National e-Governance Project (NeGP), six state governments – Haryana, Himachal Pradesh, Tamil Nadu, Chandigarh, Delhi and Tripura have implemented State Wide Area Network (SWAN) and in 18 states implementation is in process.

Annexure I: Baseline

Libraries

Introduction

Libraries play a pivotal role in the dissemination of knowledge and are extremely important in building a knowledge economy. There is a need to formulate and create mechanisms and institutions which will bring about a paradigm shift in the libraries and information system (LIS) scenario. In today's context, libraries have to play two distinct roles - to serve as a local centre of information and knowledge, and be a local gateway to national and global knowledge. To fulfill this potential, the entire LIS needs to be revamped – existing libraries must modernise their collection, services and facilities, become more pro-active and collaborate with other institutions and agencies.

Current Scenario

Data: There is no authentic information about the number of libraries actually functioning in India. All statistical information seems to be estimated on the basis of pure guesswork. Further, there are institutions operating as libraries without following any benchmark or standard. Therefore, there is a need to prepare a national census of libraries through a nationwide survey. Census data of libraries and their present situation will provide primary data for future planning.

Table 1: Libraries covered by the Raja Ram Mohan Foundation

Level	Number
State Central Libraries	28
Divisional and District Libraries	451
Sub-divisional/Taluka/Tehsil Libraries	501
Town & Rural Libraries	30134
Nehru Yuvak Kendras	272
Jawahar Bal Bhavans	49
Others	128
Total	31563

Source: Raja Ram Mohan Library Foundation

Management and quality: To provide access to knowledge and resources, each library must provide a range of services to meet the needs of a diverse user community. It must also have a well-rounded collection relevant to its user community. In the changed context, it is necessary to assess the manpower requirements for different types of libraries and departments of library and information science and adequately train the library staff.

Education and research: Library and information science education and research has been in existence since pre-independence days. There are approximately 135 universities and institutions of higher learning in this field. But presently most universities and institutions have not kept abreast with the changes in the LIS sector.

Funding: Out of the Tenth Plan outlay of Rs.131.05 crore, an expenditure of Rs.121.23 crore was incurred – indicating a shortfall of 7 per cent. There is a need to set up a central library fund to not only upgrade existing libraries within the specified period of time but to facilitate libraries to overcome the financial stringencies which presently exist. Further, public-private partnerships could be encouraged in developing library and information services in different parts of India.

Table 2: Number of libraries in India (estimated figure 1996-97)

Public libraries	54845
University/Deemed to be University Libraries	267
College Libraries	8000
Science and Technology Libraries	1200
Social Science Libraries	450
Government Department Libraries	800
Art, Culture and Humanities Libraries	500
School Libraries (Higher secondary/secondary/primary and upper primary)	404128

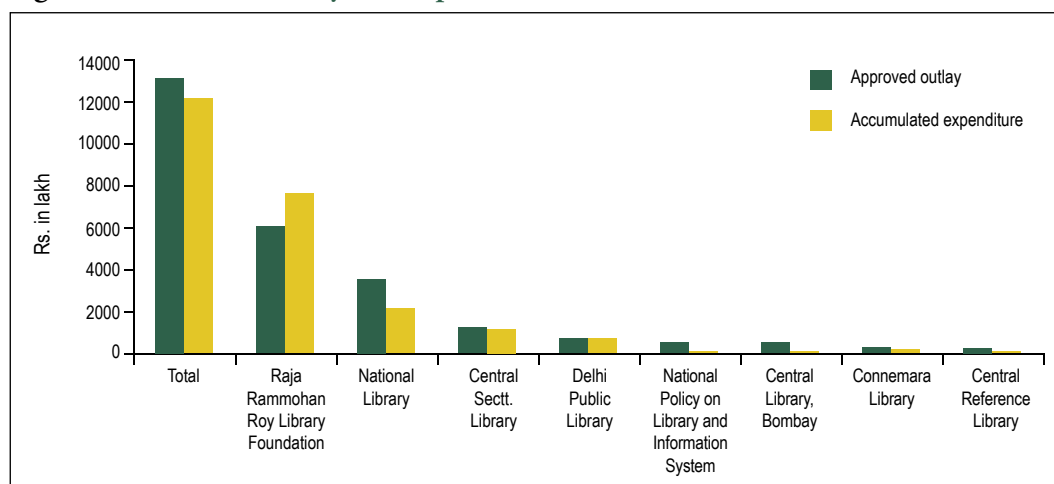
Source: Librarians in Society: An Insider's View, P.R. Goswami

Table 3: Existing library consortia in India

Indian National Digital Library in Engineering Science and Technology (INDEST) Consortium	Membership of 164 institutions – 38 core institutions funded by the Ministry of Human Resource Development, Government of India, 44 institutions by the All India Council of Technical Education (AICTE) and 82 self-supporting institutions)
Council for Scientific and Industrial Research (CSIR) e-Journals Consortium	Funded by the CSIR for its all its 44 labs
University Grants Commission (UGC) e-Journals Consortium	Funded by the UGC for 100 universities and being extended to other universities and colleges
DAE e-Journals Consortium	For 36 institutions under Department of Atomic Energy

Source: Higher Education in India, Pawan Aggarwal, ICRIER, 2006

Figure 1: Libraries: Outlay and expenditure of Tenth Five Year Plan



Source: Working Group on Art and Culture, Eleventh Five Year Plan, Planning Commission

School Education

Introduction

Reforms in school education are pivotal for creating an edifice on which a knowledge society can be structured. While India has witnessed significant progress in school education, the goal of universal access to elementary education has yet not been achieved. There are also wide disparities in access to school education between states, rural and urban areas, gender as well as different economic classes. In addition, issues of quality such as teacher training, curriculum, pedagogy, school infrastructure and learning outcomes need to be addressed on an immediate basis. There is also an urgent need to increase the resource allocation to school education.

Current Scenario

Literacy: According to the 2001 Census, the literacy rate in India was 64.8 per cent and as per the NSS 61st Round Survey Report, the literacy rate was 67.3 per cent during 2004-05. Further, the gender gap in literacy is estimated to be roughly 20 per cent.

Schools: The number of primary schools in the country increased from 6.64 lakh in 2001-02 to 7.7 lakh in

2005-06. In the same period, the number of upper primary schools increased at a faster rate from 2.20 lakh to 2.9 lakh.

Table 4: Number of schools (in lakh) 2005-06

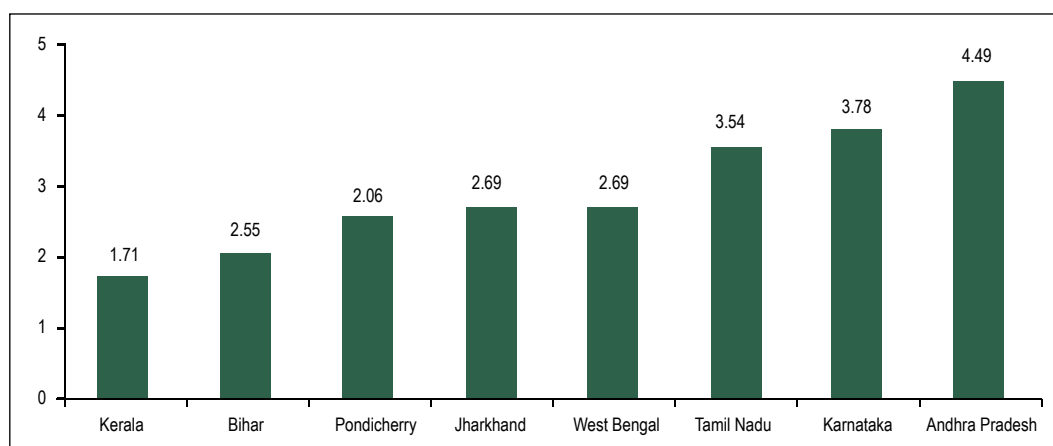
Primary	7.7
Upper primary	2.9
Secondary/Senior Secondary	1.6
Total	12.2

Source: Educational Statistics at a Glance, 2005-06, MHRD

Enrolment: The total enrolment at the primary stage has increased 7 times, from 19.2 million in 1950-51 to 130.8 million in 2004-05. In case of upper primary stage, it increased 17 times, from 3.1 million in 1950-51 to 51.2 million in 2004-05. The enrolment at the secondary/senior secondary increased by 25 times, from 1.5 million in 1950-51 to 37.1 million in 2004-05. However about 180 out of 581 districts in the DISE study (2004-05) reported a decline in primary enrolment.

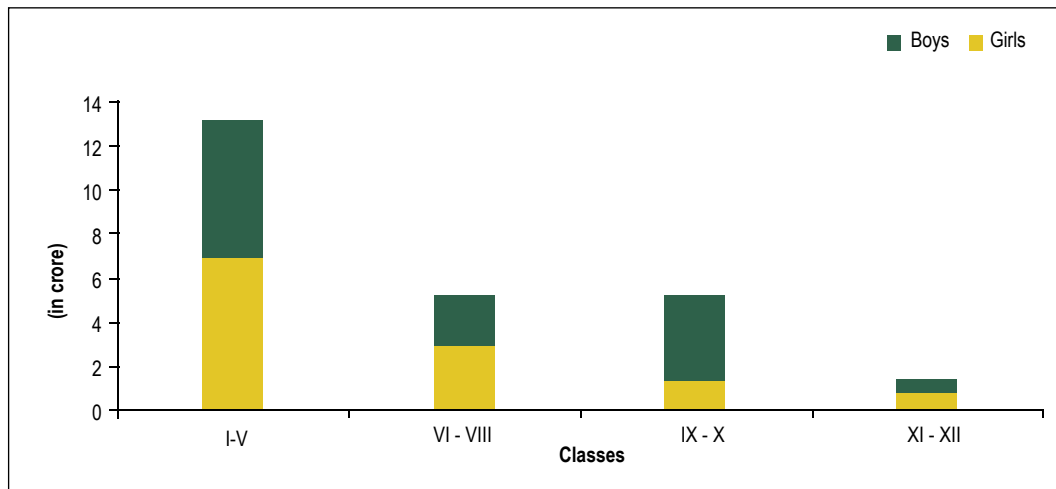
Enrolment rates are particularly low in Bihar, Arunachal Pradesh, Jharkhand, Uttar Pradesh, Rajasthan and Madhya Pradesh, with overall enrolment rates below 80 per cent. There are wide rural-urban disparities,

Figure 2: Number of schools per 1000 students in the relevant age group



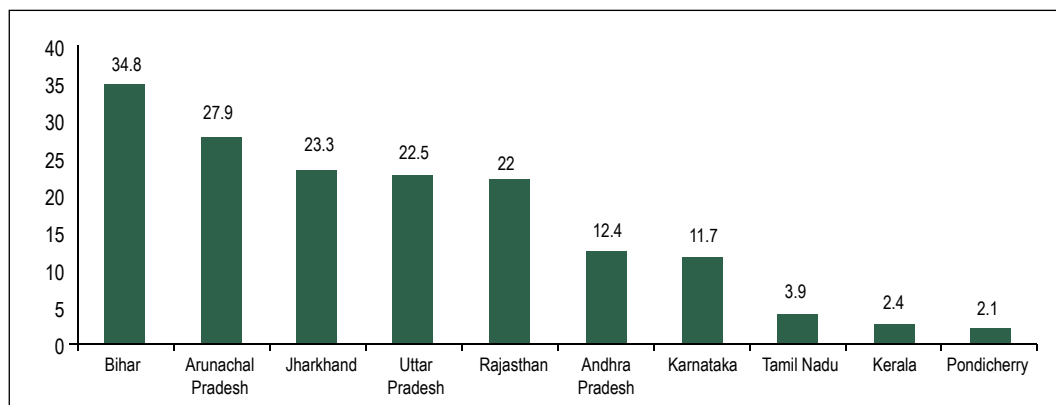
Source: Elementary Education in India, Analytical Report NUEPA, 2005-06

Figure 3: Stage wise enrolment (2005-06)



Source: National Level Statistics 2005-06, MHRD

Figure 4: Percentage of students in the relevant age-group not enrolled in school



Source: Elementary Education in India, Analytical Report, NUEPA, 2005-06

except in the Union Territories, North-eastern states, Kerala and to some extent Tamil Nadu. Gender disparities tend to be sharpest in states with low aggregate attendance rates.

The total Scheduled Castes enrolment at the primary (I-V), upper primary (VI-VIII) and secondary/senior secondary (IX-XII) stages of school education from 1980-81 to 2004-2005 increased by 2.25, 3.91 and 4.52 times respectively. The total Scheduled Tribes enrolment at the primary, upper primary and secondary/senior secondary stages of school education from 1980-81 to 2004-2005, increased by 2.94, 5.62 and 6.33 times respectively. Further, the average of 604 districts in 2005-06 indicates a gender parity index (GPI) of 0.92 in primary classes and 0.84 in case of enrolment in upper primary classes compared to 0.91 and 0.83 in 2004-05. In 2003-04, GPI in primary and upper primary enrolment was 0.90 and 0.82 respectively. The social composition of out of elementary school children indicates that 9.97 per cent of Muslim children, 9.54 per cent of STs, 8.17 per

cent of SCs and 6.97 per cent of OBC children were out of school and an overwhelming majority (68.7 per cent) was concentrated in five States viz. Bihar (23.6 per cent), Uttar Pradesh (22.2 per cent), West Bengal (9 per cent), Madhya Pradesh (8 per cent) and Rajasthan (5.9 per cent).

Drop Outs: The drop-out rates represent percentage of pupils who drop out from a given grade or level of education in a given school year. The rate of drop outs has decreased from 64.9 per cent in 1960-61 to 29.00 per cent in 2004-2005 in primary classes. The rate of dropout which was 78.3 per cent in 1960-61, has come down to 50.84 per cent in 2004-2005 in the upper primary classes. Similarly, the dropout rate which was 82.5 per cent in 1980-81, has decreased to 61.92 per cent in 2004-2005 in the secondary classes, implying an improvement in retention rates. The drop-out rates at primary levels for SCs (34.2 per cent) and STs (42.3 per cent) are substantially higher than the national average (29 per cent).

Table 5: Number of teachers by type of schools and pupil:teacher ratio

Type of School	No. of teachers (in lakh)	Percentage of trained teachers	Female teachers per 100 male teachers	Pupil teacher ratio
Primary	21.8	86	65	46
Upper primary	16.7	87	67	34
High schools	11.2	89	61	32
Higher/ Senior secondary	10.3	90	62	34

Source: National Level Statistics 2005-06, MHRD

Teachers: The total number of teachers in primary schools increased from 5.38 lakh in 1950-51 to 21.6 lakh in 2004-2005 i.e. by more than four times. However, the number of teachers is still not adequate to meet the needs of the burgeoning student population as is evident from the teacher pupil ratio.

During the year 1950-51 the pupil teacher ratio in primary schools was 1:24, in middle schools it was 1:20 and in higher/higher secondary schools, the pupil teacher ratio was 1:21. By 2004-2005 this ratio had increased to 1:46 in primary schools; 1:35 in upper primary schools and 1:33 in secondary/senior secondary schools. Though the number of educational institutions has considerably increased after Independence and also the number of teachers, the higher pupil teacher ratio indicates that the increase in enrolment at each level is comparatively more than the increase in number of teachers. The increased enrolment at various levels also underscores the need for opening of a greater number of educational institutions as well as employing more teachers for improving the quality of education.

Teacher training programs: Teacher training has been identified as a crucial input for quality school education. However, the status of teacher training in India is a matter of great concern. According to DISE data, only 33 per cent of the teachers received in-service training in 2005-06. In 2002, 65467 men and 67096 women enrolled into teacher training courses in India. There are at present, about 571 DIETs, and DRCs, 104 Colleges of Advanced Teaching and 31 Institutes of Advanced Studies in Education, for pre-service and in-service training, functioning in the country.

Teacher Absenteeism: Teacher absenteeism has been identified as a major impediment to improvement in quality of school education. The PROBE survey in 242 villages across 5 north Indian states found that in about half the schools, there was no teaching activity at the time of the investigators' visit. It is significant that this pattern

occurred even in cases where the school infrastructure (in terms of number of class rooms, teaching aids and even teacher-pupil ratio) was relatively good.

Infrastructure: There is a severe lack of basic infrastructure in schools in India. The PROBE (1999) survey, for instance, found the following with respect to government schools: (a) only a fourth of the sample schools had at least two teachers, two all-weather classrooms, and some teaching aids; (b) at the time of the investigator's visit, one-third of the headmasters were absent, one-third of the schools had a single teacher present, and about half of the schools had no teaching activity; (c) in many schools class students were systematically neglected. Similarly, the DISE survey found that only about 50 per cent of the schools had boundary walls, 33 per cent had electricity connections, and 52 per cent had playgrounds. These represent serious flaws in the schooling process.

Management: At present, government and local bodies own more than 90 per cent of the primary schools, 72 per cent of the upper primary schools and 39 per cent of the secondary schools. There are indications of a rise in the number of private unrecognised schools in India. According to the DISE Analytical Report as many as 63,411 and 1,26,110 schools in 2005-06 were being managed by the private aided and private unaided managements respectively. Together, they run a total of 1,89,521 schools (16.86 per cent). There is evidence to suggest that private schools are concentrated in areas where government funded schools are dysfunctional. Although the student profile of private schools is more economically advantaged, the rate of enrolment from poor families has also increased steadily. Findings from the MIMAP survey in India show that, of all school-enrolled children aged 5-10 years old living below the poverty line, 14.8 per cent attended private schools (8 per cent in rural and 36 per cent in urban India). The corresponding figures for ages 11-14

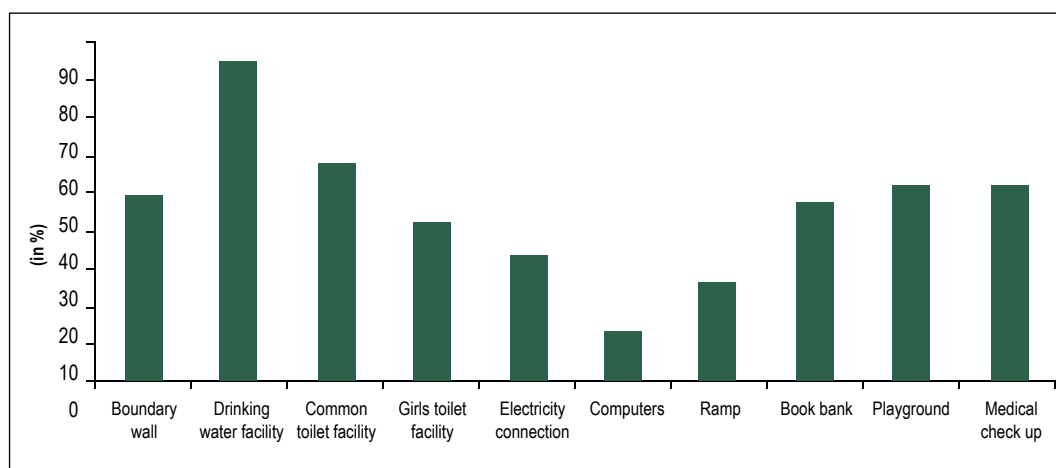
years and 15-17 years were 13.8 per cent and 7 per cent respectively (Pradhan and Subramaniam, 2000). Further, amongst the students from poor backgrounds in private schools, the majority are male.

Curriculum, pedagogy and learning outcomes: An all India study *Annual Status of Education Report (ASER)* conducted by PRATHAM in 2006 found the levels in arithmetic and reading amongst primary school children to be surprisingly low. Close to 35 per cent of children in the 7-14 age group could not read a simple paragraph (grade 1 level difficulty) and almost 60 per cent of children could not read a simple story (grade 2 level). In Government Schools, 49.6 per cent of classes II-IV could not subtract (level 1), and 77.8 per cent could not complete sums in division. In private schools, 37.9 could not subtract (level 1) and 66.7 per cent could not finish division sums (level 2).

The situation in Tamil Nadu, Karnataka and Gujarat (where the schools function and where all provision related indicators are good) are far worse than in Bihar and Chhattisgarh (where indicators like teacher-pupil ratio, drop out rates are extremely high, and there are fewer schooling facilities). The high failure rates, especially among the rural, economically weaker and socially deprived children, forces one to critically review the whole system of evaluation and examination.

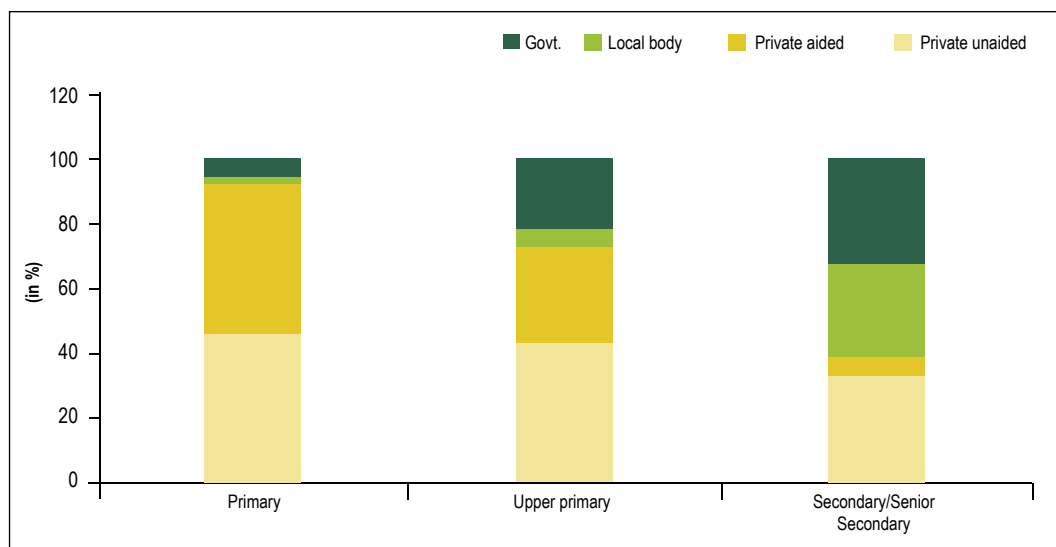
It is widely recognised that there is a need to shift focus from rote learning from textbooks to developing basic skills and the ability of students to apply their learning to real situations. Also creativity, problem-solving ability and encouragement for construction of knowledge based on students' own experiences needs to be promoted. Introducing accountability and developing other measures to improve teaching

Figure 5: Percentage of schools with basic facilities



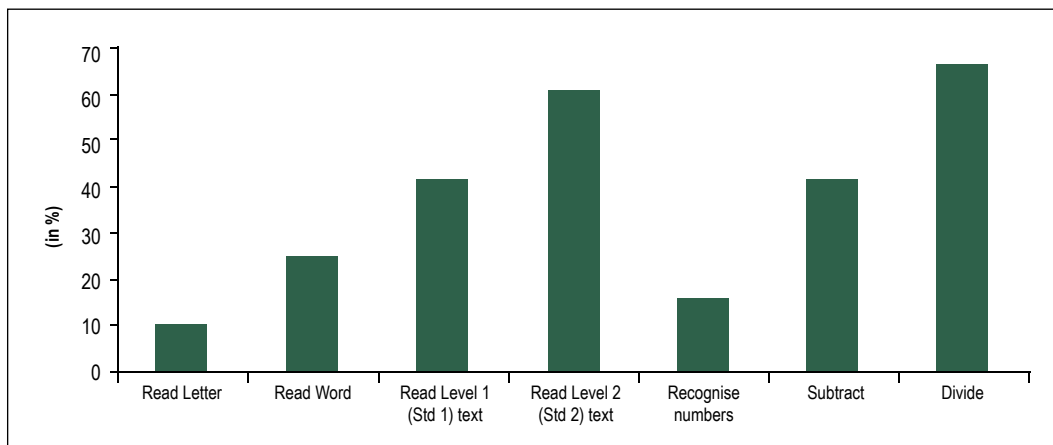
Source: Elementary Education in India, Analytical Report 2006-07

Figure 6: Management-wise percentage of schools



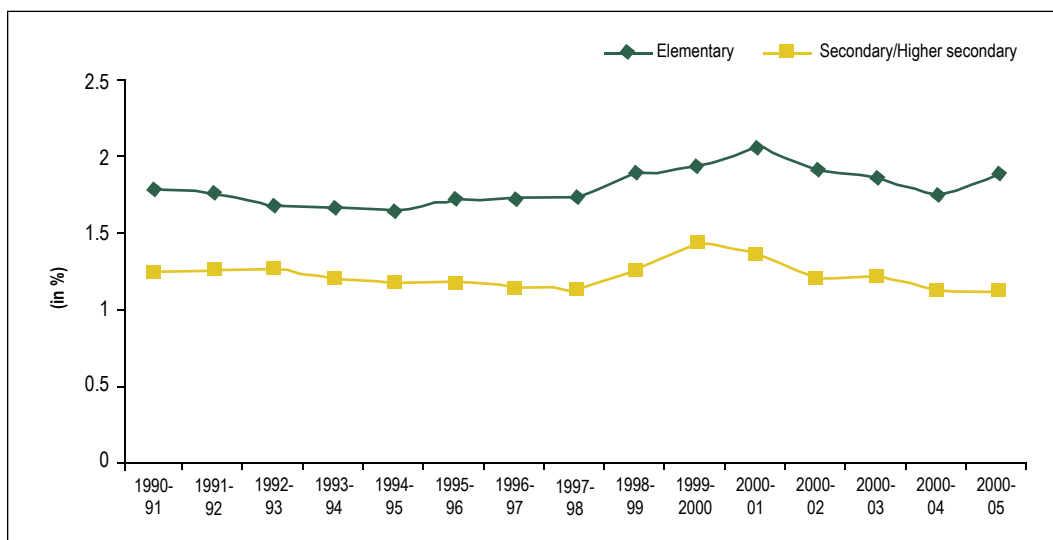
Source: National Level Statistics 2005-06, MHRD

Figure 7: Percentage of children (Class I to VIII) who cannot



Source: Annual Status of Education Report (Rural) 2006

Figure 8: Expenditure on education as a percentage of GDP



Source: MHRD

quality at the primary level needs to be thought of. The National Policy on Education (NPE), 1986 postulated that the examination system should be recast so as to ensure a method of assessment that is a valid and reliable measure of student development and a powerful instrument for improving teaching and learning be developed.

Government funding: The share of public expenditure on education has been declining steadily and was 3.5 per cent in 2004-05. The share of elementary education was Rs. 40,000 crores out of almost 100,000 crores allotted to education. This amount is insufficient to provide universal elementary education of eight years for every child in the age group 6 – 14 years. It is also less than

the proportion of GDP invested in education in many other developing countries. India's total expenditure on school education for the year 2005-06, elementary and secondary combined was around Rs. 78,661 crores, amounting to only 2.46 per cent of GDP. The Tenth Plan outlay for Elementary Education and Literacy was Rs. 30,000 crore. The actual expenditure has been Rs. 48,201 crore, out of which SSA (Rs. 28,077 crore) and MDM (Rs. 13,827 crore) account for 88 per cent. The graph below shows public expenditure on education from year 1992-93 to 2005-06 in 1993-94 constant prices. The percentage allocation for education was around 3.5 per cent of GDP until the late 1990s, rose to more than 4 per cent at the turn of the decade but has since declined to 3.75 per cent of GDP.

Vocational Education and Training

Introduction

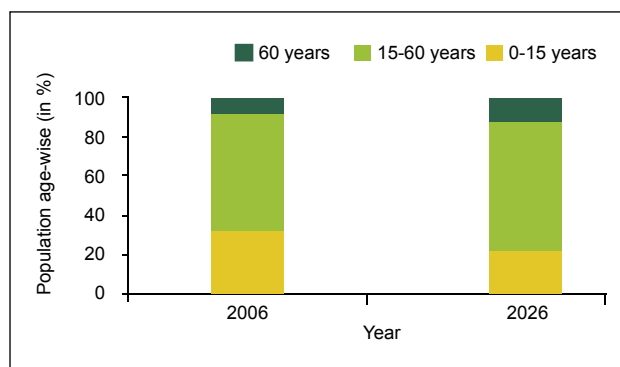
The transition of India into a knowledge-based economy requires a skilled workforce, and therefore a renewed focus on the vocational education and training (VET) system. Moreover, the current and expected demographic composition of the country's population (See Figure) makes it imperative that the issue of employability and skills be addressed immediately. A third of India's population was below 15 years of age in 2000 and close to 20 per cent were young people in the 15-24 years age group. If this demographic dividend is not optimally utilised through skill development, we run the risk of growing unemployment among high skilled "formally trained" personnel and shortages of low level skilled and vocationally trained people in the labour market.

Current Scenario

In India, skill acquisition takes place through two basic structural streams – a small formal one and a large informal one. Some of the major formal sources are listed in Table 6:

Status of vocational training received/being received:
In the NSS 61st round, among persons of age 15-29

Figure 9: Demographic Composition of India's population



Source: Based on the Report of the Technical group on population projections constituted by the National Commission on Population, May 2006

years, only about 2 per cent reported to have received formal vocational training and another 8 per cent reported to have received non formal vocational training.

Age specific rate for formal vocational training received: The proportion of persons who received formal vocational training generally increases with age of persons. In fact, the proportion increased from 0.6 per cent for the age group 15-19 years to 1.8 per cent for the age group 20-24 years and then, to 1.9 per cent for the age group 25- 29 years in the rural areas.

Table 6: Vocational education and training in India

Type of Source	Institute	Capacity	Quantity
Mainstream education system	Centrally Sponsored Scheme of Vocationalisation of Secondary Education run by the Ministry of Human Resource Development	Enrolling less than three per cent of students at the upper secondary level	9,583 schools offering about 150 educational courses of two years duration
Training institutions outside the school and university systems	Industrial Training Institutes (ITIs) and Industrial Training Centres (ITCs)	Total seating capacity of 7.85 lakh	5488 public (ITI) and private (ITC) institutions imparting VET, of which 1922 are ITIs and 3566 are ITCs.
Diploma level	Polytechnics	1,244 polytechnics run by MHRD with a capacity of over 2.95 lakhs	1,747 AICTE approved diploma programs with 294,370 seats

Formal vocational training and broad activity status: The proportion of persons (15-29 years) who received formal vocational training was the highest among the unemployed. The proportion was around 3 per cent for the employed, 11 per cent for the unemployed and 2 per cent for persons not in the labour force

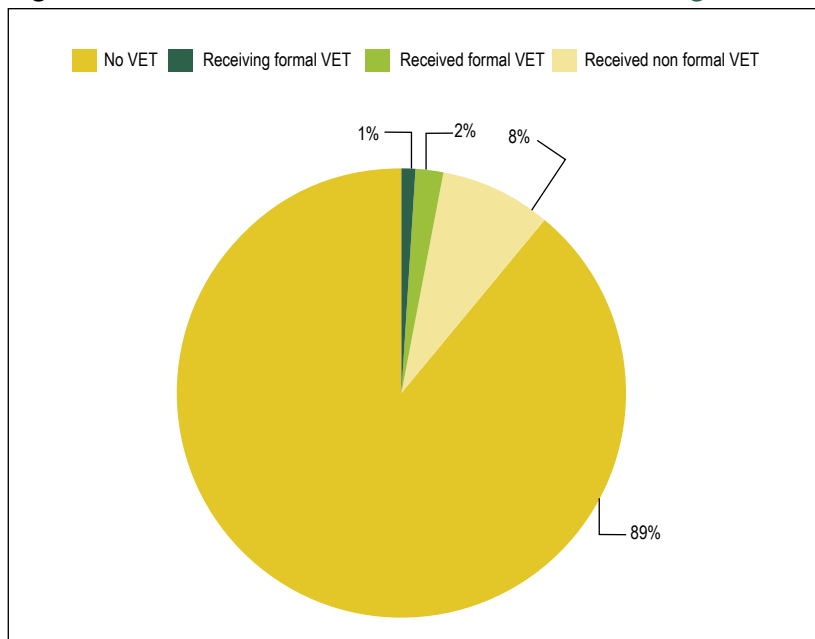
Issues in the Current Framework

1. Participation: The Kothari Commission on Educational Reforms, 1966 had visualised that 25 per cent of the students at the secondary stage would go for the vocational stream. At present only about 5 per cent of the children of the 16 to 18 age group are in the vocational stream. This is despite the fact that in urban areas, only about 19.6 per cent of male and 11.2 per cent of female workers possessed marketable skills, whereas, in rural areas only about 10 per cent of male and 6.3 per cent of female workers possessed marketable skills. This figure is far higher in developed even developing countries

2. Capacity utilisation: There is little capacity in vocational education and even that is under-utilised. Only 6,800 schools have received grants and the total enrolment reported is only about 5 per cent at most. More recent information suggests that the enrolment figure is less than three per cent of the students attending Grades 11-12. The weighted average capacity utilisation of the schools receiving grants is about 42 per cent. This implies that between 350,000 to 400,000 students are enrolled in vocational education, which works out to less than three per cent of the 14 million students or more in Grades 11 and 12, implying that less than one per cent of students who had entered Grade 1 over the last decade or so would have eventually participated in vocational education. It is also widely recognised that existing student capacity in ITIs/ITCs largely goes unutilised.

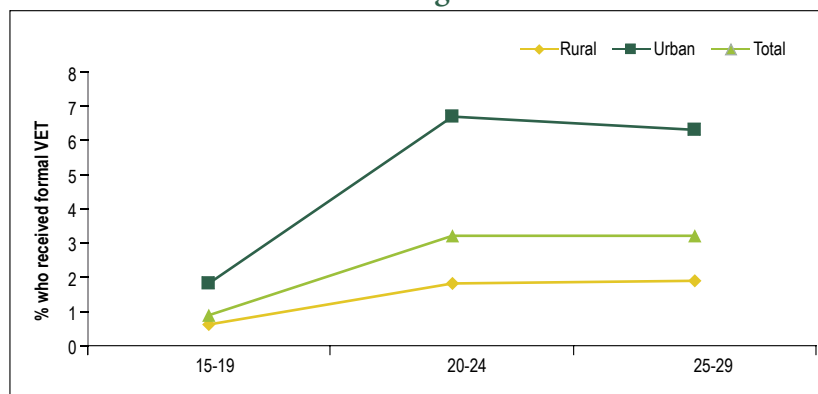
3. Flexibility: The current framework requires minimum qualifications, varying

Figure 10: Status of Vocational Education and Training (VET)



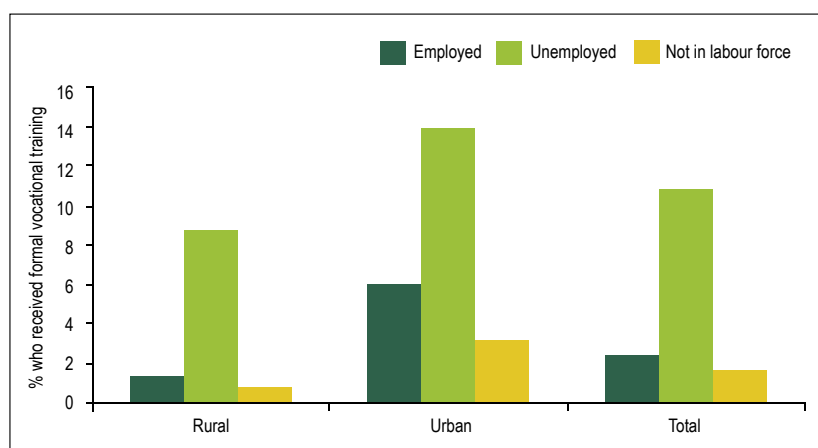
Source: Status of Education and Vocational Training in India, 2004-05, NSS 61st Round

Figure 11: Urban-rural break up of Vocational Education and Training



Source: Status of Education and Vocational Training in India, 2004-05, NSS 61st Round

Figure 12: Activity status of persons receiving vocational training



Source: Status of Education and Vocational Training in India, 2004-05, NSS 61st Round

Table 7: International comparisons on size of vocational-secondary education

Country	Secondary enrolment ratio	Number of students (thousands)	Vocational-technical share (per cent of total secondary enrolments)
Russia	88	6277	60
China	52	15300	55
Chile	70	652	40
Indonesia	43	4109	33
Korea	93	2060	31
Mexico	58	-	12
Malaysia	59	533	11
South Africa	77	-	1

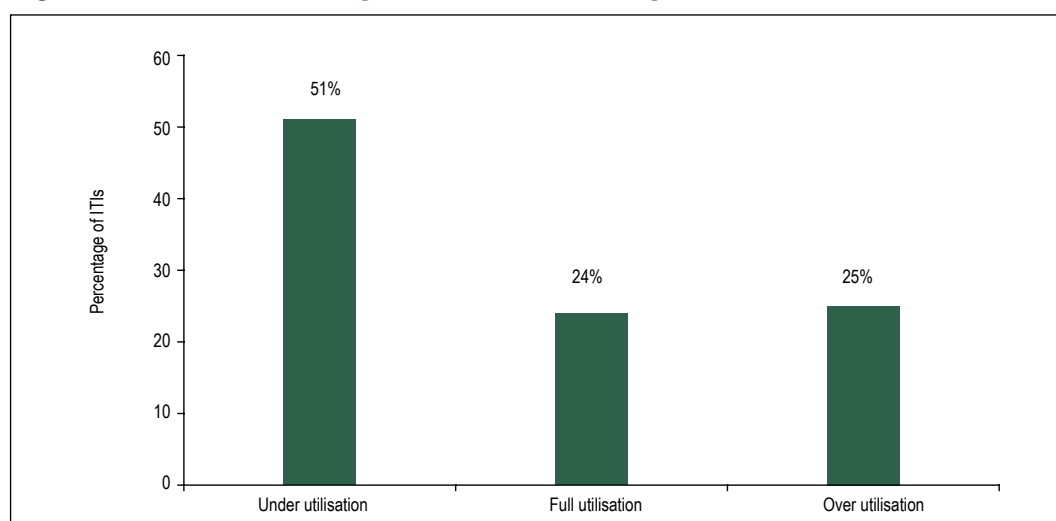
Source: World Bank, 2006

Table 8: All India seats utilisation in respect of technician, trade and graduate apprentices

	Seats located	Seats utilised	Per cent utilisation
Technician apprentices	39004	22837	59 per cent
Trade apprentices	182046	127741	70 per cent
Graduate apprentices	20420	6084	22 per cent

Source: Annual Report 2002-03, Ministry of Labour, Govt. of India

Figure 13: Seat utilisation against sanctioned strength



Source: FICCI Survey, 2006

from Class VIII – Class XII, for participation in formal vocational training. While this may be necessary for certain trades, it is unnecessarily restrictive in others. Also, once an individual leaves mainstream education for vocational training, there is no provision for him/her to return to the former at a later stage. Not only does this encourage a general view of work and study being mutually exclusive options, it also increases the perceived risk of taking up vocational training. The system is also not responsive to labour market

demand conditions. The inflexibilities in the course/curriculum set-up, lead to over supply in some trades and shortages in others. Moreover, there is not enough emphasis on short training course designed to impart specific skills. Vocational education and training in India relies exclusively on a few training courses with long duration (2 to 3 years) covering around 100 skills. In China, on the other hand, there exist about 4000 short duration modular courses which provide skills more closely tailored to employment requirements.

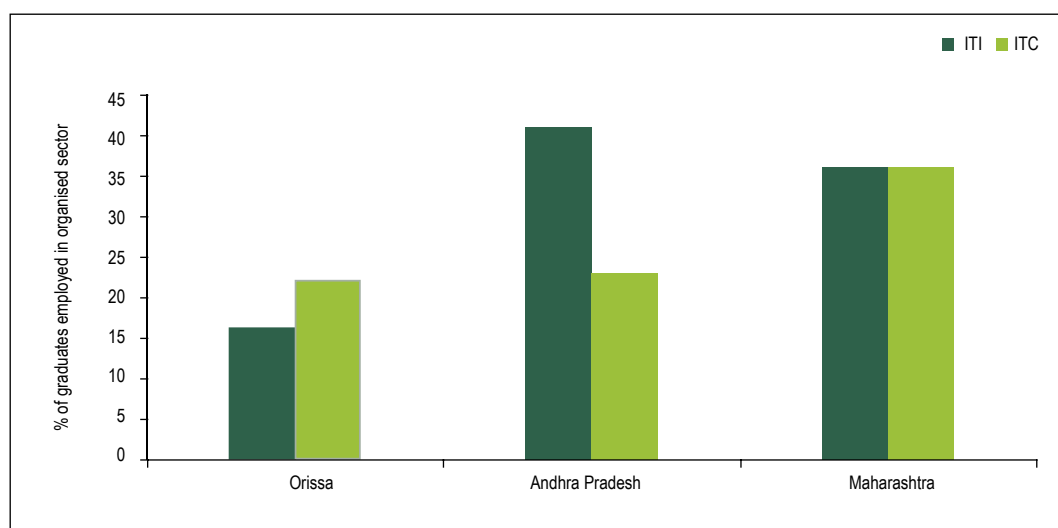
4. Impact: Of the trained candidates, the labour market outcomes as seen from placement/ absorption rates are reportedly very low. Although countrywide figures on the labour market success of ITI/ITC graduates are difficult to come by, an ILO study reports that in the states of Orissa, Andhra Pradesh and Maharashtra, the percentages of graduates found to be in wage employment/self-employment upon graduation from ITIs were 16.2 per cent, 41 per cent and 35 per cent respectively. The corresponding percentages for those graduating from ITCs were 21.3 per cent, 22.8 per cent and 35.6 per cent respectively

5. Industry linkages: Although provisions exist for the participation of industry representatives/experts in the setting of curriculum and hiring of apprentices, there is a significant mismatch between industry skill requirements and the talent pool emerging from ITIs/ITCs. This is one of the factors contributing to low success in the labour market for VET graduates. The private sector does undertake in-house training programs and to a very limited extent also trains 'outsiders'. However, such programs are limited to catering to their own felt needs,

in the nature of captive skill development. Low paying capacity of learners and the reluctance of industries to train workers for fear of losing them to competition has resulted in chronic deficiency in private investment in this area.

6. Quality and accreditation: The quality of the training imparted is also a matter of concern, as the toolkits, faculty, and curriculum are reportedly sub-standard. The existing institutions also lack financial and administrative autonomy. The testing, certification & accreditation system is reportedly weak, and since the deliverables are not precisely defined, there is no effort at evaluating outcomes and tracking placements. The problem is further complicated with lack of industry-faculty interaction on course curricula and other factors. The system of vocational training is currently characterised by a lack of ongoing monitoring for quality in institutions imparting VET. Although a system of inspections by State governments is in place, this is sub-optimal because it permits the proliferation of rent-seeking practices and does not achieve its stated objectives. An autonomous system of accreditation is missing in the VET sector.

Figure 14: Employment status of ITI/ITC graduates



Source: Industrial Training Institutes of India: The Efficiency Study Report, ILO, 2003

Table 9: Internal efficiency of ITIs and ITCs in 3 states

Indicator	Orissa		Andhra Pradesh		Maharashtra	
	ITIs	ITCs	ITIs	ITCs	ITIs	ITCs
Student retention	80.9	94.9	68.3	84.8	85.6	89
Graduation rate	88.3	95.6	62.9	62.7	77.5	79.4
Capacity utilisation	102.1	101	77.4	83.3	92.2	91
Student:Teacher ratio	9.3	5.4	5.5	9.6	-	-
Overall internal efficiency	73.8	90.9	31.8	45.7	62.6	61.1

Source: Industrial Training Institutes of India: The Efficiency Study Report, ILO, 2003

Higher Education

Introduction

A demographic explosion in the young population of the country means that higher education needs to keep pace with the growth in the relevant population. As per the 2001 Census, 31.2 per cent of the country or 337 million were below the age of 15. Providing higher education for this group is imperative and has to be provided on an unprecedented scale to meet the challenges of this unique demographic trend. The higher education sector currently faces major challenges of quality and excellence, and of improving access with inclusiveness. The proportion of our population, in the relevant age group, that enters the world of higher education is only about 10 per cent (2004-05). Access to higher education in terms of the available number of seats in universities is simply not adequate in relation to the current demand. There are also large disparities in enrolment rates across states, urban and rural areas, sex, caste and poor-non-poor.

Current Scenario

Institutions: As in 2006, the Indian higher education system consisted of 355 universities and 18,064

colleges - there exist 20 Central Universities, 216 State Universities, 101 Deemed Universities, 5 Institutions established through State Legislation and 13 Institutions of National Importance.

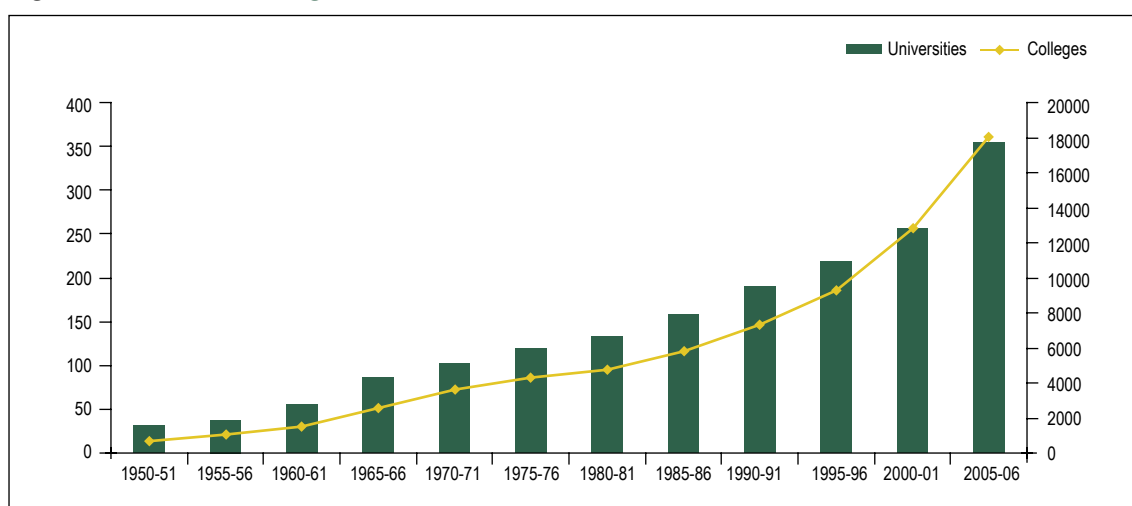
Enrolment: Around 110 lakh students were estimated to be currently enrolled in the Indian higher education system in 2005-06. The growth of student enrolment in higher education in India has been uneven and slow. For instance, while the enrolment grew by 6.7 per cent in 2001-2002, in 2005-06 it grew by 5.2 per cent.

Teachers: The total number of teachers in the higher education system is 4.88 lakhs. Out of the total teaching faculty, 84 per cent were employed in affiliated colleges and only 16 per cent in the universities and university colleges. The student-teacher ratio works out to 18 in the university departments and colleges and 23 in the affiliated colleges.

Issues in the Current Framework

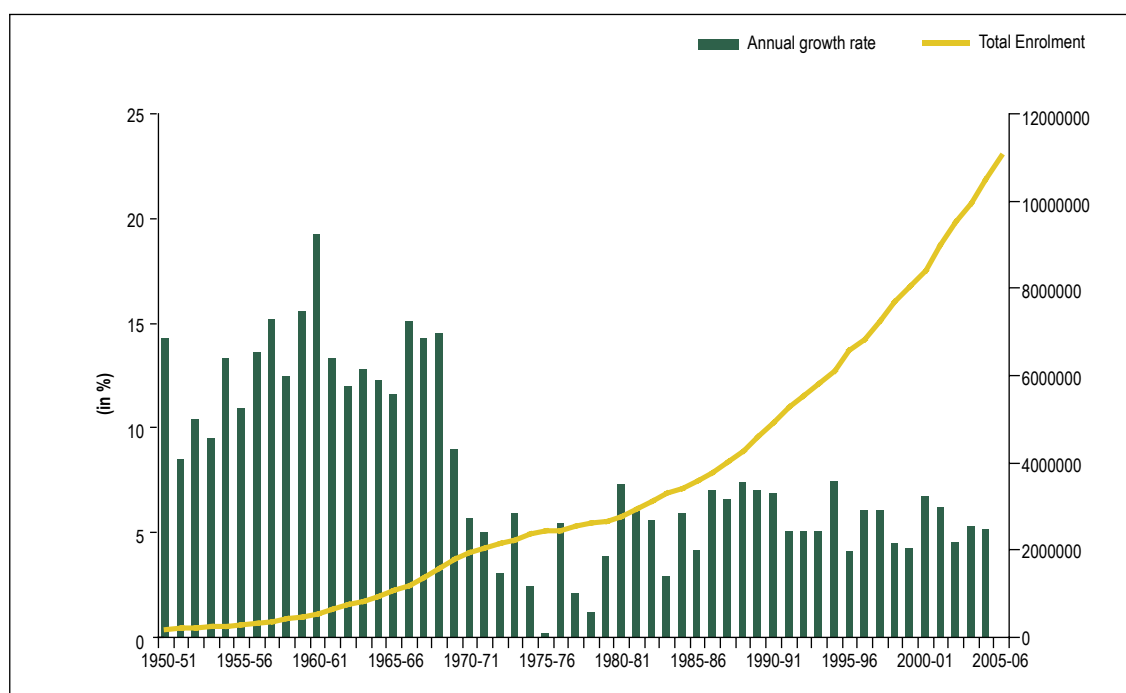
Expansion: The current enrolment in higher education stands at about 11 million. While there has been a consistent growth in enrolment in higher education over the last few years, this is not enough when compared

Figure 15: Growth of higher education system



Source: UGC

Figure 16: Growth of student enrolment in higher education in India (1950-51 to 2005-06)



Source: UGC

Table 10: Number of teachers in institutions of higher education, 2005-06

Institution	Enrolment (in thousands)	Teachers (in thousands)	Student:Teacher ratio
University Departments & University Colleges	1427	79	18
Affiliated Colleges	9601	409	23
Total	11028	488	22

Source: UGC Annual Report, 2005-06

to other countries. The gross enrolment ratio (GER) for higher education currently is around 10 per cent whereas it is 25 per cent for many other developing countries. Even South-east Asian countries show much higher enrolment: Philippines (31 per cent), Thailand (19 per cent), Malaysia (27 per cent) and China (13 per cent). The enrolment figure for the USA is 81 per cent, 54 per cent in the UK and 49 per cent in Japan. Various committees that have examined the higher education scenario in India have recommended an increase in the GER to at least 20 per cent. For instance, the CABE Committee on Financing of Higher Education concluded on the basis of international experience that an enrolment rate of 20 per cent or more is consistent with a turnaround in economic performance. If India has to achieve the target soon, it would imply more than doubling the scale and size of the higher education system within the next 5 to 7 years.

Table 11: Gross Enrolment Ratio (GER) for 18-24 years (in percentage)

Year	Higher Education
2001-02	8.07
2002-03	8.97
2003-04	9.21
2004-05	9.97

Source: MHRD

Access: With high disparities, inclusive education has remained an elusive target. Inter-caste, male-female and regional disparities in enrolment still remain prominent. For example, while the gross enrolment ratio for people living in urban areas was almost 20 per cent, it was only 6 per cent for rural areas. Further, the gross enrolment ratio for Scheduled Tribes (STs), Scheduled Castes

(SCs) and Other Backward Classes (OBCs) was 6.57, 6.52 and 8.77 respectively, much lower than the all-India figure of 11.

Regulation: The regulatory structures in the current higher education system are cumbersome. Entry through legislation alone, at present, is a formidable barrier. It requires an Act of Legislature of Parliament to set up a university. The deemed university route is much too difficult for new institutions. The consequence is a steady increase in the average size of existing universities with a steady deterioration in their quality. The absence of competition only compounds problems. A vast majority of the colleges are not recognised by UGC under section 2(f) of UGC Act. This poses a great challenge for the UGC in respect of maintenance of standard of teaching and examination in higher education. Also the current system of affiliated colleges for undergraduate colleges is not adequate. These are affiliated to large unwieldy universities, making it difficult to monitor the standard of education being imparted. Currently about 90 per cent of the undergraduate enrolment and 67 per cent of the postgraduate enrolment is in the affiliated colleges. There are a large number of institutions that are technically under the purview of the UGC but are not provided financial support by it because they fail to fulfill the minimum eligibility norms.

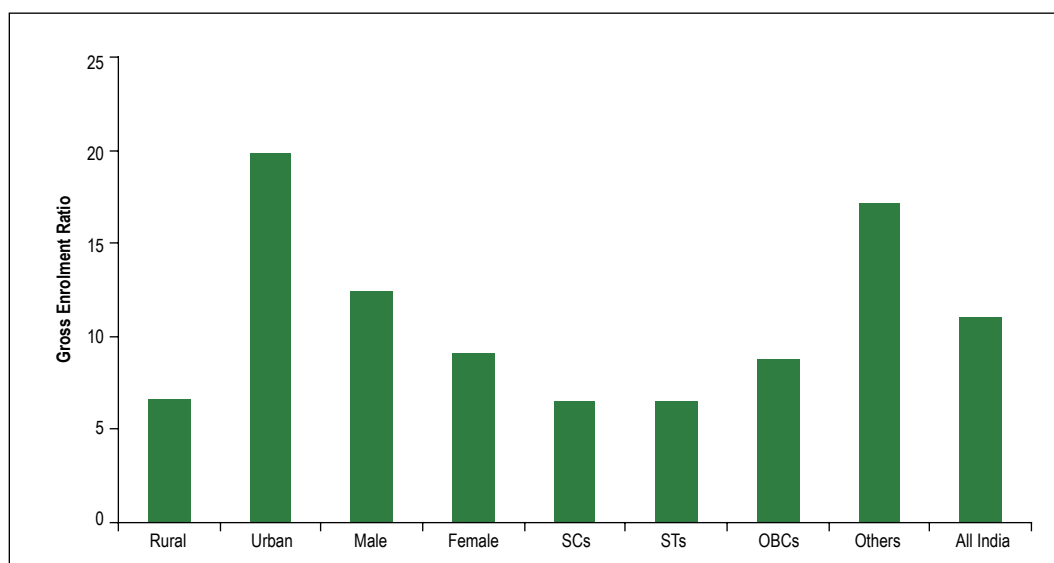
Faculty: Shortage of quality faculty is one of the main problems afflicting higher education in India today. Teacher shortages often occur due to non availability of suitably qualified people. Further, the academic profession has seen a steady decline in popularity – possibly as a result of lack of incentives here and more

lucrative opportunities in other professions. Apart from increasing compensation of teachers, there is also a need to introduce performance-based incentives in order to ensure teaching of superior quality.

Funding: Public expenditure (Centre and States) on education is only around 3.6 per cent of GDP. Government funding of higher education is still below 1 per cent of GDP. The percentage expenditure on University and Higher Education to GDP, which was 0.77 per cent in 1990-91 showed a gradual decrease to 0.66 per cent in 2004-2005. Various committees have unanimously recommended that state funding be increased to 6 per cent. While the Central Advisory Board for Education (CABE) recommends spending 1 per cent to higher education and 0.5 per cent to technical education, the proportions in 2004-05 were 0.34 per cent for higher education and 0.03 per cent for technical education.

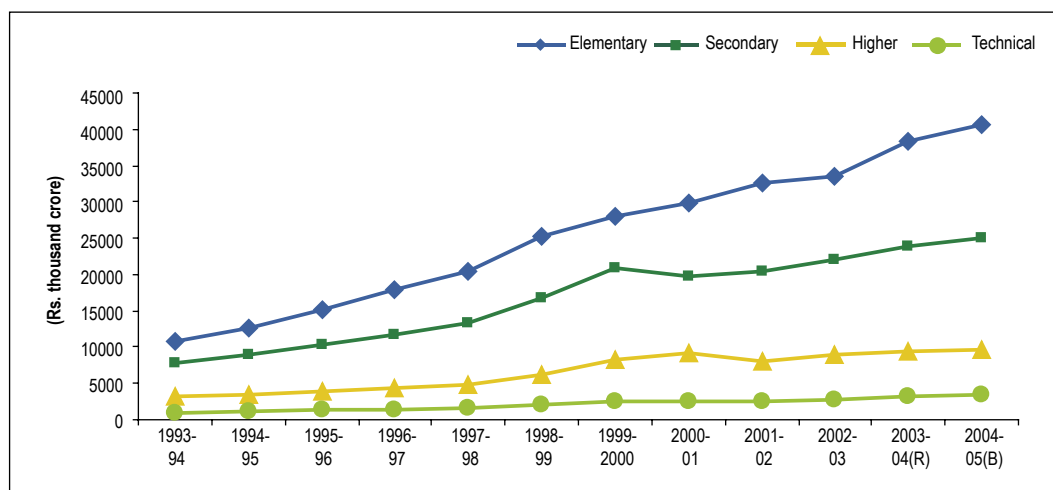
India also has one of the lowest public expenditure on higher education per student at 406 US Dollars, which compares unfavourably with Malaysia (11,790 dollars), China (2728 dollars), Brazil (3986 dollars), Indonesia (666 dollars) and the Philippines (625 dollars). In nominal terms the public expenditure per student in higher education stood at Rs. 12518 respectively in 2003-04. The trend analysis shows that the increase is not that marked if we consider the growth in enrolment, with the nominal public expenditure per student in higher education going up by only 40 per cent from 1993-94 to 2003-04. In fact, in real terms, public expenditure per student in higher education has declined from Rs. 8961 in 1993-94 to Rs. 7117 in 2003-04.

Figure 17: Disparities in enrolment in higher education (2004-05)



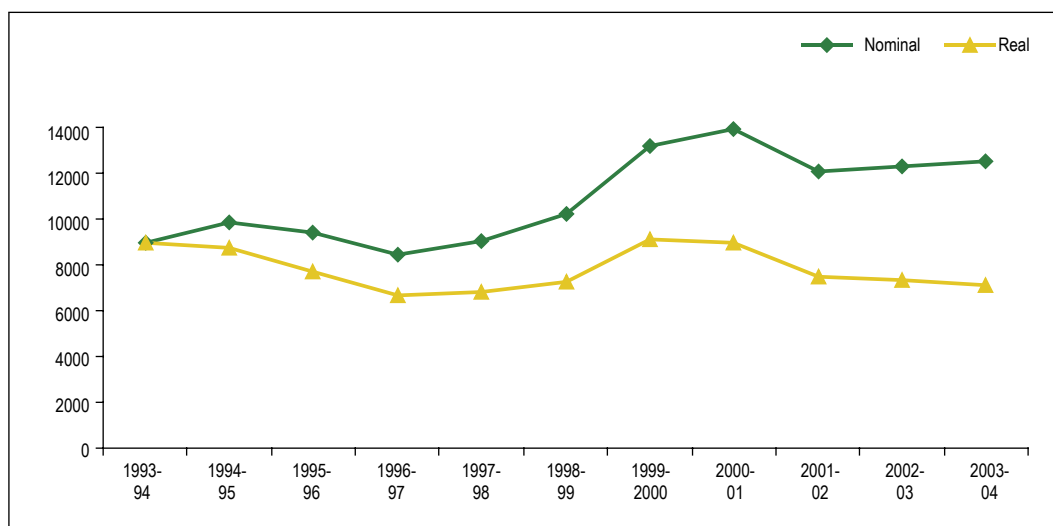
Source: UGC

Figure 18: Sector-wise plan & non-plan budgeted expenditure for education departments of State & Centre (Revenue Account)



Source: MHRD

Figure 19: Public expenditure per student in higher education - nominal and real



Source: Analysis of Budgeted Expenditure on Education, MHRD, Govt. of India

Private institutions: The share of private unaided higher education institutions increased from 42.6 per cent in 2001 to 63.21 per cent in 2006. Their share of enrolments also increased from 32.89 per cent to 51.53 per cent in the same period. This trend is likely to continue and therefore, it is reasonable to expect that about half of incremental enrolment targeted for higher education will come from private providers. There is a need for the state to recognise the role of the private sector and encourage their participation. There has already been a de-facto privatisation of the professional education sector, with more than 80 per cent of the engineering colleges being privately funded and managed. While there are strict entry barriers for the private sector, there is not enough regulation on the products and outputs of the private sector.

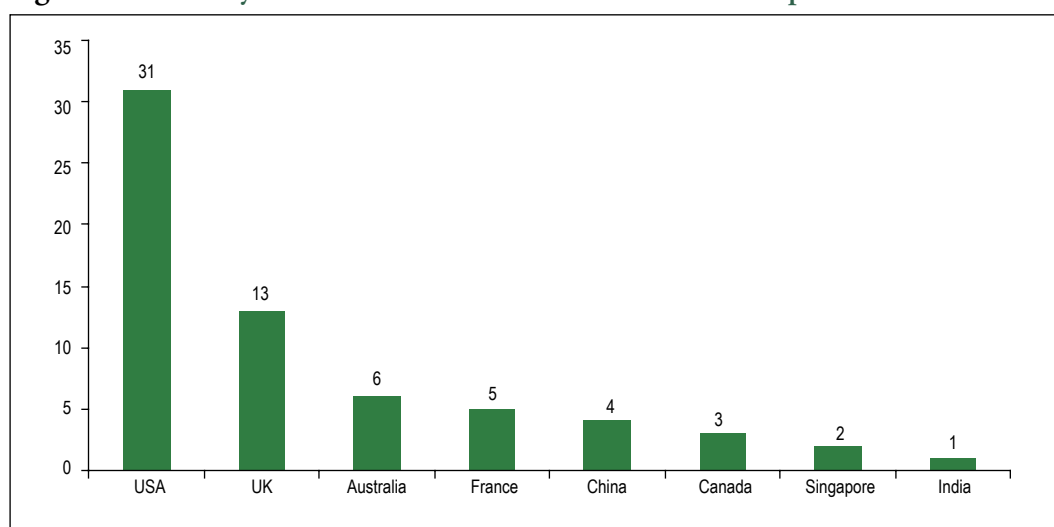
Accreditation: Accreditation in higher education pertains to determining the quality of an institution. The criteria on which institutions are judged typically involve expected student achievement, quality of curriculum, faculty, academic support and services for students, and financial capacity. In India accreditation (unlike in other countries such as the USA and the UK) is performed by government agencies. The National Assessment and Accreditation Council (NAAC) was set up by the UGC in 1994 to accredit institutions of higher education. The NAAC's assessment is based on pre-determined criteria that combine self-study and peer review. NAAC accredits and certifies for educational quality in institutions based on seven criteria with different weights for each criterion, and for different types of institutions. NAAC has so far

completed accreditation of only 140 out of the 355 universities and 3,492 out of the 18,064 colleges. This covered just over 10 per cent of all institutions, and barely any private colleges and universities. The results of the accreditation process thus far indicate serious quality problems. Only 9 per cent of the colleges and 31 per cent of the universities are rated as 'A' grade and the rest fall in 'B' and 'C' categories. Accreditation by NAAC is voluntary and valid for five years. However, very few institutions have applied for accreditation by NAAC.

Quality: There are concerns about the quality of higher education provided in India currently. There is

an annual outflow of more than 1,50,000 students to institutes in the west every year – driving out nearly 2-3 billion dollars in foreign exchange per annum. It makes India the second-largest target market globally for education institutes in the west. Though the problem of reaching world class standards is not as pressing as meeting the larger needs of the population, India's standing in this regard is indicative perhaps of the generally low standards. In a London Times Higher Education Supplement ranking of the top 200 universities, only 1 Indian institution was listed, while the Shanghai University ranking of 500 world-class universities featured only 3 Indian universities.

Figure 20: Country wise Number of Universities in Times Top 100 Universities



Source: Times Higher Education Supplement, London

Table 12: Current Quality Status in Colleges of Higher Education in India (2005)

Details	Number
Total number of colleges	17,625
Number of colleges under UGC purview	14,000
Number of colleges recognised under Section 2(f) of UGC Act	5,589 (40 per cent)
Number of colleges recognised under Section 12(B) of UGC Act	5,273 (38 per cent)
Number of colleges actually funded by the UGC	4,870 (35 per cent)
Number of colleges accredited by the NAAC	2,780 (20 per cent)
Number of colleges accredited by the NAAC and scoring above 60 per cent	2,506 (17.9)

Source: MHRD

More Talented Students in Maths and Science

Introduction

As India seeks to establish itself as a knowledge superpower, it is essential for it to build on its science and technology base. Pure sciences has a critical role to play in this – a strong foundation in science helps in building excellence in technology, propelling economic growth and prosperity, and consequently raising living standards. While India has had a rich heritage in abstract thinking and scientific discoveries, of late the progress in this field has been on the decline. It is increasingly felt that with the popularity of arts, commerce and professional courses, and more lucrative opportunities in related professions, there has been a decline in students studying pure mathematics and science. In order to create a critical base of scientific professionals in the country it is necessary that immediate steps be taken to attract more quality students in mathematics and science.

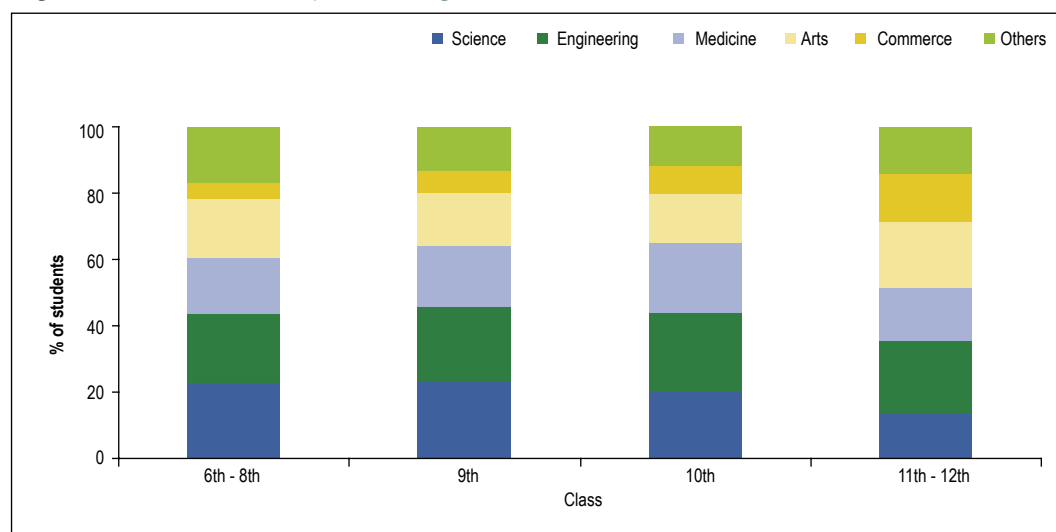
Current Scenario

School level: While science dominates as the most preferred subject at the middle school level (class 6-8), it

becomes less popular at the higher secondary level (class 11-12). In a science survey conducted by the NCAER, 22 per cent of the class 6-8 students said they would like to study pure science in the future. Yet, at the level of class 11 and 12, only 13.4 per cent of the surveyed students wanted to study pure sciences at the graduate/postgraduate level. This percentage is lower than the figure for other disciplines – engineering, medicine, arts and commerce.

Further, the number of students opting for science after the secondary school stage has dropped from 32 per cent in the early 1950s to 19.7 per cent in recent years. More significantly, while in the 1950s, the brightest students entered science, the current science students often take it as a last resort. This indicates that young students, particularly the brighter ones, are drifting away from science. For instance, as reported by Homi Bhabha Centre for Science Education (HBCSE), very few students selected for Olympiads in Physics, Chemistry or Biology went on to opt for higher education in basic sciences. The choice of the National Talent Search awardees also reflects this trend in recent years. Of the 750 awardees, only about 100

Figure 21: Preferred subject for higher education by level of students (2004)



Source: India Science Report, National Council of Applied Economic Research

opted for science and only 15 to 20 of the awardees pursued science to the post-graduation level.

Further analysis of the reasons behind why students take science or choose not to take science at higher secondary level reveals that passion for science is the primary decision factor. Not surprisingly, 'better job opportunities' is the second most important reason for taking up science at higher secondary level. Peer pressure, the changing socio-economic situation, and market mechanisms have resulted in the drift of students away from basic sciences to professional courses which lure the student pool with high salaries. (See Tables 13 and 14)

Table 13: Reasons for taking admission in science

Reason	Percentage of science students (Class 11 & 12)
Interested in science subjects	66.6
Better job opportunities	20.4
Parents' desire	3.3
Interested in doing research in science	1.8
Influenced by the work of scientists	1.3
Quality of science teachers is very good	0.8
Influence of peer group	0.7
Intend to go abroad	0.2
Others	4.8

Source: India Science Report, National Council of Applied Economic Research

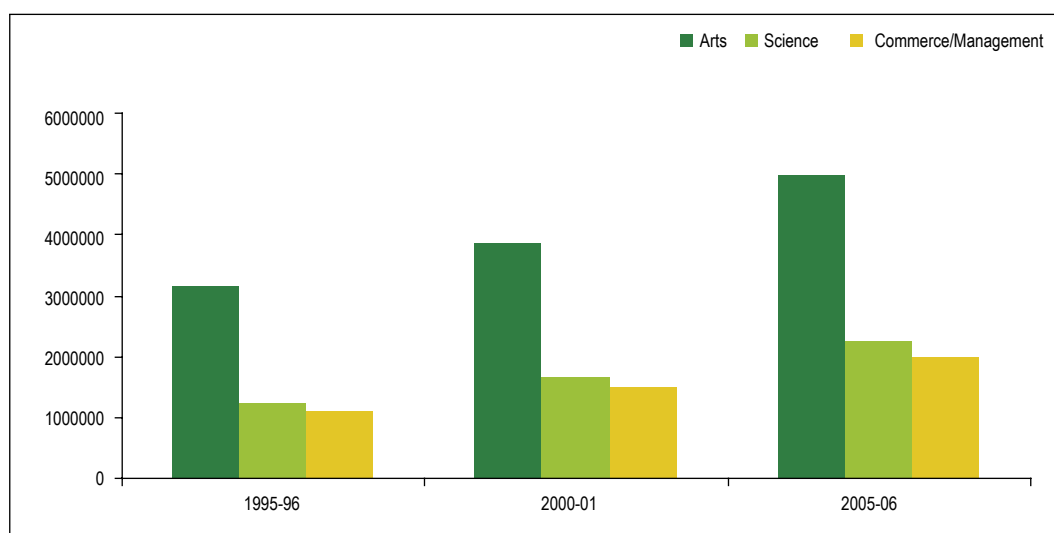
Table 14: Reasons for not taking admission in science

Reason	Percentage of non-science students (Class 11 & 12)
Not interested in science subjects	44.5
Difficult subject	20.4
Higher studies are costly	9.9
Interested in commerce	5.4
Like art subjects	4.8
No future opportunities	2.1
No science college nearby	2
Difficult to get through competitive examination	1.1
Poor quality of teaching at school	1.1
Others	8.9

Source: India Science Report, National Council of Applied Economic Research

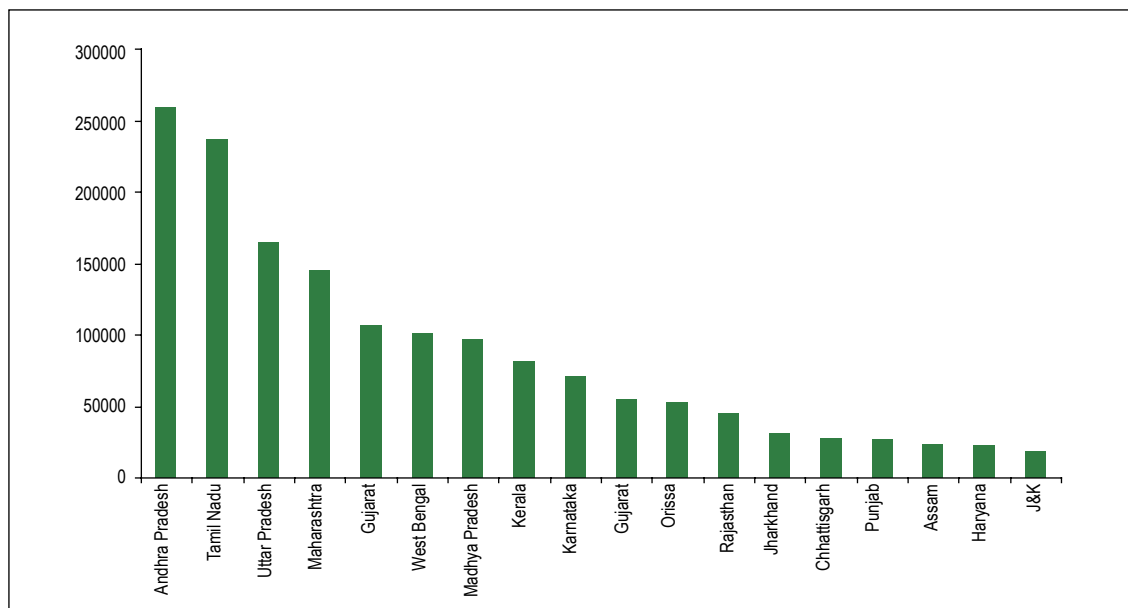
Higher education: Approximately 2.25 million students were enrolled in science in 2005-06 (UGC) – accounting for 19 per cent of the total enrolment in higher education. The number in absolute terms is not small. The stock situation in 2004 was also good. About a fourth of those qualified to the level of graduate and above had a background of science education. There are 8.74 million graduates in all (22.3 per cent of total graduates), 1.8 million postgraduates (19.4 per cent of total post graduates), and 0.1 million doctorates (one-third of total doctorates) in science. However enrolments in pure science and mathematics have not grown as much as in professional fields. Even the number of students from India going abroad to

Figure 22: Gross enrolment in higher education



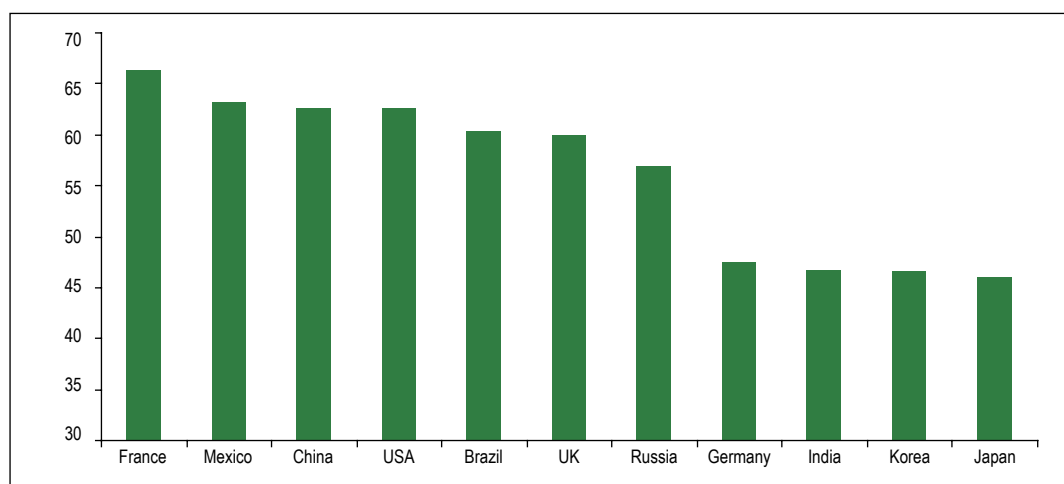
Source: UGC

Figure 23: State-wise enrolment in science (2000-01)



Source: University Development in India, 1995-95 to 2000-01, UGC

Figure 24: Science and engineering doctoral degrees as a percentage of all doctoral degrees in selected countries



Source: NSF, Science and Engineering Indicators 2004, Appendix table 2-36

pursue maths and science has fallen. According to MHRD figures, there has been an absolute decrease of 33 per cent in the number of students going abroad in the science stream (between 1991 and 1998) while the numbers in banking, technology, commerce and management have increased considerably. This could be a result of shift in student interest to pursue courses which have better career options than science.

There is also a striking regional imbalance in enrolment in science with Andhra Pradesh and Tamil Nadu having much larger students taking up science than in the other states.

Research: While research in all areas requires attention, the condition of science is particularly dismal. The

absolute number of science graduates is not small but the number of doctorates in science stream leaves much to be desired. According to 2005-06 UGC figures, science doctoral students formed only 1.1 per cent of the graduate enrolment in science. While most advanced countries have more than 60 per cent of total doctoral degrees in science and engineering fields, India has only 46 per cent doctorates in science and engineering (See Figure 24).

The declining interest in science and mathematics needs to be addressed comprehensively. Issues relating to pedagogy, evaluation, curriculum, careers, and infrastructure need to be tackled effectively. Large scale science popularisation programs could also re-establish the passion science once generated.

Legal Education

Introduction

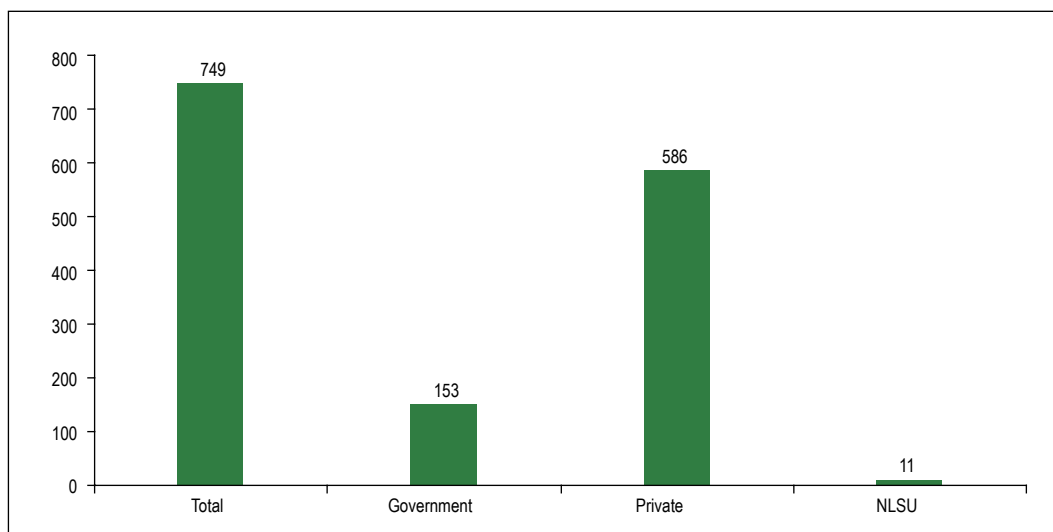
Legal Education as an aspect of professional education has assumed considerable significance, not only in terms of the historical utility of law in society but also in the current context of globalisation. Legal education is a vital link in the creation of knowledge concepts as well as in the application of such concepts in society. The need for trained law personnel in academia, litigation, corporate practice, government and civil society has increased significantly over the last few years and it is estimated that the demands for such trained personnel will rise far more exponentially in the years to come. There is therefore a need to articulate a clear long term vision on legal education in India.

Current Scenario

Institutions: As in 2006, there were roughly 750 institutions in India imparting legal education. Of these, 153 were government institutions and 586 were private institutions. There were a total number of 11 National Law School Universities (NLSUs).

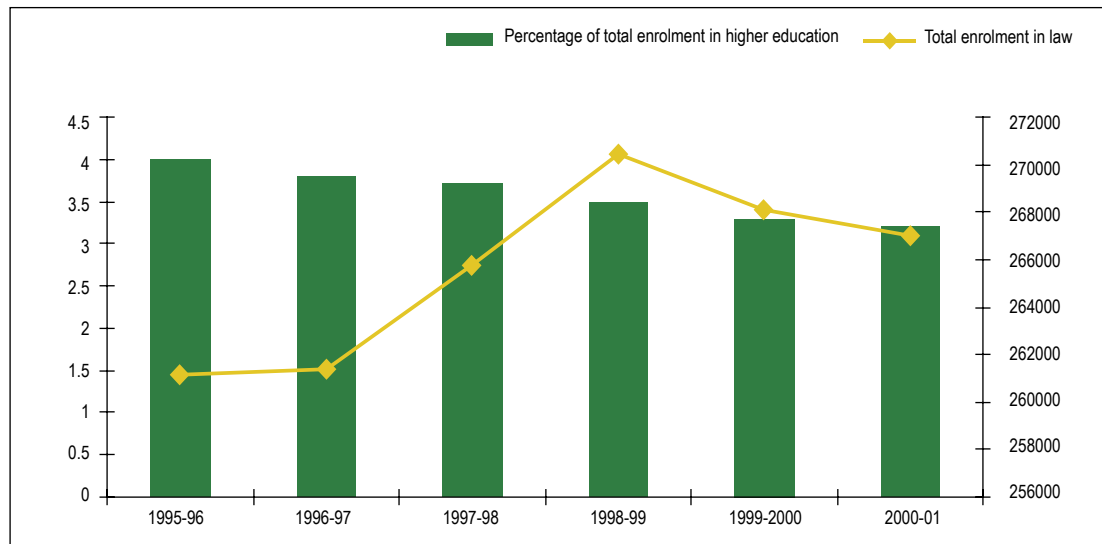
Enrolment: In 2005-06, there were 3.36 lakh students enrolled in legal education in India, accounting for 3.05 per cent of the total enrolment in higher education. Further, a total of 936 students were admitted to the NLSUs in 2006.

Figure 25: Number of institutions teaching law (2006)



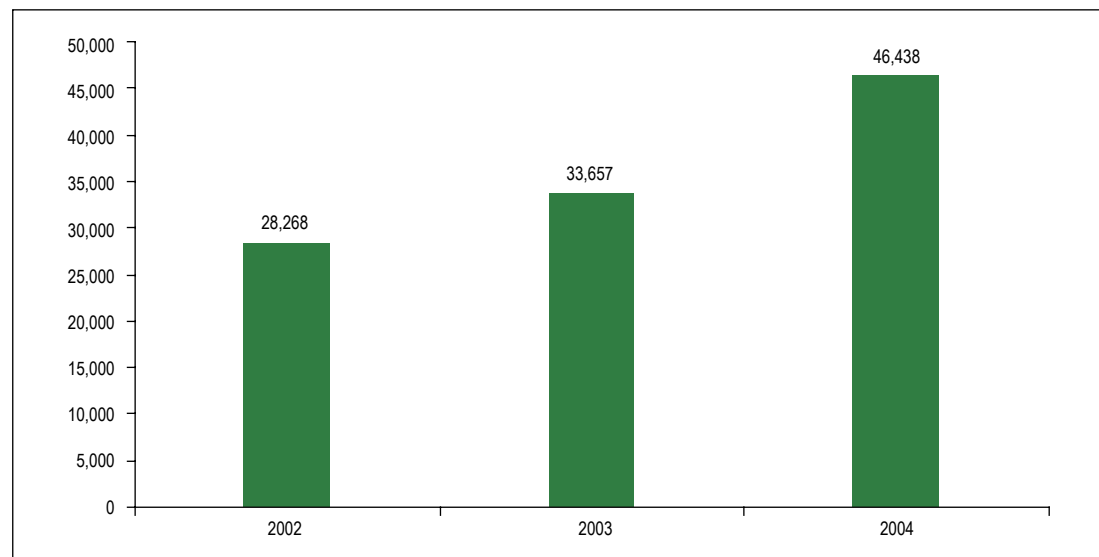
Source: Bar Council of India

Figure 26: Total enrolment in law



Source: University Development in India, 1995-96 to 2000-01, UGC

Figure 27: Total number of law graduates admitted to the Bar



Source: Bar Council of India

Medical Education

Introduction

Assuring a minimal level of health care to the population is a critical constituent of the development process. As a result, the goal and objectives of medical education, its quality and quantity has wide ramifications for human development, health services and build up of intellectual capital for the welfare of the whole country. While medical education in India has expanded in the last 60 years, it continues to remain inadequate given the needs of the country. This is reflected in the shortage of health professionals and health services, with wide disparities between rural and urban areas and also between various states. There is thus an urgent need to expand India's medical education system while keeping issues of quality in consideration.

Current Scenario

Enrolment: The number of students enrolled in medical education has increased by around 85 per cent in the last ten years, from 1,88,187 in 1995-96 to 3,48,485 in 2005-06. However, enrolment in medicine as a proportion to total enrolment in higher education has barely increased – it has changed from 2.9 per cent in 1995-96 to 3.1 per cent in 2005-06.

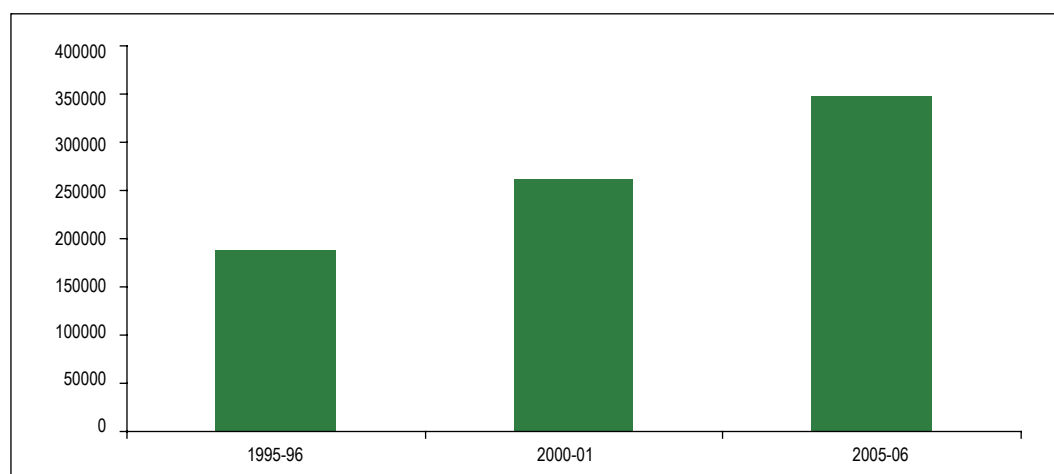
Institutions: The total number of medical colleges (allopathy, ayurveda, homeopathy, unani, dental, nursing and pharmacy) put together stood at 2092 in 2005-06. This was a sharp increase from just 817 medical colleges in 2004-05.

Allopathic Medical Colleges: As of 2006, there were 262 allopathic medical colleges in the country, out of which 174 medical colleges were recognised under Section 11(2) of the IMC Act, 1956 by Medical Council of India. The remaining 88 colleges are permitted under Section 10A of the IMC Act, 1956 for starting MBBS courses. Out of the 262 medical colleges, 131 were government medical colleges, and remaining 131 were private medical colleges. The admission capacity in these colleges is approximately 29,172 students per year. The increase in private medical colleges has been sharp – they grew from 47 in 1995 to 131 in 2006. In the same period, government run medical colleges have increased only from 109 to 131.

AYUSH Medical Colleges: Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy (AYUSH) colleges have seen a gradual increase in the last five years. (See Figure 31)

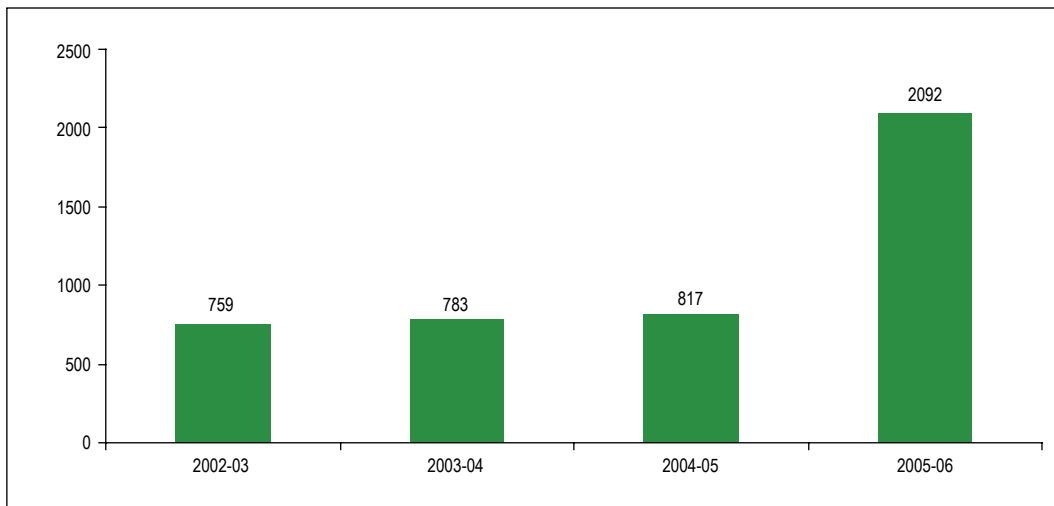
It is a matter of concern that a large number of medical colleges are concentrated in six states (Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Kerala and

Figure 28: Growth in enrolment in medicine



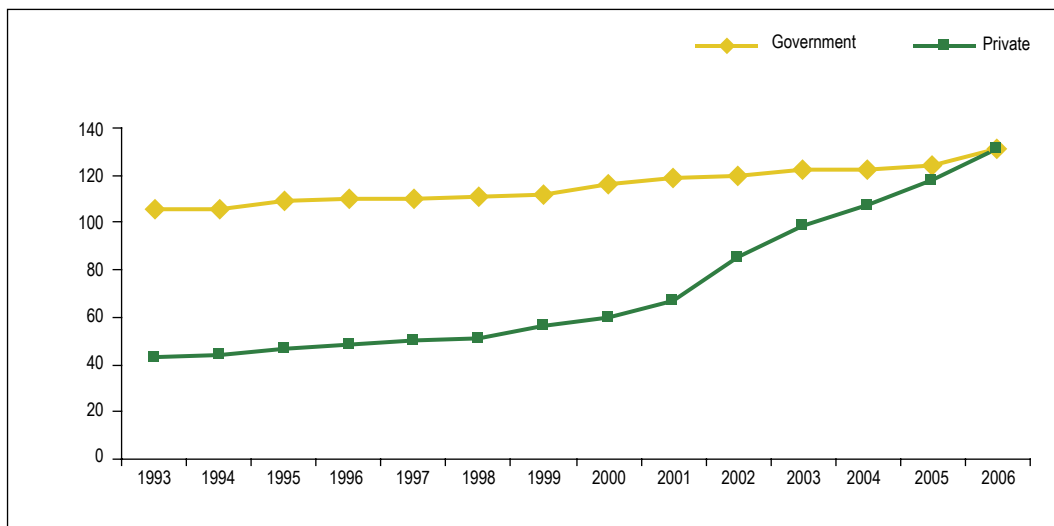
Source: UGC

Figure 29: Growth in medical colleges



Source: MHRD, Selected Statistics 2005-06

Figure 30: Growth in medical colleges – government and private



Source: Medical Council of India

Gujarat). These states cover about 63 per cent of the total number of medical colleges and 67 per cent of the number of seats. In contrast to this, a disproportionately small number of colleges/seats are located in the other states – 20 per cent of the aggregate number of colleges and 18 per cent of the seats in the case of the Empowered Action Group states; and 3 per cent of the aggregate number of colleges and 3 per cent of the seats in the North Eastern/Hilly states. There is also a rural urban divide with only 30 per cent of the population in the urban areas with 96 per cent of educational institutes here, whereas where more than 70 per cent of the population lives, availability of educational facilities is meager.

Regulation: A plethora of bodies exist to control medical education. Authorities involved include

Ministry of Health, Medical Council of India (MCI), UGC, State Medical Education Departments and Councils, Medical Colleges/Institutes, NAMS and NBE (National Board of Examinations). The Medical Council of India (MCI) was established in 1933 and as per Indian Medical Council Act 1933 is the statutory recommending body. The MCI only recognises institutions to start a course and expand it according to laid down criteria under the MCI Act of 1956. With the prior permission of the Government of India, it has no regulatory powers; it is only a recommendatory body. Over the years it has failed to serve the purpose and led to a progressive decline in medical education. The State Medical Education Departments and Councils grant licenses to practice without assessment. Medical colleges largely follow

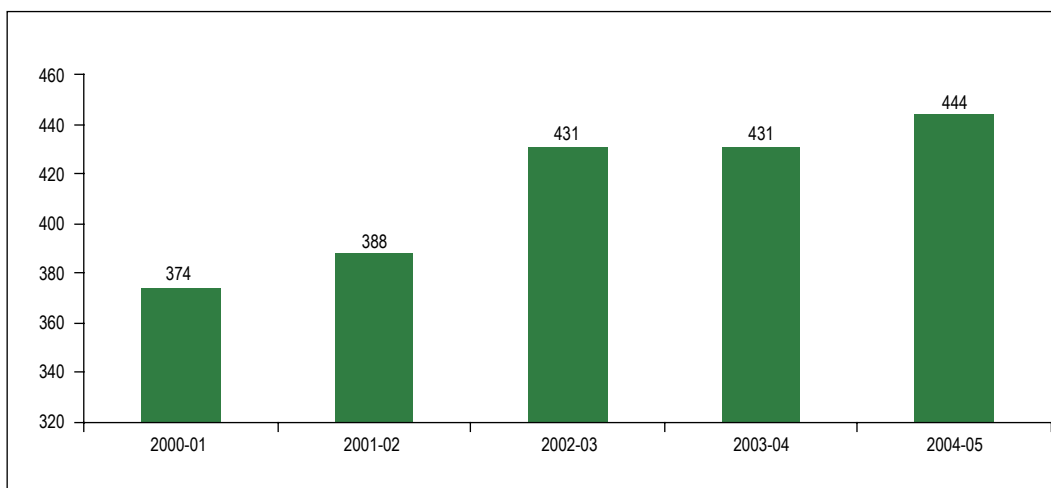
the MCI with no attempt to upgrade or evaluate students or courses.

Quality: There is lack of consistent and regulated standards in medical education with many of the colleges having questionable training capacities and no accreditation system. Medical graduates are often not assessed for clinical skills in accordance with national and international standards. There is lack of appropriate regulation and that further compounds the problem. State governments can grant license to practice general specialty, sub-specialty or super-specialty medicine with no assessment of clinical skills. With roughly 26000 graduates passing out from MBBS every year and only 11-12 thousand postgraduate seats, about 14-15 thousand graduates get into medical practice with theoretical knowledge but no application of knowledge. MCI has

neither the power nor the infrastructure to continuously monitor and standards. Major reforms at each level are needed in order to elevate the present condition of medical education in India to international standards.

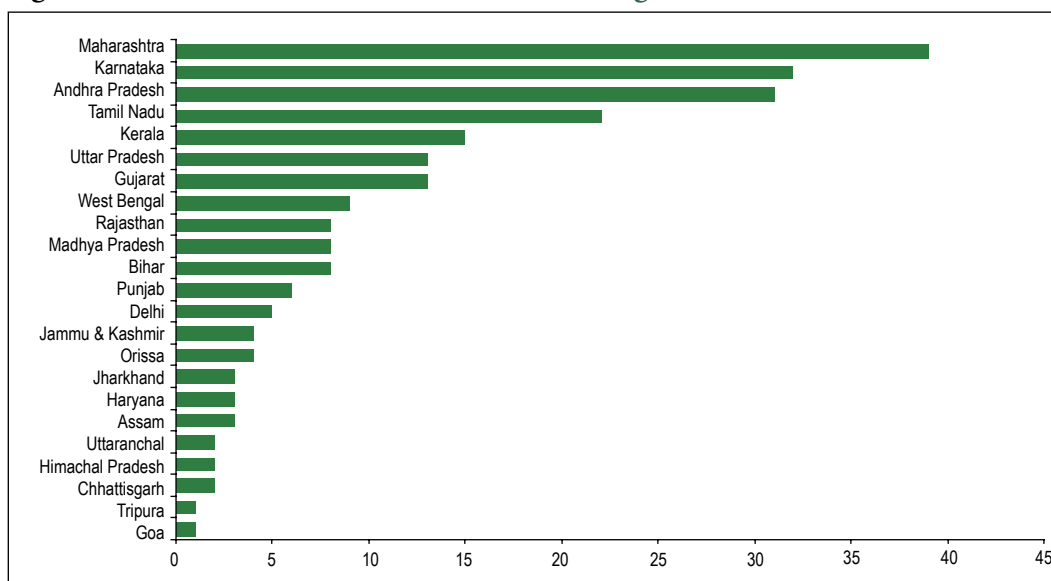
Curriculum: The graduate course is 4½ years with assessments in the 1st year and 2nd year and 2½ years later, by internal and external examiners assessing theoretical knowledge acquired. Skill assessment is limited to a case discussion. Internship is of 1 year duration with no faculty supervision or system of assessment. The graduate acquires unsupervised clinical skills after leaving medical school and before entering general practice. Only about five thousand can get a postgraduate seat and then go through a graded clinical responsibility. It is therefore not surprising that a series of studies conducted by AIIMS and a consortium of 16 medical colleges during

Figure 31: Growth of AYUSH colleges in India



Source: Medical Council of India

Figure 32: State wise distribution of medical colleges (2005)



Source: Medical Council of India

1989-1995 concluded that our medical graduates lack clinical skills. As a follow up to these studies, WHO SEARO conducted a study *General Practice in India, Nepal & Sri Lanka- a status report* (1998) which found the medical care delivered by a sample of general practitioners to be of questionable quality.

Funding: The Central Budget allocation for health which includes medical education has declined from 1.3 per cent of the GDP in 1999 to about 0.9 per cent today. As a percentage share of the Total Central Budget, it has been stagnant at 1.3 per cent, while in the states, it has declined from 7 per cent to 5.5 per cent (National Health Policy 2002). The results from the National Health Account (NHA) for the year 2001-02 showed that total health expenditure in the country was Rs. 1,05,734 crore, accounting for 4.6 per cent of its GDP. Out of this, public health expenditure constituted Rs. 21,439 crore (0.94 per cent), private health

expenditure constituted Rs. 81,810 crore (3.58 per cent) and external support Rs. 2,485 crore (0.11 per cent). In nominal terms, the per capita public health expenditure increased from Rs. 89 in 1993-94 to Rs. 214 in 2003-04, which in real terms is Rs. 122. Given these statistics, it is no surprise that the reach and quality of public health services has been below the desirable standard.

Health Services and Medical Personnel: While India has seen considerable improvements in health standards in the last six decades, problems of access to quality healthcare and shortages of skilled medical personnel still persist. As per 2007 figures, India had 6.9 lakh registered allopathic doctors, 7.2 lakh AYUSH doctors, 15 lakh nurses and 6.8 lakh pharmacists. While the absolute number is not very low for a developing country, the numbers prove inadequate in view of India's large population.

Figure 33: Growth of per capital health expenditure by Centre and States

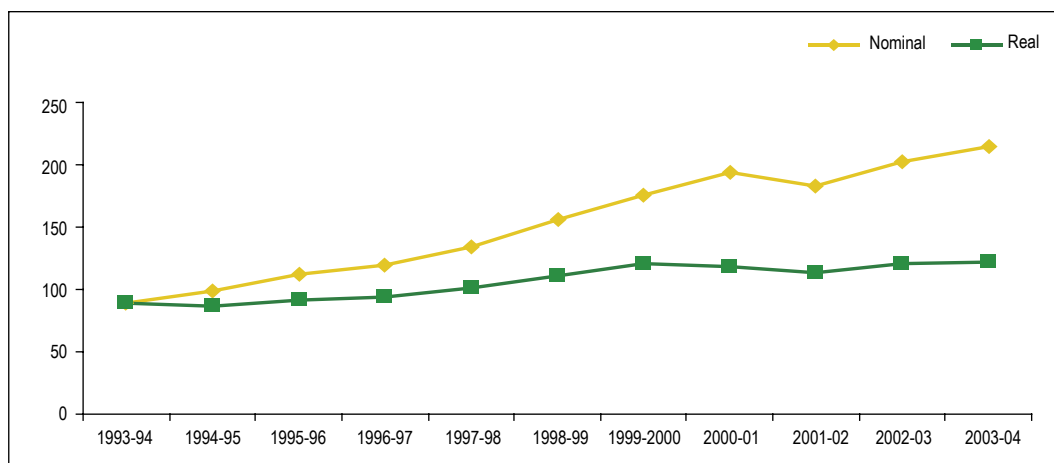
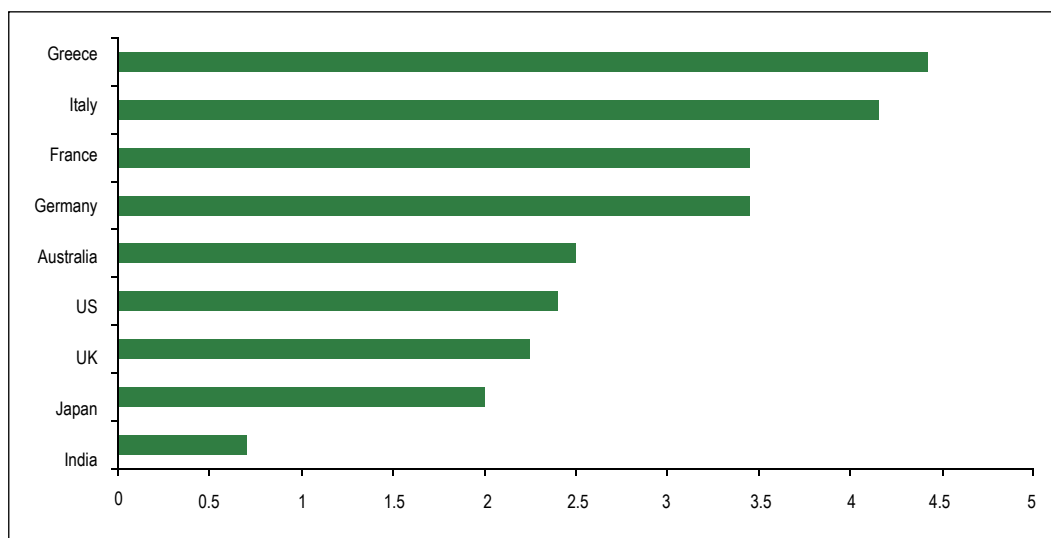


Figure 34: Number of doctors per 1000 population



Source: Journal of Royal Society of Medicine Vol. 99, June 2006

Management Education

Introduction

In recent years there has been an unprecedented number of technical and management institutions being set up, mostly through private capital. In the field of management education, India has around 1200 institutions providing undergraduate and post-graduate level courses. Since the management graduates and post-graduates produced by these institutions are primarily absorbed by industry, there is a growing need to match the curriculum and structure of management education to better fit the needs of India and to the changes in the industrial and services sectors within the country. Moreover, it is important to properly assess the quality of management education imparted to the students of various institutions.

Current Scenario

As in 2006-07, there were over 1100 business schools in the country. Of these, 5 were private aided institutions,

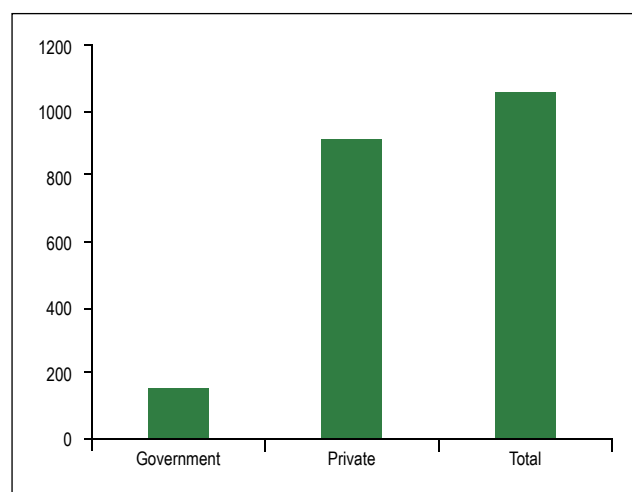
903 were private unaided and 149 were government institutions.

In the last decade, the country has witnessed a phenomenal growth in enrolment in management education. The current intake stands at roughly 92,000, with the majority of the students enrolled in private management colleges.

The distribution of management institutions shows a regional imbalance, with 86 per cent of the colleges concentrated in north and south India. There appears to be a correlation between the number of schools in a state and its economic and industrial development. The regional imbalances in development and the creation of capacity for management education in the state are probably related.

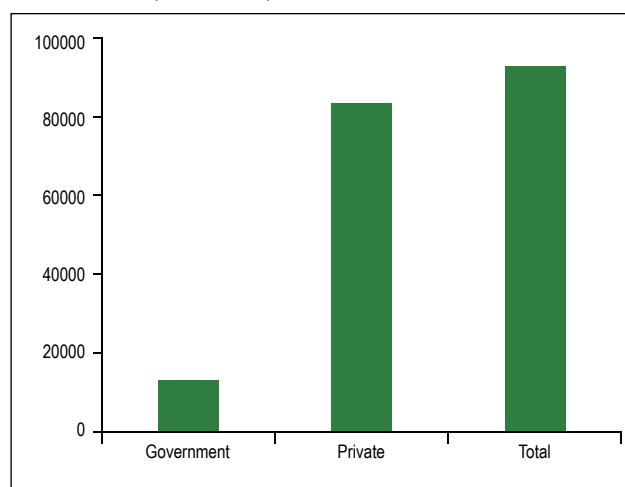
A large proportion of the capacity is filled through all-India examinations conducted at a number of locations throughout the country. Therefore, a high per capita seat capacity for a state does not necessarily mean a higher

Figure 35: Number of management institutions (2006-07)



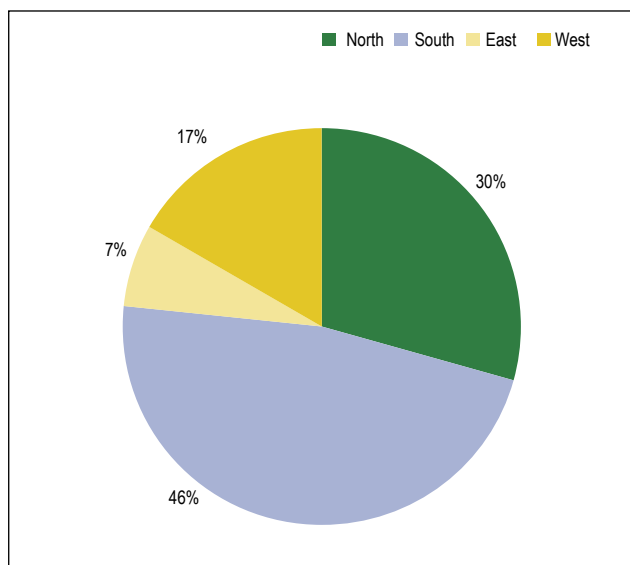
Source: MHRD

Figure 36: Intake in management colleges (2006-07)



Source: MHRD

Figure 37: Regional distribution of management colleges (2006-07)



Source: MHRD

level of opportunity for aspirants from that state. The per capita seats per lakh of population may be partly a reflection of the state's capacity to absorb a higher percentage of management graduates.

Growth in the number of business schools has accelerated over the last two decades. This acceleration, propelled by the increase in the rate of growth of the Indian economy, speaks also for the entrepreneurial initiative of promoters to seize commercial

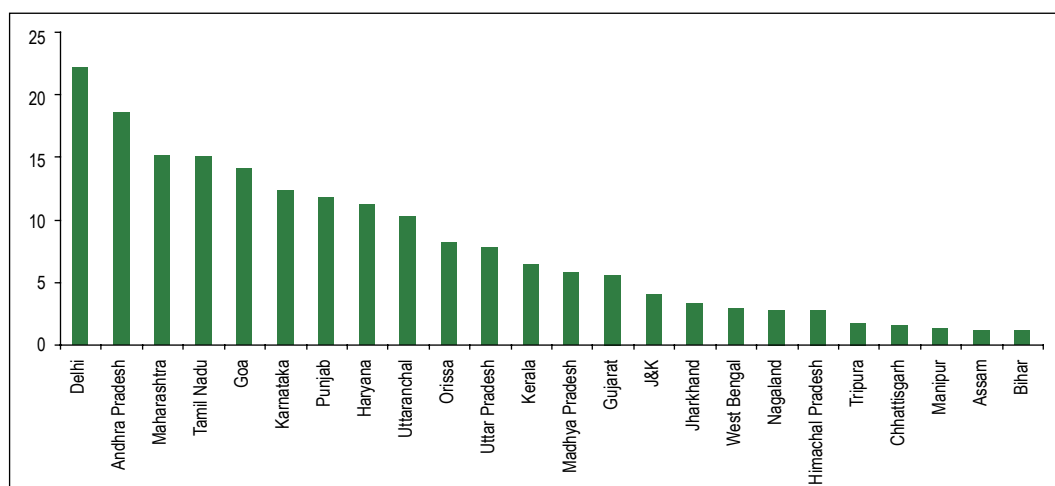
opportunities in education. The imbalance between demand and supply for management graduates has led to an overly commercial and exploitative environment in management education. It is not clear how many of the recently started institutions are merely speculative and how many are seriously committed to the cause of management education. It is not also clear how many actually meet the norms and standards established by the All India Council for Technical Education. The regulatory framework and implementation has been unable to link the entrepreneurial initiative to performance in terms of educational quality. It has a control perspective focusing on inputs such as land, faculty, and other infrastructure rather than on the outcomes such as quality of education, research, access, cost effectiveness or relevance.

Table 15: Growth of business schools in India during 1950-2006

Period	No. of Business schools added	Average annual addition
1950-80 (30 years)	118	4
1980-1995 (15 years)	304	20
1995-2000 (5 years)	322	64
2000-2006 (6 years)	1017	169

Source: Adapted from Dayal, I., "Developing Management Education in India", *Journal of Management Research*, 2(2), August 2002, page: 101.

Figure 38: State-wise MBA/PGDBM seats per lakh population (2006)



Source: Report of the Working Group on Management Education, National Knowledge Commission

Engineering Education

Introduction

With economic growth and the spread of technology, the demand for engineers has increased manifold. This has been matched by an increase in enrolments in engineering as well as rise in number of engineering institutes in India. However keeping in mind the growing opportunities for engineers, particularly in the field of information technology and business process outsourcing, there is scope for further expansion. A NASSCOM report foresees a shortage of 500,000 knowledge workers by 2010, 70 per cent of which would be in the BPO industry. At the same time, the quality of engineering institutes and engineering graduates needs to be improved. Apart from a few elite institutes, engineering education in India is often seen as outdated and irrelevant. Most graduates do not possess the requisite skills, and industries have been facing a consistent deficit of quality trained engineers. Also, most institutes, including premier institutes, fail to attract and retain quality faculty. These deficiencies in engineering education need to be tackled immediately to ensure that India does not miss out on significant opportunities.

Current Scenario

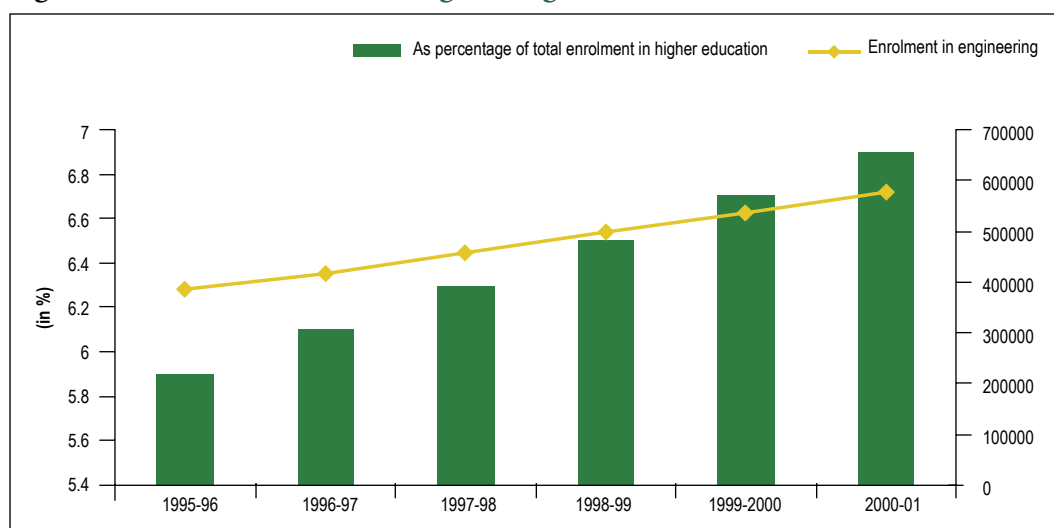
Enrolment: Enrolment in engineering education has seen a rapid increase in the last decade. The total enrolment in 2005-06 stood at 795120 – accounting for 7.21 per cent of the total enrolment in higher education.

Institutions: There has been a phenomenal growth in the number of engineering institutions at the graduate level, from 158 in 1980-81 to 1512 in 2006-07. A major reason for this explosive growth in the last decade has been the entry of private (aided as well as self financing) institutions. With the growth in demand, the average sanctioned intake per institution has also increased with time.

The investment from private sector has had a large role to play in the growth of institutions. However, the quality of these many of these private institutions is suspect. This has also been a major reason for the creation of a regional imbalance in the country.

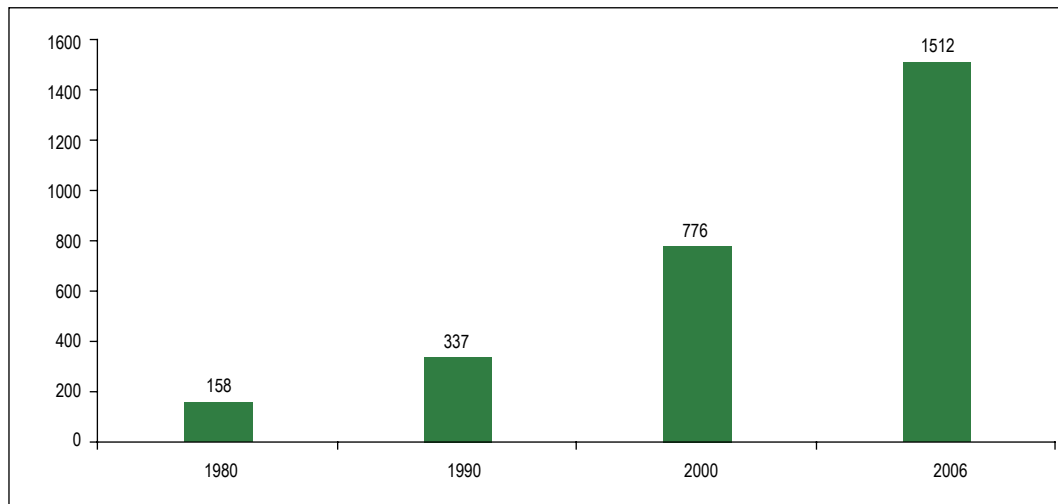
Regional imbalance: Although the number of engineering institutions is more than 1500 at present,

Figure 39: Time series trend in engineering enrolments



Source: University Development in India, 1995-96 to 2001-01, UGC

Figure 40: Growth in engineering institutions



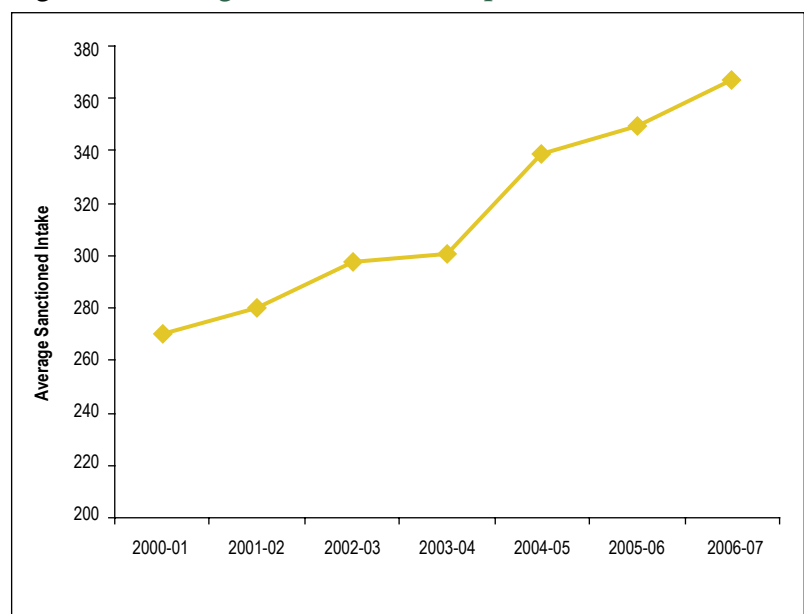
Source: UGC

data on the region-wise distribution of institutions and sanctioned intake of students indicates regional disparity. On one hand, where there are around 268 institutions in the southern region, there are only 9 institutions in the eastern region. At the extreme end of the spectrum, Nagaland, Andaman and Nicobar, Daman & Diu have no engineering institutions at all. Out of the seven Indian Institutes of Technology, three (Delhi, Kanpur and Roorkee) are located in the North, two in the East (Kharagpur and Guwahati) and two in the South (Chennai and Mumbai).

Faculty: The rapid growth of engineering institutions and the inadequate supply of teachers together have created a shortage of faculty across engineering disciplines and institutions. India has a faculty strength of around 67,000 in engineering. According to the AICTE Review Committee Report 2003, the increase in the sanctioned number of student intake has led to an escalation of faculty requirements of about 95,924. This indicates a shortfall of over 26,000 engineering doctorates and 30,000 engineering postgraduates for meeting the teaching requirements.

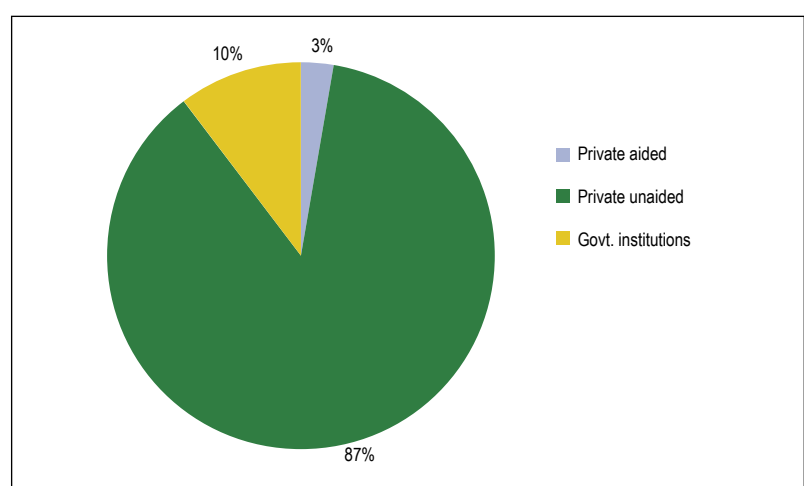
Quality: Engineering education in India has a pyramidal structure, with a few elite institutions at the peak and a large proportion of institutions at the bottom of this pyramid. Flexible institutions, world

Figure 41: Average sanctioned intake per institution



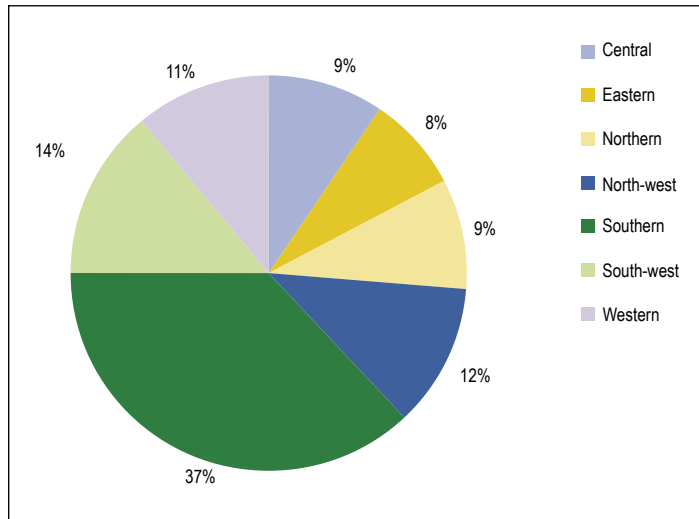
Source: AICTE

Figure 42: Share of institutions by intake (2006-07)



Source: AICTE

Figure 43: Region-wise distribution of engineering institutions in 2006-07



Source: AICTE

class infrastructure, relevant curriculum, good faculty and industry linkages are crucial inputs needed to enhance quality of engineering education in India. Current engineering graduates are often found to be ill-equipped to meet the skill demands of the industry – a survey by the McKinsey Global Institute showed that multinationals found only 25 per cent of Indian engineers employable.

Research: Postgraduate education in engineering and technology had a late start in our country. At the time of India's independence only 6 institutions offered postgraduate programs in engineering and technology to just about 70 students. In 2003, 1552 postgraduate engineering programs were recognised in engineering, offered by 321 institutions with a total sanctioned intake of over 26,000. In 2004-05, only 968 doctorate degrees were awarded in engineering, the majority of which came either from the Indian Institutes of Technology or the Indian Institute of Science, Bangalore.

Open and Distance Education

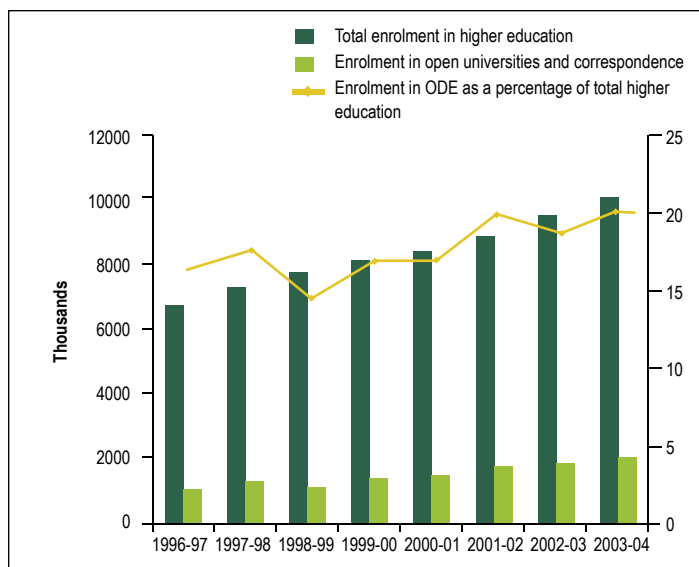
Introduction

Distance education is provided by open universities and correspondence courses offered by Distance Education Institutions (DEIs) of conventional universities. Almost one-fifth students enrolled in higher education in India are receiving education through the distance mode, i.e. through the open universities or through the correspondence courses of traditional universities. Given the rapid expansion required in higher education in India, open and distance education can play an extremely significant role in meeting the increased demand for higher education. Moreover, there is an unprecedented opportunity with regard to technology especially in the form of open courseware. However, problems relating to quality as well as brand equity of distance education persist.

Current Scenario

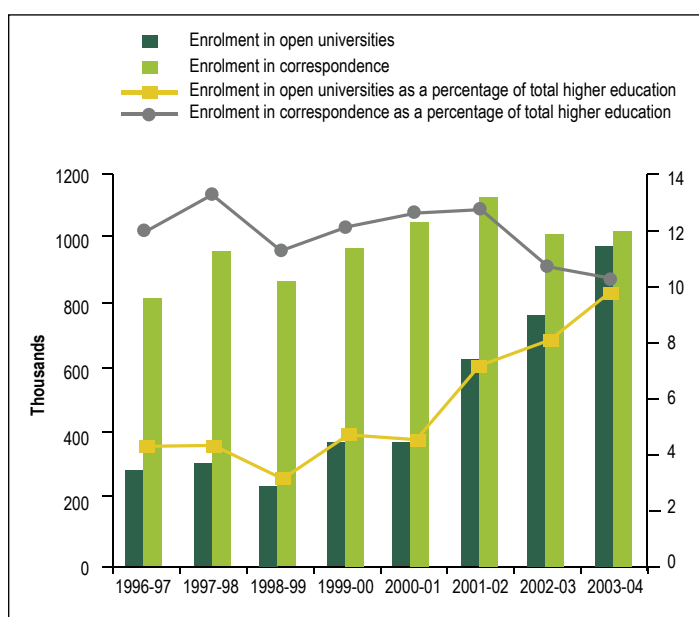
Enrolment: In 2004-05, around eleven million people were enrolled in higher education in India, of which the open and distance education system (including correspondence courses offered by distance educational institutions (DEIs) of conventional colleges) served roughly 20 per cent. Within this, open universities served 10 per cent of the higher education need. The figure below illustrates the growth in enrolment in higher education and open and distance education from 1996 to 2004. In 2000-01, only 4 per cent of the higher education need was served by open universities, but in 2003-04 the figure was around 10 per cent, while the overall distance education contribution is around nineteen per cent. The figure below also shows the contribution to distance education by open universities and by correspondence courses of conventional universities.

Figure 44: Contribution of Open and Distance Education (ODE)



Source: MHRD

Figure 45: Enrolment in open universities and correspondence courses



Source: MHRD

Institutions: In India there are 14 open universities – 13 state open universities and one national Open University – Indira Gandhi National Open University (IGNOU). IGNOU now has a cumulative enrolment of about 15 lakh, offers a total of 126 programs and has a teaching staff of 325 and 1157. Distance education through correspondence courses is provided by other regular universities as well. As on date there are 119 Correspondence Course Institutes (CCIs) in conventional Universities. In 2003, open universities served only eight per cent of the total higher education enrolment, while correspondence courses constituted nearly one fifth of the total higher education enrolment.

Quality: The quality and delivery mechanisms of distance education provided by correspondence courses are relatively poor. Most correspondence courses are instituted as a mode of resource generation in view of the unmet demand for higher education. Further, the resources thus earned are not used for the improvement of the correspondence programs. Therefore, quality concerns become secondary to those of numbers and income. Due to inadequate mechanisms of quality control and regulation, students graduating from both regular courses and correspondence courses get the same degree, despite sharp differences in quality of pedagogical process and achievement. Substantial investments in

Table 16: Enrolment in open universities and correspondence courses (1996 to 2003)

Year	Total enrolment in higher education	Enrolment in open universities	Enrolment in open universities (% of total)	Enrolment in correspondence	Total enrolment in open & distance education
1996-97	6842598	294947	4.31	819110	1114057
1997-98	7260418	316089	4.35	959228	1275317
1998-99	7705520	247168	3.21	868459	1115627
1999-00	8050607	381862	4.74	971991	1353853
2000-01	8399443	379286	4.52	1055317	1434603
2001-02	8821095	632214	7.17	1123344	1755558
2002-03	9516773	765489	8.04	1012779	1778268

Source: Department of Secondary & Higher Education, MHRD

Table 17: Enrolment and teachers in open universities in India (2003-2004)

Open University	Enrolment	Students on Roll	Teachers	Budget [#]	Revenue Receipts [*]
Indira Gandhi National Open University, New Delhi	334315	1187100	307	21170	13950
Dr. B.R. Ambedkar Open University, Hyderabad	190320	-	89	3320	2730
Vardhaman Mahaveer Open University, Kota	5999	-	30	355	390.5
Nalanda Open University, Patna	1805	8484	6	948	95.95
Yashwantrao Chavan Maharashtra Open University, Nashik	102642	800587	39	2189	1600
Dr. Babasaheb Ambedkar Open University, Ahmedabad	13824	68865	39	-	-
Madhya Pradesh Bhoj Open University, Bhopal	192230	192230	36	121.5	1129.04
Netaji Subhas Open University, Kolkata	14734	225244	4	310	175
Uttar Pradesh Rajarshi Tandon Open University	8025	22172	11	-	-
Karnataka State Open University, Mysore	19580	33172	63	46	1156
Tamil Nadu Open University, Chennai	9361	9361	20	192.9	192.9
	[#] Budget plan + non plan			[*] in Rs Lakh	

Source: Distance Education Council

correspondence courses must be made by universities to improve resources, delivery and modes of pedagogical assistance and assessment.

International comparisons: Most of the developing countries worldwide have realised the need for open universities. Developed countries such as France and UK have pioneered open and distance education. United States remains the undisputed leader in online education. Table 18 below lists *mega* open universities of the world, along with enrolments and budget.

Issues in the Current Framework

1. The same form and structure of degree programs:

Open and distance education imparted in open universities system has evolved alternative delivery modes with a lot of flexibility. However, it has retained the same form and structure, eventually culminating in a degree or diploma certification. Though this is followed to retain recognition from employers and acceptance from society, it has not made the system responsive to the dynamic developmental needs of the people.

2. Limited linkages with the workplace: The emphasis on people's education with a focus on work related skills and productivity as expected in the Report of Education Commission (1964-66) on Education

and Development is yet to be achieved and built into the open and distance education system. Linking education with productivity demands linking learning with workplace based training and education for value addition.

3. Limited coverage and access: Although the existing size and the share of the open and distance education system in higher education is significant, it is still too small to support life-long learning for the citizens of the country.

4. Lack of access to media: Study texts form the main study materials for a large majority of students. Pedagogical use of various electronic media is yet very limited.

5. Lack of coordination: There is an overlap of target groups to be covered by the open schooling and open and distance higher education. The latter is for mature adults and many open universities have reduced the age criteria from 21 years to 18 years to enable open admission for preparatory courses essential for admission to open degree programs, for those who have not class twelve graduates. Since open schools also cater to mature adults, it is essential to have coordination amongst the school and higher education programs to cater to diverse needs of mature adults.

Table 18: Open and distance education in other countries - mega universities

Country	Institution	Enrolment	~Budget in Million US\$		Unit Cost*
Pakistan	AIOU	456,126			
Turkey	Anadolu	1,187,100	32.4	budget for 2000	10
China	CCRTVU	2,300,000			40
France	CNED	184,614	56.0	1995 figure	50
India	IGNOU	1,187,100	47.0	budget for 2004	35
Korea	KNOU	196,402	> 79.0	1995 figure	5
UK	OU	203,744	> 300.0	1995 figure	50
Thailand	STOU	181,372	> 46.0	1995 figure	30
Indonesia	UT	222,068	> 21.0	1995 figure	15

* Unit cost per student as a percentage of the average for other universities in the country

More Quality Ph.Ds

Introduction

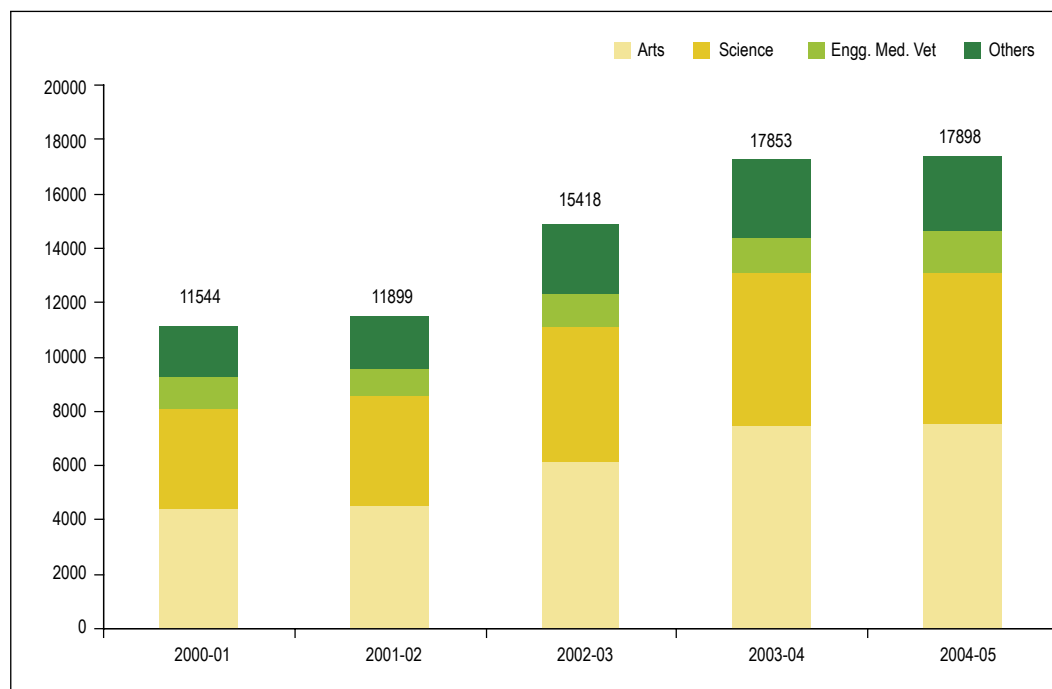
As India seeks to transform itself into a knowledge society, reviving the culture of research and innovation becomes all the more important. High quality research in all frontiers of knowledge is essential to achieve long term competitive advantage. However, the growth in higher education in India has not been accompanied by an equivalent growth in doctoral students. The declining quality of research work and deteriorating research standards and infrastructure in the country are a cause of concern. Inadequate infrastructure and lack of strong incentives to practice quality research are major causes of decline in interest towards research work. Administrative hurdles add to the already unfavourable environment for research.

Current Scenario

The current quantum of research happening in India is insufficient. Of the 11 million students enrolled in higher education in 2005-06, only 0.64 per cent were enrolled in research programs. Further, out of the 17898 of doctorate degrees awarded in 2004-05, the Faculty of Arts awarded 7532 degrees and the Faculty of Sciences had 5549 degrees. Thus, these two faculties together accounted for 73 per cent of the total number of research degrees awarded. There are also wide disparities within states in the number of doctoral degrees granted.

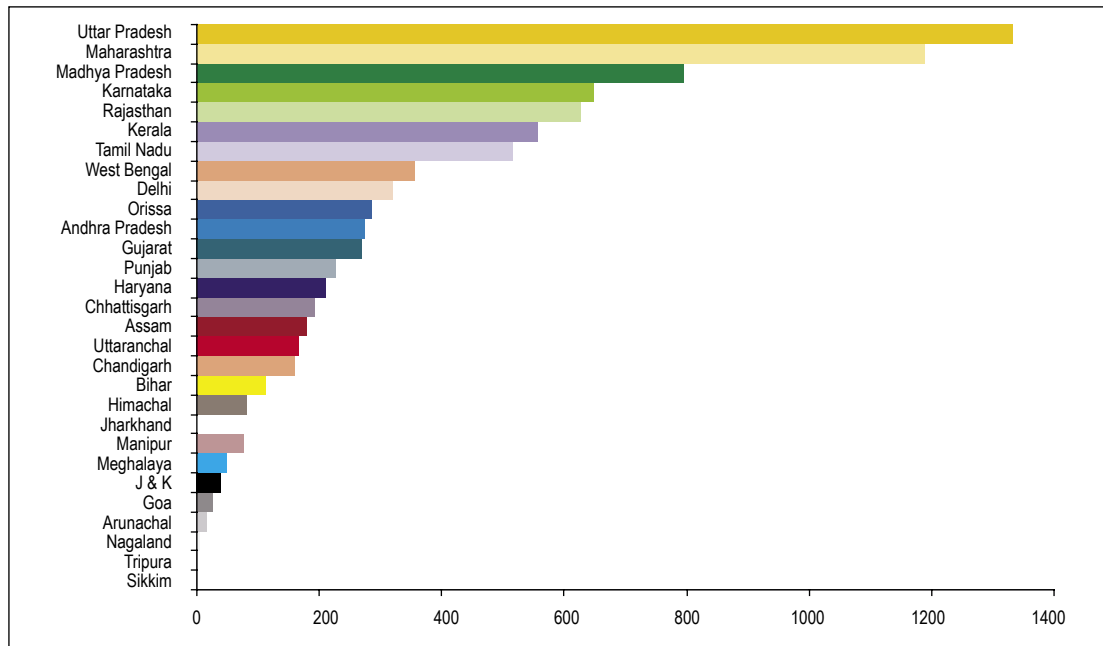
India's poor performance in research is also highlighted by comparisons with other countries. In 2002, USA had 4373, Japan had 5084, Germany had 3208 and even

Figure 46: Growth of doctorates: Faculty-wise number of doctorate degrees awarded



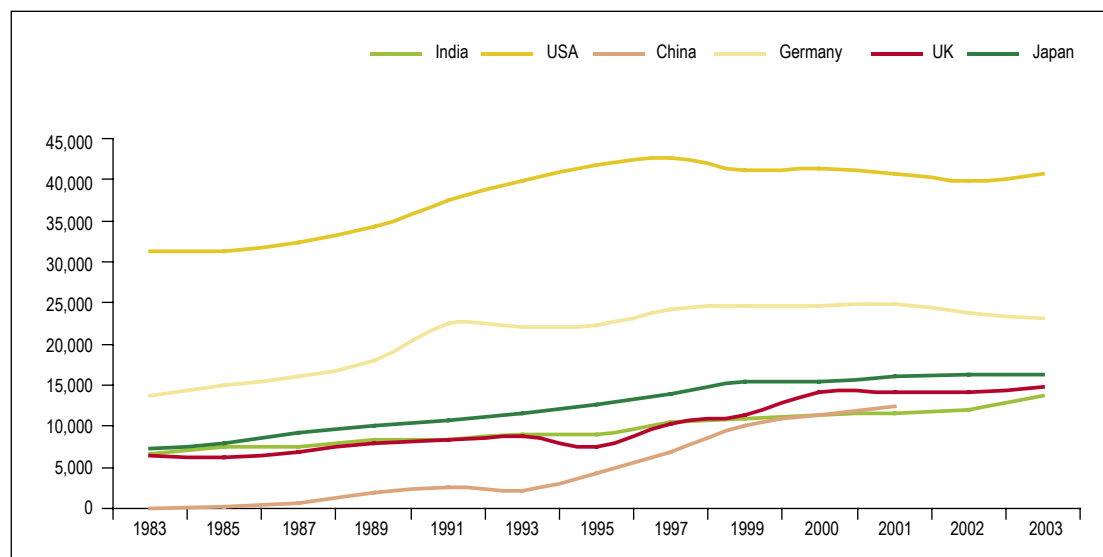
Source: Annual Report, 2005-06, University Grants Commission

Figure 47: State-wise distribution of Ph.D degrees awarded



Source: MHRD, Selected Statistics, 2004-05.

Figure 48: Growth in number of doctorates compared to other countries



Source: NSF, Science and Engineering Indicators 2006, Appendix Tables 2.42 and 2.43

China had 633 researchers per million inhabitants while India had only 112. Similarly, while the number of doctorates increased by only 20 per cent in India, China showed a spectacular growth of 85 per cent in Ph.Ds, Taiwan 57 per cent and Japan 48 per cent between 1991 and 2001.

Further, according to National Science Foundation, USA, the number of Indians who received US

doctorate degrees in 2003 in science and engineering is approximately 14000, a figure roughly double for Indian science and engineering doctorates who received degrees in India. Indians also earned by far the largest number of U.S. doctoral degrees awarded to any foreign group in computer and information sciences. This points out to the absence of a conducive research environment in India.

Intellectual Property Rights

Introduction

Intellectual property rights (IPR) have emerged as an indispensable strategic tool in today's knowledge economies and societies, particularly in the context of economic globalisation. An entity's ability to compete in the global market depends to a large extent on its capacity to generate new ideas through innovation in science and technology. IPR, by conferring exclusive monopoly rights to its owner for a limited duration, has emerged as a significant factor in creating incentives for innovation and generation of economic value. An effective IPR system is also a constituent of a reliable legal environment, which in turn becomes an important factor for decisions on foreign investment and technology transfer.

Current Scenario

Patent trends: India has witnessed a marked rise in the number of patent applications filed. While in 1992, 3467 applications were filed, in 2006-07, almost 29000 applications were filed.

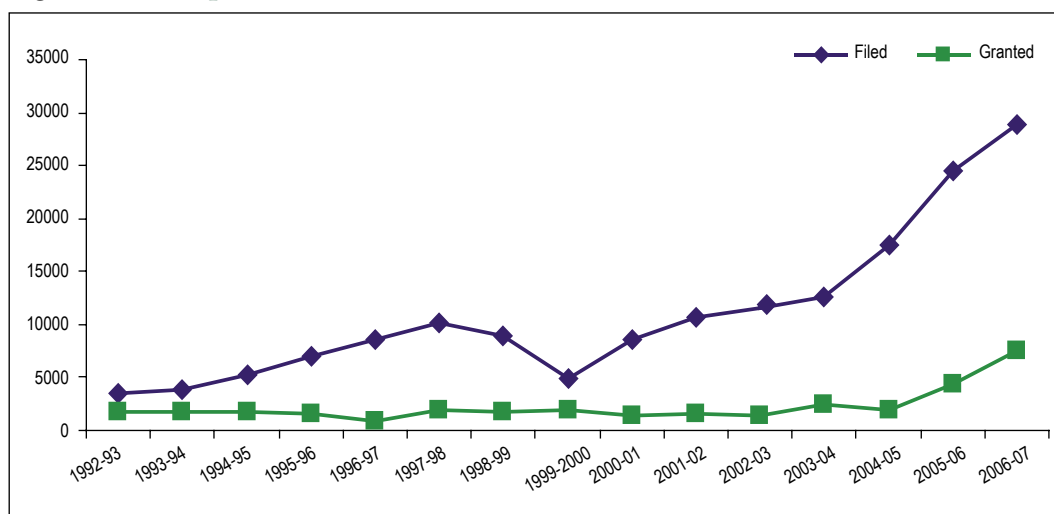
Similarly, number of patents granted has increased – although less rapidly. In the past five years, patent grants have shown a more than five-fold increase.

Further, of the total of 28940 applications in 2006-07, only 18 per cent were filed by Indian residents – the remaining were filed by foreign applicants. This in sharp contrast with countries such as USA, China, France, Germany, Korea and UK, where domestic patent application filing is much higher than foreign applications.

A sector-wise analysis of patents filed in India show that the chemical, mechanical and computer fields rank the highest in terms of number of applications filed. However, the food, biotechnology and electrical industries have seen the highest growth in the last three years.

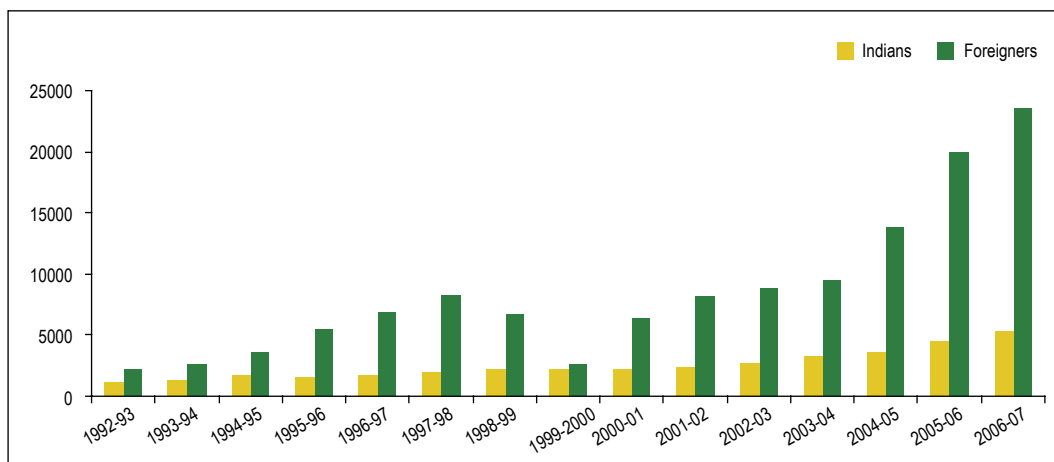
International comparisons: India figures in the top 20 patent offices, both by patent filings and patent grants. Its ranking further improves if one takes into account

Figure 52: Comparative Trend of Patents Filed and Granted



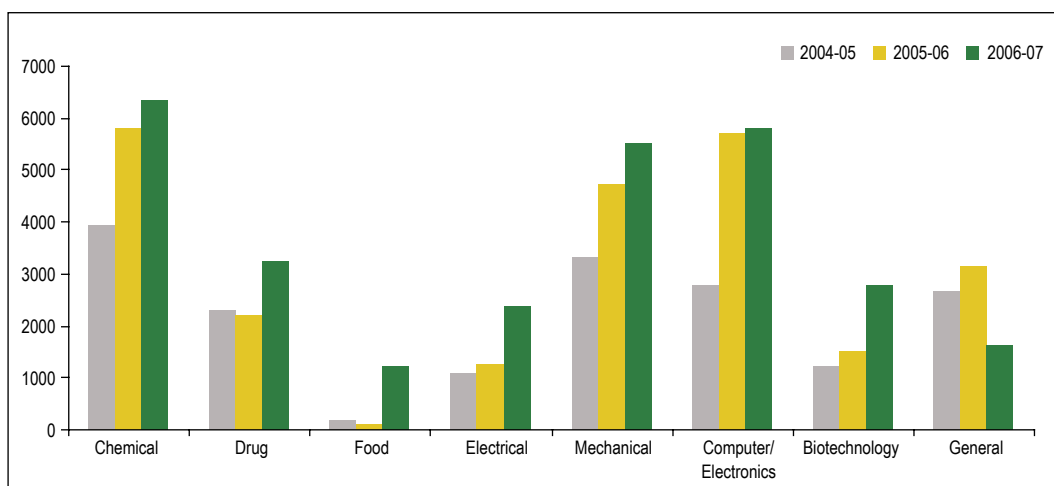
Source: Annual Report of the Office of the Controller General of Patents, Designs, Trademarks, Geographical Indications, Intellectual Property Training Institute, and Patent Information System, 2006-07

Figure 53: Applications filed by Indians and Foreigners



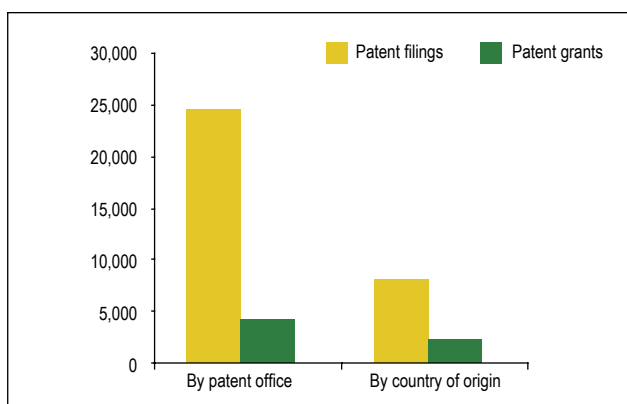
Source: Annual Report of the Office of the Controller General of Patents, Designs, Trademarks, Geographical Indications, Intellectual Property Training Institute, and Patent Information System, 2006-07

Figure 54: Number of patent applications filed under various fields of inventions



Source: Annual Report of the Office of the Controller General of Patents, Designs, Trademarks, Geographical Indications, Intellectual Property Training Institute, and Patent Information System, 2006-07

Figure 55: India patent figures (2005)



Source: WIPO Statistics Database

the data for the year 2006 (WIPO rankings shown below are based on 2005 figures for India and 2006 figures for the other countries). Yet, when one takes into account patent filings as a proportion of population, GDP and R&D expenditure – a better index for innovation – India fares badly.

Table 21: Patent filings by patent office: Top 20 offices, 2006

		2006
1	United States of America	425966
2	Japan	408674
3	China	210501
4	Republic of Korea	166189
5	European Patent Office	135231
6	Germany	60585
7	Canada	42038
8	Russian Federation	37691
9	Australia	26003
10	United Kingdom	25745
11	India (2005)	24505
12	Brazil	24074
13	France	17249
14	Mexico	15505
15	Hong Kong (SAR), China	13790
16	Singapore	9163
17	Israel	7496
18	New Zealand	7365
19	Thailand	6248
20	Norway	6076

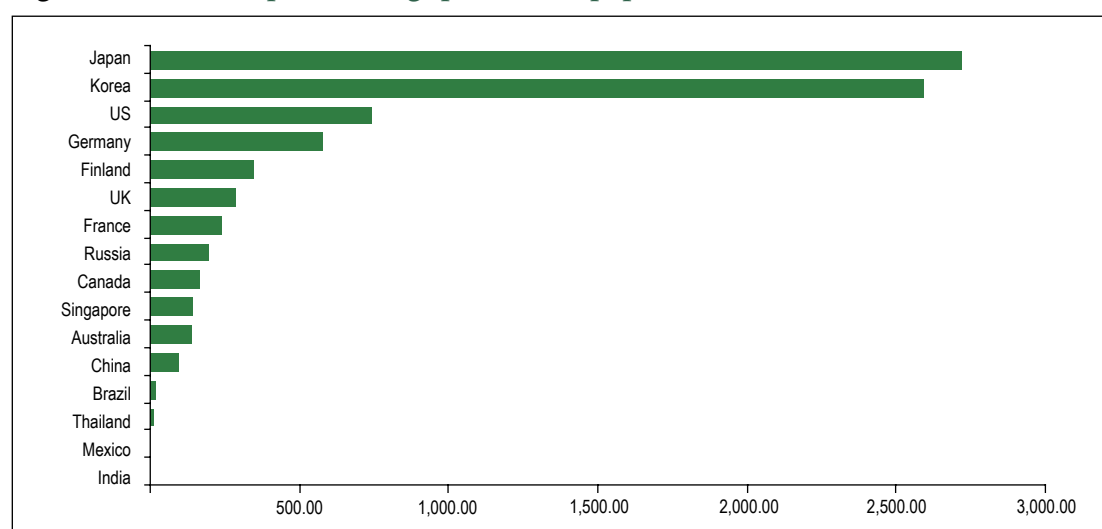
Source: WIPO Statistics Database

Table 22: Patent grants by patent office: Top 20 offices, 2006

		2006
1	United States of America	173770
2	Japan	141399
3	Republic of Korea	120790
4	European Patent Office	62780
5	China	57786
6	Russian Federation	23299
7	Germany	21034
8	Canada	14972
9	France	13788
10	Mexico	9632
11	Australia	9426
12	United Kingdom	7907
13	Singapore	7393
14	Hong Kong (SAR), China	5146
15	India (2005)	4320
16	Ukraine	3705
17	New Zealand	3412
18	Poland	2686
19	Israel	2584
20	Brazil	2465

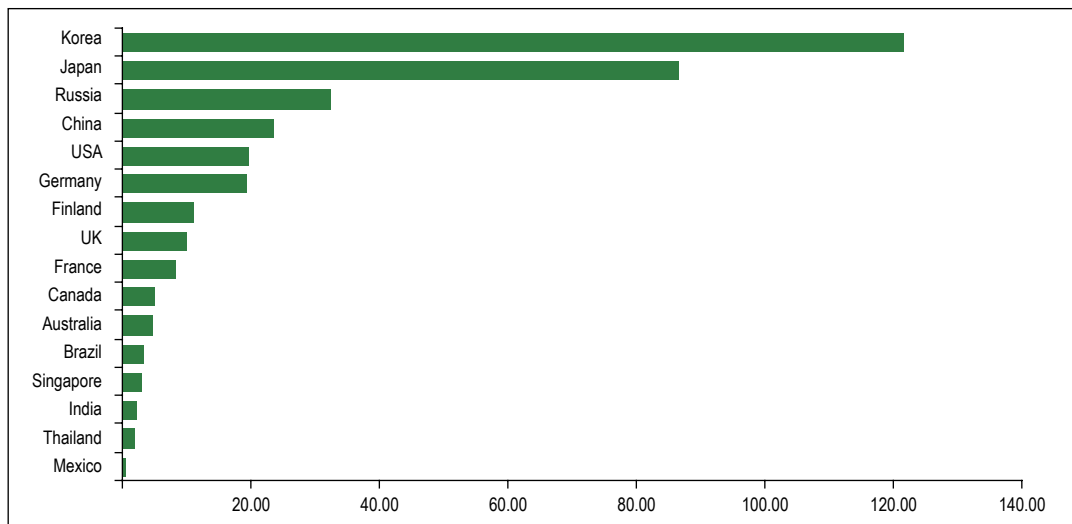
Source: WIPO Statistics Database

Figure 56: Resident patent filings per million population (2006)



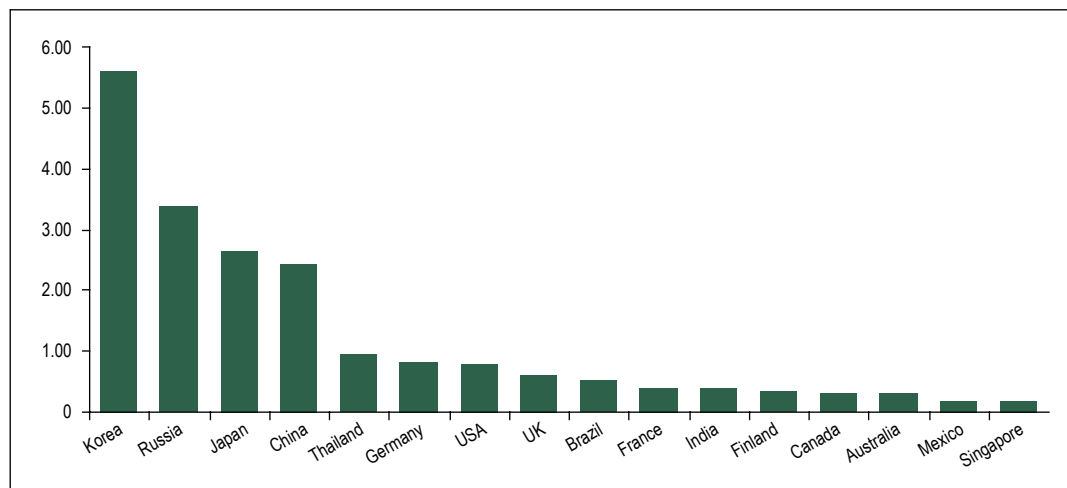
Source: WIPO Statistics Database

Figure 57: Resident patent filings per \$Billion GDP (2006)



Source: WIPO Statistics Database

Figure 58: Resident patent filings per \$Million R&D expenditures (2006)



Source: WIPO Statistics Database

Entrepreneurship

Introduction

Entrepreneurship is considered to be a significant determinant of economic development. New entrepreneurial activities play a vital part in the process of *creative destruction* that fosters innovation, employment, and growth. While India has traditionally been an entrepreneurial country, it fares poorly in numerous global studies exploring the entrepreneurial and business potential of countries. For instance, in the World Bank Doing Business report (2008) which investigates regulations that enhance business activity, India is ranked 120 out of 178 economies. Similarly, in the World Economic Forum's Global Competitiveness Index (2007), India ranks 48th among 131 countries.

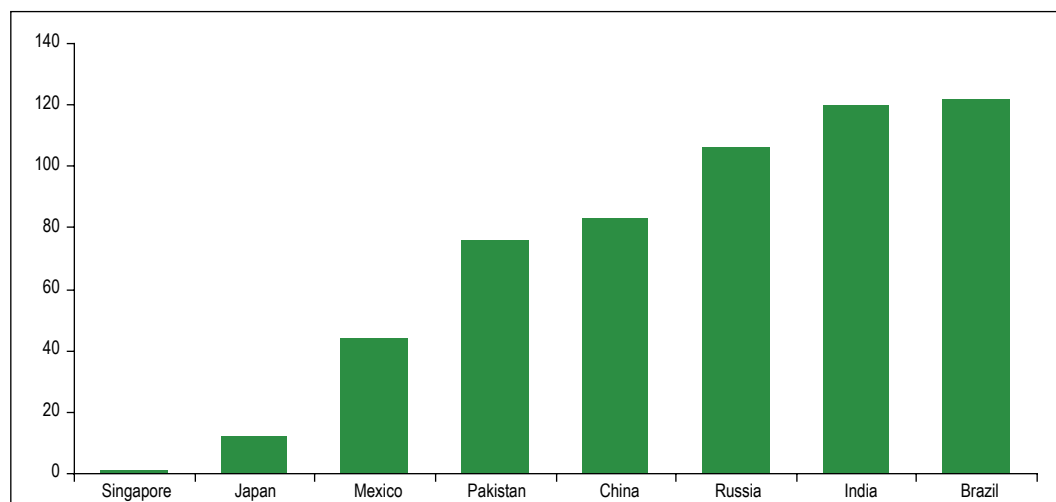
Current Scenario

According to the Global Entrepreneurship Monitor (2007) report, India's High-Growth Expectation Early-Stage Entrepreneurship (HEA) rate is only one-fifth of that of China. Further, among medium and low income countries, while China's nascent and new entrepreneurs appear to be the most growth-oriented,

with more than 10 per cent of them anticipating high growth. Early-stage entrepreneurial activity in India is marked by low levels of growth expectation. This is despite the extremely high levels of potential entrepreneurial activity as perceived by the non-entrepreneurially active population in the country (See Figure 60).

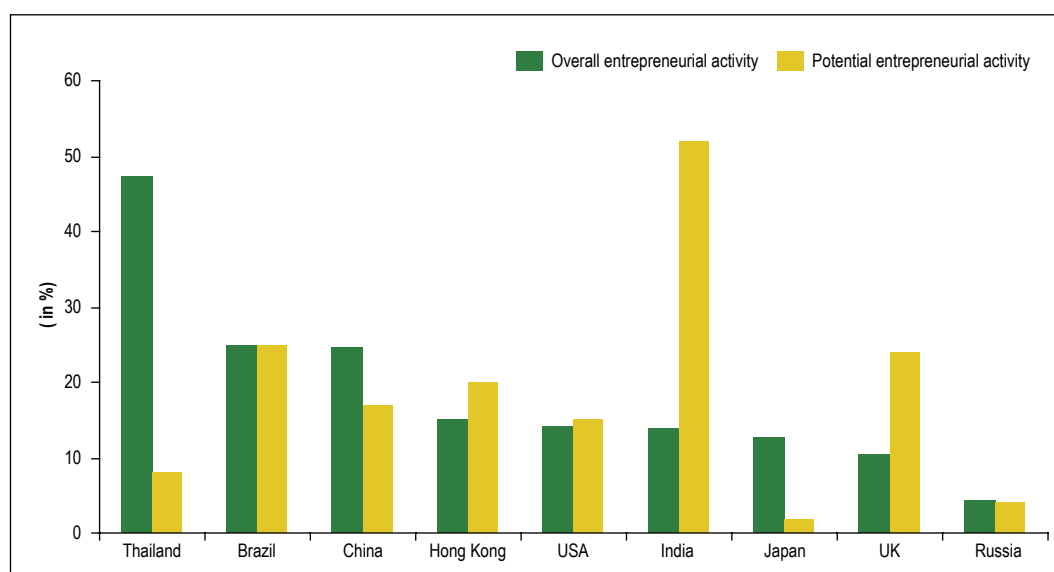
While data on entrepreneurship is hard to come by, the following numbers are telling. According to the NSS 62nd round, in rural India, almost 50 per cent of all workers are self-employed – 57 per cent among males and nearly 62 per cent among females, while the corresponding figures in urban India are 42 for males and 44 for females. The NSSO defines a *self-employed* person as one who has worked in household enterprises as own-account worker; worked in household enterprises as an employer or worked in household enterprises as helper. The essential feature of the self-employed is that they have autonomy (decide how, where and when to produce) and economic independence (in respect of choice of market, scale of operation and finance) for carrying out their operation. According to the 5th Economic Census

Figure 59: Ease of doing business – Global Rank



Source: Doing Business, 2008

Figure 60: Overall and potential entrepreneurial activity



Source: Global Entrepreneurship Monitor, 2007

conducted by the Central Statistical Organisation (CSO), there are 41.83 million establishments in the country engaged in different economic activities other than crop production and plantation. Five states viz. Tamil Nadu (10.60 per cent), Maharashtra (10.10 per cent), West Bengal (10.05 per cent), Uttar Pradesh (9.61 per cent) and Andhra Pradesh (9.56 per cent) together account for about 50 per cent of the total establishments in the country. The same five states also have the combined share of about 50 per cent of total employment.

Issues in the Current Framework

Finance: Access to credit is considered to be one of the key problems faced by entrepreneurs in India. This problem is particularly acute at the start-up stage, where bank finance is hard to obtain. Despite new sources of finance such as venture capital, angel funding and private equity becoming increasingly popular, institutional finance is still not able to meet the current entrepreneurial demands.

Regulation and governance: An entrepreneur has to deal with a host of regulatory and compliance issues. These include registering one's business, obtaining government clearances and licenses, paying taxes and complying with labour regulations. Cumbersome paperwork, long delays and red tapism involved in such transactions create unnecessary burdens for entrepreneurs, constraining their productivity and their ability to do business. As seen in the Doing

Business 2008 rankings, India performs poorly in these indicators. A study investigating the effect of regulation on entrepreneurship using the GEM dataset shows India to be having one of the worst regulatory indices. (See Figure 61). Moreover, lack of clarity on information relating to legal and procedural aspects of starting an enterprise, as well as those relating to clearances, licenses and government schemes further aggravates the problem.

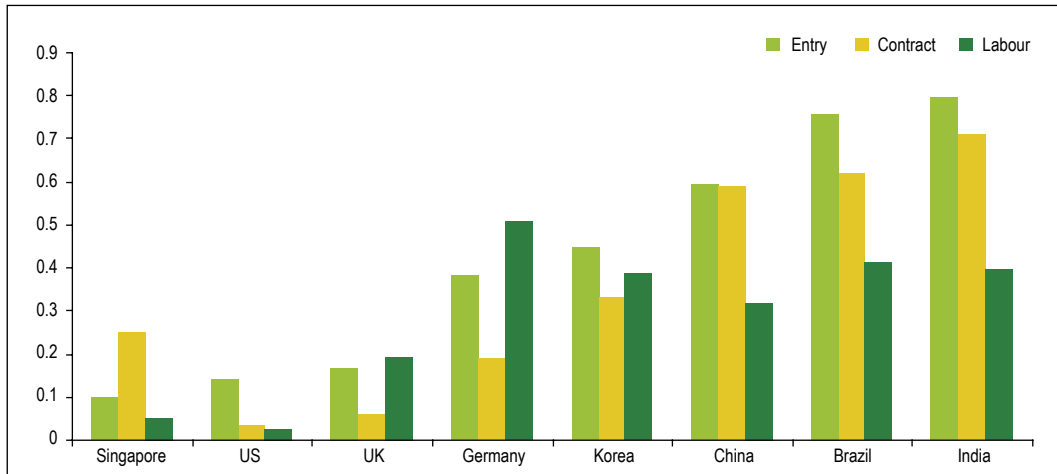
Table 23: India's Ranking in Doing Business 2008

Starting a Business	111
Dealing with Licenses	134
Employing Workers	85
Registering Property	112
Paying Taxes	165
Trading Across Borders	79
Enforcing Contracts	177
Closing a Business	137

Source: Doing Business, World Bank, 2008

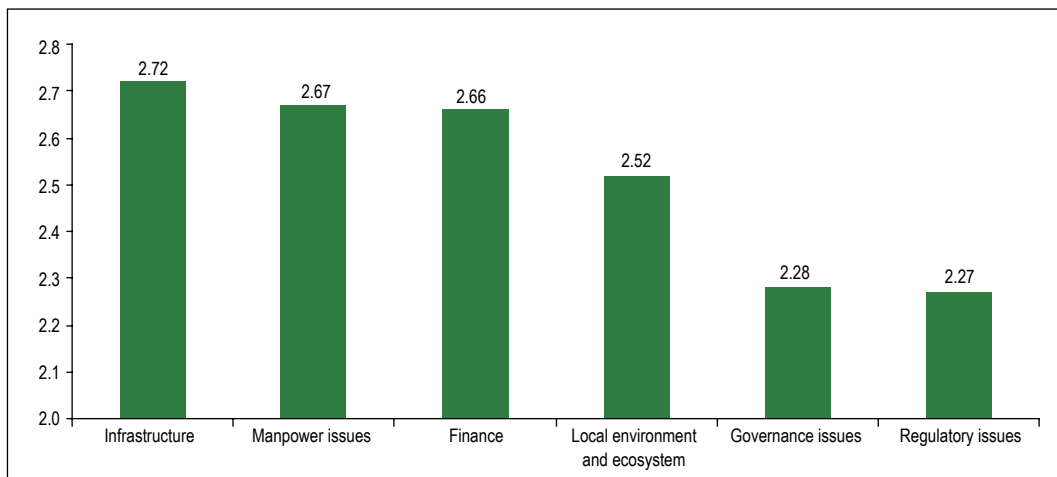
Manpower: Availability of skilled manpower is another crucial issue for entrepreneurs. For example, in a survey of entrepreneurs conducted by KPMG and TiE in 2008, skilled manpower emerged as the second most important factor for fostering entrepreneurial growth. Further parameters reflecting labour market efficiency and flexibility are dismal. In the Global Competitiveness Index, India ranks 102nd in *hiring and firing practices* and 85th in *employing workers* in the Doing Business 2008 report.

Figure 61: Regulatory indices



Source: Explaining International Differences in Entrepreneurship: The Role of Individual Characteristics and Regulatory Constraints, Silvia Ardagna and Annamaria Lusardi, 2008

Figure 62: Relative importance of factors on a scale of 1-3



Source: Entrepreneurial India, KPMG-TiE Report, 2008

Infrastructure: India's physical infrastructure – roads, rail, ports, power, and telecom – is also considered to be a bottleneck to the smooth operation of entrepreneurial activity. The high transport and supply chain costs that poor infrastructure entails can affect competitiveness to a great extent, particularly for a small and medium enterprise. Enterprises surveyed in the Global Competitiveness Report 2007-08, rated inadequate infrastructure as 'the most problematic factor' for doing business in India.

Education: While the influence of education on entrepreneurship is considered debatable, increasingly education is being seen as part of the larger ecosystem that impacts entrepreneurship and entrepreneurial motivations. Greater practical exposure, critical analysis, entrepreneurship curriculum, incubation and mentoring, industry-research linkages can help in fostering entrepreneurship.

Agriculture

Introduction

Agriculture is the principal means of livelihood for over 60 per cent of India's population. Despite a steady decline of its share in the GDP (from 36.4 per cent in 1982-83 to 18.5 per cent in 2006-07), it remains the largest economic sector in India. Low and volatile growth rates plaguing agriculture are symptomatic of agrarian crises in several parts of the Indian countryside. Public investment in agriculture has declined and this sector has also not been able to attract private investment because of lower/unattractive returns. A well thought-out strategy for promoting agricultural growth is essential for both alleviating poverty and achieving food-security at the national level. Generation and application of knowledge – through agricultural research and extension services can play a crucial role in meeting the above objectives.

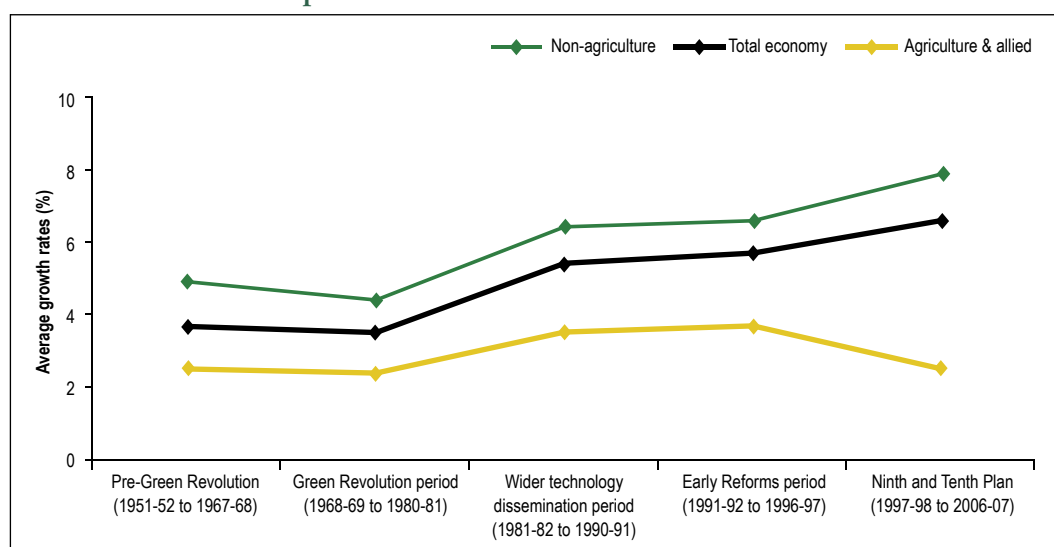
Current Scenario

Research: The Department of Agricultural Research and Education (DARE) is responsible for addressing

agricultural research and education needs in the country. This responsibility is discharged through the Indian Council of Agricultural Research (ICAR), an apex and autonomous organisation for agricultural research and education. The DARE has an extensive network comprising 48 Central Institutes, 5 National Bureau, 12 Project Directorates, 32 National Research Centres and 62 All-India Coordinated Research Projects.

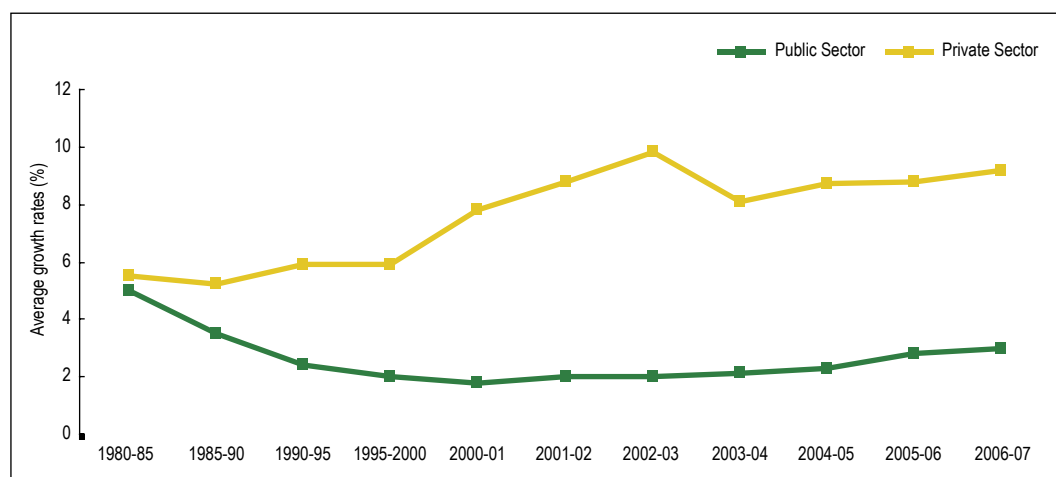
Education: The Indian agricultural education system comprises of 40 State Agricultural Universities (SAUs), four ICAR Institutes (IARI, IVRI, NDRI, CIFE), Allahabad Agricultural Institute, one Central Agricultural University and four Central Universities which have a strong agricultural faculty. There are also a large number of private colleges both affiliated and non-affiliated to SAUs. According to UGC, there are currently 63962 students enrolled in agriculture education in India, accounting for just 0.58 per cent of the total enrolment in higher education. There is a striking regional imbalance in enrolment with Uttar Pradesh accounting for almost 30 per cent of the all-India student enrolment. Further, agricultural studies are not an attractive option anymore

Figure 49: Average GDP growth rates of agriculture and other sectors at 1999-2000 prices



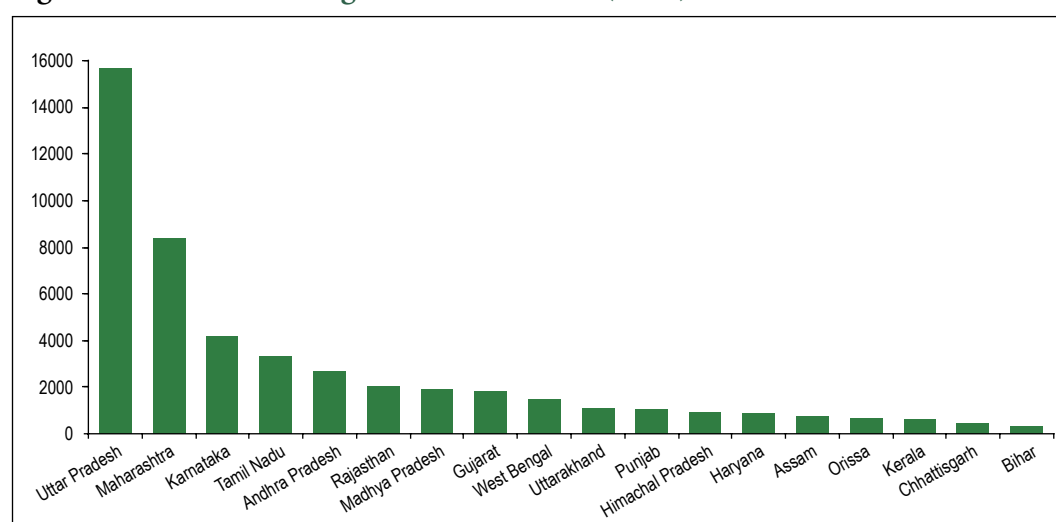
Source: Economic Survey, 2007-08

Figure 50: Investment in agriculture: Gross capital formation in agriculture as a percentage of GDP from agriculture



Source: Eleventh Five Year Plan, Planning Commission

Figure 51: Enrolment in agriculture education (2001)



Source: University Development in India, 1995-96 to 2000-01, UGC

– it is looked upon as an inferior science to be taken up when all else fails.

Extension: The Department of Agriculture and Co-operation (DAC) is the central agency coordinating agricultural extension. In addition, the National Institute of Agricultural Marketing (NIAM) and the National Institute of Agricultural Extension Management (MANAGE) are autonomous bodies established for providing the government further assistance, especially in facilitating the acquisition of managerial and technical skills by personnel involved in the agricultural economy.

Various structures, projects and initiatives have been put in place in order to promote agriculture extension in the country. These include Agricultural Technology Management Agency (ATMA), Krishi Vigyan Kendras

(KVKs), Agri-clinic and agri-business centres, Kisan Call Centre Scheme etc. ATMAs have been set up in various districts to decentralise, integrate and coordinate R&D activities, using modern information and communication technology to improve linkages between the various extension agencies. KVKs have been initiated by ICAR to identify the technological gaps, critical needs and requirements of the farmers, and impart skill through various programs. In addition to the demonstration of latest technological development, assessment and refinement at farmers' fields, the KVKs also provide farm information services through literature, exhibitions, field days, farmers tours, crop seminars, kisan melas, radio and television programs, correspondence services, telephone consultancy and helpline services etc. So far over 554 KVKs (as on August 2007) have been established.

Table 19: Global extension practices

Country	Extension Practices
United States of America, Canada, Australia, Denmark	Strong extension services – first public, and now public and/or private. None of these very developed countries has ever considered the discipline of extension as inferior to other agricultural disciplines at the time of resource allocation. Several developed countries have fully or partially privatised their agricultural extension services in a variety of ways.
Costa Rica	The government provides farmers with extension vouchers which can be used for getting extension advice from private specialists.
England	The public extension service has evolved over time into a private consulting practice. The positive result is enhanced efficiency of staff, and the negative effect is the deprivation of small farmers of extension services as the result of their inability or unwillingness to pay.
Holland	About 60 per cent of the extension budget comes from farmers, while the remaining 40 per cent is provided by the government. The benefits include increased efficiency, improved quality, client-orientation, job satisfaction for staff, and expanded marketing opportunities for farmers.
Albania	Private sector entrepreneurial initiatives to create a long-term relationship with farmers have proved to be successful.
Uganda	Privatisation of extension through the creation of a pool of private extension specialists out of its existing public extension service. Registered farmers' associations could call upon this pool through bidding for providing services related to selected enterprises, and pay for the services from the funds given to them by the donors through decentralised government units.
Israel	The government is still responsible for providing extension advice, but encourages privatisation through the standing practice of growers to contribute portion of their income to research and development including extension, public and private partnership in financing and operating units within the extension service, payment for services by commodity production and marketing boards beyond a basic extension package, the provision of more intensive extension activities at the request of needy growers, special agreements with commodity farmers' organisations, extension staff working on their day off in exchange for direct payment from farmers, provision of equipment like mobile phones to extension advisers by growers associations, and direct payment by farmers for participation in training activities.
Indonesia	Some projects have not only encouraged NGOs and the private sector, but also agricultural research institutes, agricultural universities and farmers' associations, to participate in the delivery of extension services. Indonesia has successfully established new institutions called Agricultural Technology Assessment Institutes at provincial level, bringing together farmers, researchers and extension specialists.
Lao People's Democratic Republic, Vietnam and Mali	Experimenting with <i>tele-centres</i> , which have already exhibited their benefits in several Western European countries. Virtual linkages are being established for bringing research and extension together, and one example is the VERCON (virtual extension, research and communication network) tool, which FAO has introduced in Egypt and Bhutan. Under an FAO project in the Philippines, the Internet and interactive e-mail facilities have been established at municipality level for supporting decentralised extension staff. <i>Expert systems</i> are also being developed to compensate, to some extent, for the too-rare visits of subject-matter specialists to farmers' fields. Over 30 per cent of extension staff in Estonia use the Internet. One can find programs like "virtual gardens" and "virtual farms" on the Internet.

Source: 'Modernising National Agricultural Extension Systems, A Practical Guide for Policy-Makers of Developing Countries', FAO, 2005.

Issues within the research and extension framework

Funding: The current allocation to agricultural R&D, which stands at is 0.7 per cent of agriculture GDP, is grossly inadequate. This funds crunch is the main factor behind the disintegration of public systems of agricultural R&D in several places. Today almost in all SAUs about 80-85 per cent of the budget goes towards salary and other establishment costs. The ICAR share also has dwindled and varied from 33 per cent in the Fifth Plan to almost

9 per cent in the Eighth Plan. In all SAUs, 25 to 30 per cent posts are not filled on account of squeeze in budget and this has seriously impacted quality of instruction. Allocations to this sector must be significantly increased both at the Centre (to at least 1 per cent of GDP) and in states.

Infrastructure and human resources: The financial crunch coupled with bureaucratic rigidities has caused colossal gaps both in basic infrastructure and human resources. Lack of water, power, basic equipment like cell phones

and vans, vacancies in the scientific posts in agricultural universities and understaffing of extension providing bodies by underpaid workers are just some of the problems plaguing public research and extension units.

Service providers outside the public sector: The Farmers Commission Report testified that in the 40 per cent of farmer households at an all-India level who *did* access modern technology, “other progressive farmers” emerged as the most popular source (16.7 per cent); followed by “input dealers” (13.1 per cent) and “radio” (13 per cent). Private R&D institutes and demand-driven extension service providers have entered the agricultural economy in a big way. As R&D providers by proxy, they may well be motivated by vested interests and thus pose a real threat to the farmer who has no other option. Alternatively, service providers in the private sector may fulfill an important function efficiently, in the absence of a more reliable mechanism.

Research-Extension linkages: There is often disconnect between the research done by agricultural scientists and the on-farm practices of farmers. (See Table 20) The structure of the present public extension system is linear and compartmentalised, thus propagating a top-down approach that does not encourage interaction and co-operation amongst the several actors. Most

importantly, it does not incorporate a mechanism for feedback. Therefore, extension workers continue to disseminate technology that may not only be irrelevant, but also harmful for the farming community.

Information and Communication Technology (ICT): The availability and convergence of ICTs – computers, digital networks, telecommunication etc. – has been significant in the dissemination of knowledge and information to the rural population in recent years. The village knowledge centres established by the MS Swaminathan Research Foundation (MSSRF) in Pondicherry, and the village internet kiosks established by ITC under the “e-chaupal” program are examples of highly successful ICT deployment for research and extension and market access in agriculture.

Agricultural universities: In order to meet the systemic challenges in the R&D arena, the syllabus and curriculum in agricultural universities need to be more flexible and interdisciplinary. Incorporation of social sciences and management techniques, primacy accorded to fieldwork and regular training and refresher courses for extension workers must be added to the curriculum in order to address the disconnect between the lab and the land. Incentives and schemes must be established to attract the best minds to stimulate R&D activities in universities.

Table 20: State-wise performance and potential yield of selected crops

State	Improved practice (I)	Farmer practice (F)	Actual yield 2003-04 (A)	Gap (%)	
				I and F	I and A
Wheat (Yield: Kg/ha - 2002-03 to 2004-05)					
Bihar	3651	2905	1783	25.7	104.8
Madhya Pradesh	3297	2472	1789	33.4	84.3
Uttar Pradesh	4206	3324	2794	26.5	50.5
Rice (irrigated) (Yield: Kg/ha - 2003-04 to 2004-05)					
Uttar Pradesh	7050	5200	2187	35.6	222.4
Bihar	4883	4158	1516	17.4	222.1
Chhattisgarh	3919	3137	1455	24.9	169.4
Sugarcane					
Maharashtra	127440	99520	51297	28.1	148.4
Karnataka	147390	128000	66667	15.1	121.2
Bihar	74420	49440	40990	50.5	81.6

Source: Economic Survey 2007-08

Note: The data and statistics provided in the baseline section, unless stated otherwise, have been taken from Ministry of Human Resource Development (MHRD), Planning Commission, University Grants Commission (UGC) and District Information System for Education (DISE).

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National Seminar on School Education at NKC, New Delhi 29th July 2006

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*National Seminar on School Education at NKC,
New Delhi 20th November 2007*

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Centre for Policy Research
15. Mr. K.B. Kain
Principal, Delhi Public School, Jaipur
16. Dr. Madhav Chavan, Pratham
17. Prof. Krishna Kumar
Director, NCERT

Regional Workshops

*Southern Region at National
Institute of Advances Studies, Bangalore 17th-18th
July, 2007.*

1. Prof. A.R. Vasavi (Nodal Convener)
National Institute of Advanced Studies (NIAS)
2. Sh. D.R. Garg, IAS
Secretary, Sarva Shiksha Abhiyan, Andhra Pradesh

3. Mr. Rao
Rishi Valley Rural Schools
4. Sh. Vijay Bhaskar
Secretary, Primary and Secondary Education
Karnataka
5. Prof. P.R. Panchamukhi
Founder-Director, Centre for
Multi-Disciplinary Development Research
Dharwad
6. Ms. Benazir Baig
Raza Education and Social
Welfare Society
7. Mr. Samiullah
Raza Education and Social Welfare Society and
General Secretary, Federation of Karnataka
Muslims' Association
8. Father Claude D'Souza
St. Joseph's College of Arts and Science
9. Dr. Padma Sarangapani
DQEP, NIAS
10. Dr. Sonali Nag
The Promise Foundation
11. Ms. Mythili Ramachandra
Rishi Valley Foundation
12. Kamal Peter
Oracle Education Initiative
13. Sister Cecilia D' Souza
Maria Krupa, Provincial Head
Mysore
14. Ms. Mamatha M.R.
Swami Vivekananda Youth Movement (SVYM)
15. Ms. Malathi
SVYM
16. Mr. M.P. Vijayakumar
State project Director, Sarva Shiksha Abhiyan
17. Ms. Lakshmi
Principal, Olcott Memorial High School
18. Mr. Muralidharan
Founder-President, Sevalaya
19. Dr. Aruna Ratnam
Project Officer, Education, UNICEF
20. Mr. Balaji Sampath
Tamil Nadu Science Forum
21. Mr. S.M. Arasu
Prime Educational and Social Trust

22. Mr. Desigan
23. Mr. K.T. Radhakrishna
Kerala Sahitya Shastra Parishad
24. Dr. Ajit Kumar
Director, Centre for Socio-Economic and
Environmental Studies (CSES)
25. Dr. K.M. Unnikrishnan
Senior Lecturer, DIET Kasaragod
26. Mr. C. Madhusudhanan
27. Ms. K. Latha
NIAS

Central Region at IIM, Lucknow 3rd and 4th August, 2007.

1. Dr. M.M. Jha (Nodal Convener)
Principal Secretary, Department of Education
Govt. of Bihar
2. Sh. Raghuvansh Kumar
Director, Bihar School Education Board
3. Sh. Ajit Kumar,
Deputy Director, Secondary Education, HRD
Bihar
4. Dr. P.P. Ghosh
Director, Asian Development Research Institute
(ADRI), Patna
5. Smt Abha Rani
Bihar Education Project Council
6. Sh. Mahendra Sahni
General Secretary, Teachers Association, Bihar
7. Sh. Kedar Nath Pandey
General Secretary, Bihar State Secondary
Teachers Association
8. Smt. Bilkas Jahan
Principal, Govt. Secondary School, Bankipur
Patna,
9. Sh. Bisheshwar Yadav
Principal, Govt. Secondary School
Gardhanibagh, Patna
10. Sh. Satrughan Pd. Singh
Chairman, Bihar State Secondary
Teachers Association
11. Sh. Jagdish Pandey (Thakurai)
Chairman, Uttar Pradesh Secondary
Teachers Association
12. Job Zachariah
Education Specialist, UNICEF, Patna
13. Mr. Bhushan Kumar
PRATHAM, Nawada, Bihar
14. Sr. Sudha Vargheese
NariGunjan, Patna
15. Mr. Vinay Kanth
East and West Foundation
16. Mr. Sanjib Kundu
PRATHAM
17. J. B. Tubid
Secretary, HRD, Jharkhand
18. Sh. Rabindra Singh
General Secretary, Jharkhand Secondary Teachers
Association, Ranchi
19. Smt. Poonam Kumari
Principal, DIET, Ratu, Ranchi
20. Sh. S.S. Pradhan
Asst. Program Officer, Jharkhand Education
Project, Ranchi
21. Sh. S.B. Kundu
Teacher, Middle School, Ghaghra Khunti, Ranchi
22. Sh. Kritwas Kumar
Teacher, E.L.T.I. Ratu DIET Campus
Ranchi
23. Mr. H. K. Jaiswal
PRATHAM, Jharkhand
24. Dr. Yoginder Sikand
Professor, Jamia Milia Islamia University
25. Mr. Manoj Kumar
Principal Secretary Primary Education, Jharkhand
26. Ms. Shruti Nag
PRATHAM
27. Sh. Abhimanyu Tewari, President
Uttar Pradesh Prathmik Shikshak Sangh
28. Dr. Veena Gupta
Moradabad, UP
29. Mr. Vinobha
UNICEF, Project Director
30. Ms. Mira Kumari
PRATHAM
31. Mr. Smitin Brid
PRATHAM
32. Mr. Amit Bajpai
PRATHAM
33. Dr. Mishra
Directorate of Education, MP

34. Dr. Manohar, Commissioner
Rajeev Gandhi Shiksha Mission, MP
35. Dr. Vinod Raina
Eklavya Foundation
36. Sh. S.S. Pachpor
Director, MP Open School
37. Smt. Uma Sri
UNICEF
38. Mr. K.L. Shejwar
Block Resource Coordinator, Gohad Block
39. Mr. Sajaan Singh Shekhawat
PRATHAM
40. Mr. Shutanshu Shukla
Rajya Shiksha Kendra, Madhya Pradesh

Eastern Region at Indian Council of Social Science Research, Kolkata 25th and 26th August 2007.

1. Ms. Nandita Chatterjee, IAS
Principal Secretary, School Education,
West Bengal
2. Mr. Dibyen Mukherjee
Director, School Education,
West Bengal
3. Mr. Manik Chandra Dolui
Joint Director, Department of School Education
School Education
West Bengal
4. Dr. Rathindranath De
Director, SCERT, West Bengal
5. Mr. Tushyant Nariala
State Project Director, Sarva Shiksha Abhiyan
District Primary Education Program
West Bengal
6. Ms. Sampa Basu
Department of Development and Planning
West Bengal
7. Mr. Tapas Kumar Layek
West Bengal Board of Madrassa Education
8. Mr. M. Fazlur Raldai
Secretary, Board of Madrassa Education
West Bengal
9. Mr. Udayan Bhowmik
District Inspector, Department of Secondary
Education, Howrah
10. Dr. R.C. Chattopadhyaya
Professor, IIM Kolkata
11. Ms. Preeti Mondol
School Teacher (Retd.), Barasat District
North 24 Pargana
12. Ms. Bhupali Ray
Headmistress, Suniti Academy, Cooch Behar
13. Mr. Gopa Dutta
President, West Bengal Council of Higher
Secondary Education
14. Mr. Ujjwal Basu
President, West Bengal Board of
Secondary Education
15. Mr. Kumar Rana
Senior Research Associate, Pratichi Research Trust
Kolkata
16. Dr. Manabi Majumdar
Professor, Centre for Studies in Social Sciences
Kolkata
17. Dr. Achin Chakravarty
Professor, Institute of Development Studies
Kolkata
18. Dr. Malini Bhattacharya
Professor, Institute of Development Studies
Kolkata
19. Ms. Sandhya Das
Principal, DIET Joynagar, 24 Parganas (South)
West Bengal
20. Mr. Somnath Roy
Principal, DIET Baraguli, Nadia District
West Bengal
21. Mr. Shiv Prasad Mukhopadhyay
General Secretary, All Bengal Teacher's Association
22. Mr. Ranju Gopal Mukherjee
Vice Chancellor, (Retd.) North Bengal University
23. Mr. Bhabesh Moitra
Principal, Teacher's Education College, Kolkata
24. Mr. J.B Dutta, Consultant
Shishu Shiksha Kendra, Kolkata
25. Mr. Pranab Chanda
Principal, College for Teacher Education, Siliguri
26. Mr. Pranab.K Chaudhary
David Hare Training College, Kolkata
27. Mr. Debashis Maiti
Secretary, West Bengal Council of Rabindra
Open Schooling, Kolkata
28. Mr. Dev Kumar Chakrabarty
Shishu Shiksha Mission, Sidhu-Kanu Bhawan
Kolkata

29. Mr. Sujit Sinha
Swanirbhar, NGO, West Bengal
 30. Dr. Arijit Chaudhry
Honorary Visiting Professor, Indian Statistical
Institute
 31. Mr. Baidynath Mukherjee
President, All Bengal Teachers' Association
 32. Dr. S. Bhattacharya
President, West Bengal Board of Primary
Education
 33. Dr. P. Bhattacharya
Professor, Centre for Studies in Social Sciences
Kolkata
 34. Dr. Sudipta Bhattacharyya
Reader, Department of Economics and Politics
Visva Bharati Univerisity
 35. Dr. Parthapritam Pal
Professor, IIM Calcutta
 36. Dr. Niladri Saha
Senior Lecturer, Barisat College, 24 Parganas
West Bengal
 37. Dr. Samir Guha Roy
(Ex) Professor, Indian Statistical Institute
 38. Mr. Suresh Patnaik
Secretary, School Education, Orissa
 39. Mr. D.C Mishra
Director, Secondary Education, Orissa
 40. Mr. Sebak Tripathy
Director, State Institute of Education and Training
and SCERT, Orissa
 41. Dr. P.K. Acharya
Reader, Department of Social Anthropology, NKC
Centre for Development Studies, Bhubaneswar
 42. Mr. D.K Singh
State Project Director, Sarva Shiksha Abhiyan
Orissa
 43. Dr. M.K. Pathy
Principal, P. M. Institute of Advanced Studies in
Education, Sambalpur, Orissa
 44. Dr. U.C Khadanga
Dr. P.M Institute of Advanced Studies in
Education, Sambalpur, Orissa
 45. Mr. Anil Pradhan,
Member-Secretary, Sikshasandhan, Bhubaneswar
 46. Dr. Uddhab C. Nayak
Aragamee, District Rayagada, Bhubaneswar
 47. Mr. Akhileswar Mishra
Headmaster, D.M. School, Bhubaneswar
 48. Dr. Madan Mohan Jha
Principal Secretary, Education, Govt. of Bihar
 49. Dr. A.R. Vasavi
Professor, National Institute of Advanced Studies
 50. Mr. A.K. Behara
Joint Director, OPEPA
 51. Dr. G.C. Nanda
Additional Directory (Pedagogy), Orissa Primary
Education Program Authority (OPEPA)
 52. Dr. M.K. Mishra
State Tribal Coordinator, OPEPA
 53. Mr. G.C. Mishra
DI of schools, Jeypore, Koratput, Orissa
 54. Mr. B.K. Ghosh DI of schools, Birapada
Mayurbhanj, Orissa
 55. Dr. Adikanda Mahanta
SI of schools, Chitrada, Baripada, Orissa
 56. Dr. Minakshi Panda
Teacher Educator, DIET, Khurda, Orissa
 57. Dr. Susandhya Mag
Teacher Educator, DIET, Dhenkanal, Orissa
 58. Dr. P.P. Mahato
Chairman, Anthropology Research Committee,
Bhubhaneswar
- North-East Region at Indian Institute of Technology,
Guwahati 10th and 11th September 2007.*
1. Prof. J.B. Baruah
Nodal Convener, Dept. of Chemistry, IIT
Guwahati
 2. Mr. Prateek Hajela
Mission Director, Sarva Shiksha Abhiyan (SSA)
Assam
 3. Mr. Abdul Wahab
Lecturer, District Institute of Educational Training
(DIET), Kamrup
 4. Mr. Ashok Mutum PRATHAM, Assam
 5. Smt. Juriti Borgohain
Banikanta College of Teacher Education, Assam
 6. Mr. Ramen Sharma
G.U. Model H.E. School, Assam
 7. Mr. Ajit K. Choudhury SSA, Assam
 8. Mr. Kandarpa Kalita
SSA, Assam

9. Ms. R. Laskar
SSA, Assam
 10. Ms. Shahnaz Deka
GBN Academy
 11. Fr. V.M. Thomas
Don Bosco Institute (DBI)
Guwahati
 12. Sr. Elizabeth George
DBI, Guwahati
 13. Dr. A. Basu
HSS, Guwahati
 14. Mr. C. Sonowal
Teacher, Kendriya Vidyalaya, Khanapara
 15. Prof. N. Bhagwati
 16. Ms. L. Sangma
Secretary, Education, Meghalaya
 17. Sh. P.K Hajong
Inspector of Schools, South Garo and West Garo
Hills, Meghalaya
 18. Ms. A Kynjing
Senior lecturer, DERT, Shillong
 19. Mr. K.J. Lohe
Joint Director, School Education, Nagaland
 20. Mr. K.Z. Mero, Chairperson
Village Education Committee, Chizami
 21. Dr. Benjongkumba
Lecturer, Zunheboto Govt. College
 22. Ms. Seno Tshuhah
Govt, Primary School and North East Network
Coordinator
 23. Mr. J.H. Biakmawia
Principal, KM H/SS, Mizoram
 24. Ms. H. Zirkungi
SCERT, Mizoram
 25. Mr. Lalhmachhunana
Young Mizo Association
 26. Mr. H. Lalsawmliana
Young Mizo Association
 27. Prof. Lianzela
Mizoram University
 28. Mr. C. Laremruata
Mizoram Educational Foundation
 29. Mr. R.K. Sukumar
State project Director, SSA, Manipur
 30. Mr. M. Harekrishna
Director, Education (Schools), Manipur
 31. Mr. V. Tonsing
High School Principal, Manipur
 32. Ms. Grace Jajo
Fraternal Green Cross Volunteers for Village
Development (FGCVVD), Manipur
 33. Mr. N. Dhiren Singh
Principal, Jawahar Navodaya Vidyalaya, Imphal
 34. Mr. P.D. Rai
Educational Development Trust of Sikkim
 35. Fr. George A. D'Souza
Principal, Namchi Public School, Sikkim
 36. Mr. K.N. Subudhi
Deputy Director, VE (Coord.), Human Resource
Development Department (HRDD), Sikkim
 37. Mr. B. Bagdas
Joint Director, PME, HRDD, Sikkim
 38. Ms. Anamika Debarma
Headmistress, Higher Secondary, Jirania, Tripura
 39. Mr. N. Sinha
Lecturer, SCERT, Tripura
 40. Mr. L.C. Das
Headmaster, Higher Secondary, Udaypur, Tripura
 41. Ms. A. Deb Burman
Tripura Adibashi Mahila Samiti
 42. Mr. M. Rina
Deputy Director, School Education, Arunachal
Pradesh
 43. Mr. B. P. Sinha
Principal, DIET, Roing
Arunachal Pradesh
 44. Ms. Labi Lombi
Arunachal Citizens' Rights (ACR)
 45. Mr. Ashok Tajo
Deputy Director, SSA
Arunachal Pradesh
 46. Mr. Binoy Boruah
Teacher, Govt. School University Campus
Rono Hills, Arunachal Pradesh
 47. Mr. G. Tachang
Block Resource Centre Coordinator
Mengio, Arunachal Pradesh
- Northern Region at India Habitat Centre, Delhi,
20th November, 2007*
1. Mr. Mohammad Rafi
Director of Education, Srinagar

2. Prof. Neeraj Sharma
Pratham, Jammu Education Movement
3. Dr. Renu Nanda
Assistant Director, Centre for Adult and
Continuing Education, Jammu University
4. Prof. Bashir Ahmed Dar
Srinagar
5. Mr. Ramzan
Teacher and Teacher Trainer
Jammu
6. Prof. Jagdish Sharma
Jammu
7. Prof G.N. Masoodi
Srinagar
8. Dr. M.K. Bhandary
Deputy Commissioner, Leh
9. Sh. Krishna Kumar, IAS
State Project Director, SSA, Punjab
10. Dr. Malviner Ahuja
Reader, Punjab University
11. Mr. Kulwarn Singh
DIET Ajjowal, Punjab
12. Sh. Ramesh Dutt
Lecturer in English, Govt. Girls Senior Secondary
School, Khanna
13. Sh. Devinderpal Singh Dhillon
DEO, Amritsar
14. Ms. Kalpna Rashmi
SSA, Haryana
15. Mr. Vivek Sharma
Pratham
16. Dr. Dinesh Sharma
Block Education Officer, Haryana
17. Smt. Kalpna Singh
Principal, Govt. Senior Secondary, Haryana
18. Sh. Rajpal
Headmaster, Govt. High School, Haryana
19. Sh. Suraj Prakash
Teacher, primary School, Haryana
20. Sh. Satya Dev Prakash
DIET Palwal, Haryana
21. Dr. Yogesh Vasistha
SCERT, Gurgaon, Haryana
22. Sh. Rajedev Singh
DIET Mattarsham, Hissar, Haryana
23. Sh. Harshvardhan Joshi
DIET Solan, Himachal Pradesh
24. Sh. Ramesh Verma
SCERT, Solan
25. Sh. Pardeep Thakur
Himachal Gyan Vigyan Samiti (HGVS)
26. Dr. O.P. Bhuraita
HGVS
27. Sh. Joginder Singh Rao
Principal, Govt. Senior Secondary
Bilaspur, Himachal Pradesh
28. Sh. R.K. Duggal
District Project Director
29. Sh. Paramjeet Singh
Deputy Director
Higher Education
30. Sh. Surjeet Singh Rao
Principal, Govt. Senior Secondary
Moorang, Himachal Pradesh
31. Sh. Sanjeev Atri
Principal, Govt. Senior Secondary
Kaffota, Himachal Pradesh
32. Dr. Harendra S. Adhikari
SCERT, Uttarakhand
33. Sh. V. Rama Rao
Education Advisor, Dehradun
34. Sh. B.S. Negi
Principal, Govt. Intercollege
Miyanwala, Dehradun
35. Dr. Anita Chauhan
DIET, Baghpat, Uttar Pradesh
36. Sh. Rajesh Kumar
Lokmitra, Uttar Pradesh
37. Sh. Ajay Kumar Singh
Mandaliya Sahayak Shiksha Nideshak
38. Sh. Kader Ahmed
Coordinator, Nayi Panchayat Resource
Coordinator, Rae Bareli
39. Sh. Jeetendra Kumar
NIOS, Noida
40. Mr. Kamlesh Bhartiya
GGIE, Meerut
41. Mr. O.P. Arya
GGIE, Meerut
42. Mr. Sanjay Yadav
Deputy Director, School Education, Meerut

43. Sh. S.K. Sethia
State Project Director, SSA and DPI Schools
Chandigarh (UT)
 44. Dr. S. Dahiya
Director, SIE, Chandigarh (UT)
 45. Ms. Harsh Batra
Principal, Govt. College of Education, Chandigarh
 46. Ms. Jasvir Chahal
Senior Lecturer, Govt. College of Education
Chandigarh
 47. Mr. Shailendra Sharma
Pratham, Delhi
 48. Mr. Anil Kumar
S.I., In Service Teacher Training
Delhi
 49. Ms. Neelam Katara
Education Officer, Kendriya Vidyalaya Sangathan
(Delhi region)
 50. Mr. N.S. Mehra
ADE (School)
 51. Mr. S.D. Sharma
Principal, Govt. Boys Senior Secondary School
Shakti Nagar, Delhi
 52. Mr. Dinesh Kumar
Govt. Boys Senior Secondary School, Gokulpuri
- Western Region, Indian Institute of Education, Pune
23rd November, 2007*
1. Mr. Begde
Director, SCERT, Maharashtra
 2. Dr. Gajanand Patil
Principal, DIET Yavatmal
 3. Smt. Mruguja Prakash Kulkarni
Asst. Teacher, Modern High School, Pune
 4. Mr. Ranganath Jayram Thorat
Sri Bhairavnath High School, Sinnar
Nasik
 5. Sh. S.G. Patil
Sriram Vidyalaya, Panchvati, Nasik
 6. Ms. Asha Sundararajan
MOEMS India, Mumbai
 7. Prof. Ram Takwale
Ex Vice-Chancellor IGNOU, YCMOU and
Pune University
 8. Mr. Ramesh Panse
Maharashtra Knowledge Corporation Limited
(MKCL), Grammangal
 9. Ms. Aditi Natu
MKCL
 10. Mr. Alok Sharma
Assistant Professor, SIEMAT
Raipur
 11. Mr. Yogesh Shivhare
District Project Coordinator
Rajiv Gandhi Shiksha Mission
Durg, Chhattisgarh
 12. Mr. Hemant Upadhyaya
Deputy Director, DPI, Raipur
 13. Mr. O.P. Birthare
Principal, Basic Training Institute
Bilaspur, Chhattisgarh
 14. Mr. Yogesh Agarwal
President, Mitra Jan Kalankari Samiti
Rajnandgaon, Chhattisgarh
 15. Mr. Lakshmi Nath Pathak
Principal, Shishu Mandir Higher Senior
Secondary, Naila, Chhattisgarh
 16. Ms. Deepa Dass
SIEMAT, Raipur
 17. Mr. S.K. Verma
Assistant Professor, SCERT, Raipur
 18. Mr. V.P. Chandra
Lecturer, DIET, Nagri, Chhattisgarh
 19. Ms. Gayatri Vijay
Deputy Director, School Education, Kota
 20. Ms. Snehlata Chaddha
Principal, Srinathpuram, Kota
 21. Mr. Shailendra Rajawat
Academic Officer, Secondary Education, Ajmer
 22. Mr. Radheyshyam
Principal, Jaipur Primary School
 23. Mr. Anil Gupta
Sandhan, Jaipur
 24. Mr. Arvind Ojha
Urmul Trust, Bikaner
 25. Mr. Dushyant Agarwal
Project Officer, SIERT, Udaipur
 26. Ms. Riddhi Shah
Seva Mandir, Udaipur
 27. Ms. Megha Jain
Seva Mandir, Udaipur
 28. Ms. Meena Bhatt
State Project Director, SSA, Gujarat

29. Mr. H.N. Chavda
Gujarat Secondary and Higher Secondary Board
30. Mr. H.N. Hingu
Joint CEO, SCOPE, Gujarat
31. Mr. Rajabhai Pathak
Principal, Swastik Secondary School, Gujarat
32. Mr. Architt Bhatt
Principal, Tripada International School
33. Dr. V.B. Bhensdadia
Deputy Director, Commissioner of Schools
Gujarat
34. Mr. Ketan Thaker
CRCC, Rampura, Distt. Ahmedabad
Gujarat
35. Dr. B.P. Choudhury
DIET, Patan, Gujarat
36. Ms. Roda Billimoria
Sir Shapurji Billimoria Foundation

Vocational Education

1. Gen. S.S. Mehta
CII
2. Dr. Pankaj Chandra
IIM A
3. Dr. Partha Mukhopadhyay
CPR
4. Mr. K.P. Murthy
MICO-BOSCH
5. Dr. P.M. Bhargava
NKC
6. Mr. Vivek Singhal
India Development Coalition of America

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IIT Kanpur
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Theoretical Statistics and Mathematics Unit, ISI
Delhi
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Director, Ramanujan Research Centre for Higher
Mathematics, Alagappa University

4. Prof. V. Vinay
Chief Technology Officer, Geodesic Information
Limited
5. Prof. T.V. Ramakrishnan
Department of Physics, BHU
6. Prof. Shiva Prasad
Director, IndoFrench Centre and Department of
Physics, IIT Bombay
7. Prof. N. Mukunda
Former President, IAS and Centre for High
Energy Physics, IISc
8. Prof. Alladi Sitaram
Statistics and Mathematics Unit,
ISI Bangalore
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Sri Jayachamarajendra College of Engineering
10. Prof. S.G. Dani
School of Mathematics, TIFR
11. Prof. Rajendra Bhatia
Theoretical Statistics and Mathematics Unit, ISI
Delhi
12. Dr. Rajesh Gopakumar
Harish-Chandra Research Institute, Allahabad
13. Prof. Dinesh Singh
Director, South Campus, Delhi University
14. Prof. P. Banerjee
Director, NISTADS, CSIR
15. Prof. Suman Kapur
School of Life Sciences, BITS Pilani
16. Prof. K.R. Sreenivasan
Director, ICTP, Trieste
17. Dr. Challa Suguna
Scientist, Centre for Cellular Biology, Hyderabad
18. Prof. M.S. Raghunathan
School of Mathematics, TIFR
19. Dr. Somdatta Sinha
Scientist, Centre for Cellular Biology, Hyderabad
20. Dr. Pramod Kumar Yadav
Dean, School of Life Sciences, JNU
21. Mr. Kiran Karnik
Former President, NASSCOM
22. Prof. Sanjay Puri
Dean, School of Physical Sciences, JNU
23. Dr. S.K. Sikka
Scientific Secretary, Office of Principal Scientific
Adviser

24. Prof. C.S. Seshadri
Director, Chennai Mathematical Institute
25. Prof. N. Satyamurthy
Director, IISER, Mohali
26. Mr. Ramesh Panse
Member, MKCL
27. Dr. M.K. Mishra
Orissa Sahitya Academy, Bhubaneswar
28. Mr. Venkatesh Valluri
Agilent Technologies
29. Mr. P.S. Deodhar
Executive Chairman, APLAB Limited
30. Dr. Achyutananda Samanta
Vice Chancellor, KIIT University

More Quality Ph.Ds

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Director, Reliance Life Sciences
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Managing Director, Agilent Technologies
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Principal Research Scientist, HLRC
4. Ms. Valsa Williams
Intel Technology India Pvt. Ltd.
5. Dr. Sandhya Chintala, Director
Education Initiative, NASSCOM
6. Dr. Vidyasagar, Executive Vice President, TCS
7. Dr. Meenu Singh, Additional Professor of
Paediatrics, PGIMER, Chandigarh
8. Dr. Bala Subramanian, Director, LVPEI
9. Dr. Y.S. Rajan, Principal Advisor, CII
10. Dr. R.B. Grover, Director, Knowledge
Management Group, BARC
11. Dr. Gyan Arora, Tata Motors
12. Prof. G.D. Yadav, UICT
13. Dr. Sushma Gupta, Ranbaxy Laboratories
14. Prof. B.D. Singh, Dean Sciences
Banaras Hindu University
15. Prof. E. Haribabu, Dean, Social Sciences
University of Hyderabad
16. Dr. A.N. Desai, The Bombay Textile
Research Association
17. Prof. Balaji Parthasarthy
IIIT Bangalore

18. Prof. Pankaj Jalote, IIT Delhi
19. Prof. Shashiprabha, Jawahar Lal Nehru University
20. Dr. J.K. Bhasin, NEERI
21. Dr. Ajit Ranade, Chief Economist
Aditya Birla Group
22. Dr. Rajendra Singh, CMIR Dhanbad
23. Prof. Varyam Singh, Dean Languages, JNU
24. Dr. Ashok Ganguly, Member, National Knowledge
Commission
25. Dr. Sujatha Ramdorai, Member, National
Knowledge Commission

National Science and Social Science Foundation

1. Dr. U.R. Rao
Former Director, ISRO
2. Prof. R. Ramaswamy
Jawaharlal Nehru University
3. Prof. Senthil Todadri
4. Dr. B.M. Hegde
Postgraduate Medical Education Board
Govt. of India
5. Prof. C.S. Seshadri
Chennai Mathematical Institute
Chennai
6. Dr. Mangala Rai
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7. Prof. Sabyasachi Bhattacharya
TIFR
8. Dr. A.V. Rama Rao
AVRA Laboratories
9. Prof. Ajit Kembhavi
IUCAA, Pune
10. Prof. S. Umamathy
IISc, Bangalore
11. Prof. S.M. Chitre
University of Mumbai
12. Prof. Sanjeev Galande
National Centre for Cell Science
Pune
13. Dr. N.K. Ganguly
ICMR
14. Dr. V. Rao Aiyagari
SERC, Department of Science and Technology

15. P.M. Bhargava
NKC
16. Ashok Ganguly
NKC
17. Deepak Nayyar
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18. Ashok Kolaskar
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Intellectual Property Rights

1. Dr. R.A. Mashelkar
CSIR
2. Dr. P.M. Bhargava
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3. Dr. Prabuddha Ganguli
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4. Mr. Anjan Das, CII
5. Dr. Malathi Lakshmikumaran
Lakshmikumaran and Sridharan
6. Dr. Krishna Ravi Srinivas
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7. Mr. Akash Taneja
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8. Dr. Ramesh Shukla
Board of Appeal, European Patent Court
9. Dr. Somesh Kr. Mathur
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10. Mr. Anand Grover
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11. Mr. V.K. Gupta
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12. Mr. Naresh Nandan Prasad
DIPP, Ministry of Commerce and Industry
13. Mr. R.K. Gupta
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14. Mr. Anand Wali
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15. Mr. T.C. James
DIPP, Ministry of Commerce and Industry
16. Dr. B.K. Keayla
National Working Group on
Patent Laws
17. Mr. Rakesh Prasad
ALG Associates

Surveys

Innovation

1. Arvind Mills Ltd.
2. Ashok Leyland Ltd.
3. Aurobindo Pharma Ltd.
4. Ballarpur Industries Ltd.
5. Bharat Forge Ltd.
6. Bharat Heavy Electricals Ltd.
7. Bharat Sanchar Nigam Ltd.
8. Biocon Ltd.
9. Cadila Healthcare Ltd.
10. Central Bank of India
11. Citigroup Global Services Ltd.
12. CRISIL Ltd.
13. Essel Group of Companies – Zee Group
14. Fortis Healthcare Ltd.
15. Glenmark Pharmaceuticals Ltd.
16. Great Eastern Shipping Co. Ltd.
17. Gujarat Co-operative Milk Marketing Federation Ltd.
18. HCL Infosystems Ltd.
19. IBM India Ltd.
20. ICICI Bank Ltd.
21. Indian Airlines Ltd.
22. Infosys Technologies Ltd.
23. Jagran Prakashan Ltd.
24. Jet Airways (India) Ltd.
25. Jindal Stainless Ltd.
26. Kirloskar Brothers Ltd.
27. Kotak Mahindra Bank Ltd.
28. Kudremukh Iron Ore Company Ltd.
29. Mahindra & Mahindra (Mahindra Group)
30. MSPL Ltd.
31. National Bank for Agriculture and Rural Development (NABARD)
32. National Mineral Dev Corp Ltd.
33. NTPC Ltd.
34. Nuclear Power Corporation of India Ltd.
35. Oil and Natural Gas Corporation Ltd.
36. Oil India Ltd.
37. Pantaloon Retail
38. Philips Electronics India Ltd.
39. Power Grid Corporation of India Ltd.
40. Punjab National Bank
41. Reliance Industries Ltd.
42. RPG Enterprises
43. Rural Electrification Corpn.
44. Sesa Goa Ltd.
45. Shopper's Stop Ltd.
46. SICPA India Ltd.
47. Singareni Collieries Co Ltd.
48. Star Group India
49. Steel Authority of India Ltd.
50. Sun Pharmaceuticals Industries Ltd.
51. Syndicate Bank
52. Tata Consultancy Services Ltd.
53. Tata Group
54. Tata Motors Ltd.
55. Tata Steel Ltd.
56. Thermax Ltd.
57. West Coast Paper Mills Ltd.
58. Whirlpool India Ltd.
59. Abhinav Enterprises
60. Accurate
61. Affair

62. Agricultural & Processed Food Products Export Development Authority (APEDA)
63. Ajay Windecor Products
64. Ajinkya Enterprises
65. Artzone
66. Asha Chemicals
67. Athitya
68. Atul Electro Formers Pvt. Ltd.
69. Auto Cluster Development & Research Institute Ltd.
70. Beed Cyber Infotech
71. CADLine India
72. Cartoprint
73. Clean Foods Ltd.
74. Dayal Fertilizers Group
75. Digital Empowerment Foundation
76. Dnyaneshwar Vidyapeeth
77. Electronica Machine Tools Ltd.
78. Engg Tools & Equipment
79. Feelings
90. Golopore IMS
91. GreenGarden
92. Hoyt Engineering Solutions Pvt. Ltd.
93. Ideal Computer Education
94. Ideal Diamond Products Pvt. Ltd.
95. Indian Academy of Foreign Trade & Development
96. Innova Rubbers Pvt. Ltd.
97. Innovative Technomics Pvt. Ltd.
98. Intelux Electronics Pvt. Ltd.
99. International Institute of Corporate Management
100. International Institute of Information Technology
101. KNOW-IT
102. KPMG
103. Lakshmi Embroidery
104. Logus Business Systems
105. Macintel
106. Maharashtra Knowledge Corporation Ltd.
107. Mana Pet Clinic Labs
108. Manjushri Extrusions Ltd.
109. Mavin Adhesives Pvt. Ltd.
110. Medsynaptic Pvt. Ltd.
111. Melk Services
112. Membrane Filters Pvt. Ltd.
113. Mutha Founders Pvt. Ltd.
114. N V Electronics Pvt. Ltd.
115. Neelesh Engineers
116. Nichrome India Ltd.
117. Nirmiti Electronics Pvt. Ltd.
118. Paranjape Metal Shapes Pvt. Ltd.
119. Pragati Leadership Institute Pvt. Ltd.
120. Praj Industries Ltd.
121. Prajakta Computer Education
122. Prescient Technologies Pvt. Ltd.
123. Rezonant Design
124. Rohini Industries
125. Ronak Associates
126. SAI Test Plat Pvt. Ltd.
127. SEMCO ELECTRIC Pvt. Ltd.
128. Serum Institute
129. Shree Systems
130. Simply Delicious
131. Smile Automation Pvt. Ltd.
132. Sumanya HMX Systems Ltd.
133. Symtronics Automation Pvt. Ltd.
134. System India Computer and Management Services
135. Tact Global Services
136. Teamfill
137. Tecel Magnetics
138. Technical Associates Ltd.
139. Tony Travels Pvt. Ltd.
140. Unite Industries
141. Virane Engineers
142. Voicetech Solutions
143. Weaver Computer Embroidery System
144. Yenkey Instruments & Controls Pvt. Ltd.
145. Zarekar Computers
146. Zephyr Industries/Zephyrs Systems

Entrepreneurship

1. Mr. Vishwas Joshi and Subhada Joshi
Girikand Travels Pvt. Ltd.
2. Mr. M.D. Adoni
Certified Management Consultant
3. Mr. Milind Pandit, Akshay Urja Pvt. Ltd.
4. Ms. Gayatri & Mr. Gopal Tambe
FRP Toilets
5. Mr. N.S. Rao, Intelux Electronics
6. Ms. Rajashree Jhangle, Simply Delicious
7. Mr. Ravi Bhagwat, Symtronics Automation
Private Limited
8. Dr. Sunita Chaudhari, Consulting
Ayurvedacharya
9. Mr. Vincent D'Souza, V.R. Coatings
Pvt. Ltd.
10. Mr. Linesh Thakur, Aishwarya Enterprises
11. Mr. Subhash Devi, Membrane Filters
12. Ms. Mrunal Gokhale, Feelings Flowers
13. Mr. Ravindra Bam, Ajay Windecor
14. Mr. Vivek Sawant, Maharashtra Knowledge
Corporation Ltd.
15. Mr. Pravin Dhole, Technofour
16. Mr. Sunil Bhandari, Food Grade Products
17. Mr. Raj Pathak, Akshay Urja Pvt. Limited
18. Mr. H.M. Bakshi, Innova Group
19. Mr. Firoz Poonawalla, Fila Rozil Exporters
Pvt. Ltd.
20. Dr. Ashish Dhawad, Medsynaptic
Pvt. Ltd.
21. Dr. Prashant Lahane, Medsynaptic
Pvt. Ltd.
22. Mr. Anil Deshpande, Atul Electroformers Private
Limited
23. Mr. Partha Das, Partha Das and Associates
24. Dr. Aloke Roy, Medica Synergie
25. Mr. Amit Dastidar and Mr. Subhajt
Bhattacharya, The Event Managers
26. Mr. Sourav Chakraborty, Aunwesh Knowledge
Technologies Pvt. Ltd.
27. Mr. Siddharth Pansari, Pansari Group of
Enterprises
28. Mr. Anjan Ghosh, Kol Web
29. Mr. Jhelum Chowdhry, Crystal Research and
Consulting Pvt. Ltd.
30. Ms. Sunira Chamaria, Sunira Foods
31. Mr. Arun Lohia, Alliance Mills (Lessees) Ltd.
32. Mr. Rajiv Poddar, Smartpower Computer Centre
33. Mr. Namit Shah, Harley Group
34. Mr. Sidharth Kaul, NICCO Engineering
35. Mr. Aditya Chamaria, Indian Ropeways & Engg
Co. Ltd.
36. Dr. Mousmi Ghosh, Future Business School
37. Mr. Vijay Kumar Shroff, Vijay Kumar & Co
(Jute) Pvt. Ltd.
38. Mr. Cecil Anthony, Synergy Group
39. Mr. S. Bhattacharya, Midland Packers
40. Mr. Shoummo Acharya, VI eTrans
Pvt. Ltd.
41. Mr. S. Daspal, Info Horizon
42. Mr. Manish Chandani & Mr. Talat Ahmed
Ajanta Leather Fashions Pvt. Ltd.
43. Mr. Pradip Poddar
Shanta Colibri (India) Pvt. Ltd.
44. Mr. Nitin Himatsingka, Car Showroom
45. Mr. Indraneil Bose, Futuretech Solutions
46. Mr. Kumar Shivam, ALB Consultancy
47. Ms. Roopa Mehta, SASHA
48. Mr. P.K. Saha, P.K. Saha & Associates
49. Dr. Partha Ray, R M Clinical Laboratoies
Pvt Ltd.
50. Mr. Ashish Mitra, Exterior-Interiors Ltd.
51. Mr. Prateek Surekha, Brainwave Live
52. Mr. Ankur Gattani, Lifelines
53. Mr. Sundeep Tibrewal, ResolveQuery.com
54. Mr. Ramachandran N & Mr. T Srinivasan, MEL
Systems & Services Ltd.
55. Mr. Ramachandran A, Ganga Chemicals
56. Mr. Sanjeevi V, eLogistics Pvt. Ltd.
57. Mr. G.R. Ravi, Medik India Phytoceuticals
58. Mr. L. Ashok, Futurenet Technologies
59. Mr. Govindachari P.S.
Rajsriya Group of Industries
60. Mr. K Shivaram Alva, Allva Plast

61. Mr. V.P.N. Rahman, Nadeem Leatherware Exports
62. Mr. Vara Prasad Raju P, Sigma Solid Strips Pvt. Ltd.
63. Mr. Amit Vaishnav, Megafoods Products Madras (P)
64. Mr. D.S. Balachandra Babu, Fram Implements Pvt. Ltd.
65. Mr. Naveen Velagapalli, Vitalife Clinic
66. Mr. Suhas Gopinath, Globals ITeS Pvt. Ltd.
67. Mr. B.A. Srinivasa, Vivek Ltd.
68. Ms. Rajeshwari, Akshya
69. Mr. A Benedict, Mercy Hygiene Healthcare Products
70. Mr. Anoop Mehandale, Latent View Analytics
71. Mr. Rupesh Shah, Sonya Ceramics
72. Dr. Nita Goswami, Rucha Pharmaceuticals
73. Mr. Indrajit Simlai, SSBI Exports
74. Mr. Jasvinder Singh, ACTUNIV
75. Mr. Sajjan Kejriwal, Acme International Ltd.
76. Mr. Samir N Patel, Amos Enterprise Ltd.
77. Mr. Malay Kantharia, Team Spirits India Pvt. Ltd.
78. Mr. E. Sarath Babu, Foodking
79. Ms. Kala Amin, Kanisha
80. Mr. Samir Shah, JBS Group of Companies
81. Ms. Seema Mehta, Sparkle Granites
82. Ms. Jayshree Mehta, Infinium Toyota
83. Mr. Amit Khaitan, Gujaratgifts.com
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85. Mr. Aniket Nagri, Nagri Group
86. Mr. Bhakti Vohra, Vastrapur Times
87. Mr. Deepak Vakil, Yeti Leather Products
88. Mr. Rajiv Gandhi, Hester Pharmaceuticals Ltd.
89. Mr. S.V. Modi, S.V. Modi Export Import
90. Mr. Sushil Handa, Claris Lifesciences Ltd.
91. Mr. Sheshgiri Bekal, Incubatee at Nirma Labs
92. Mr. V. Venkata Raju, VEM Technology Pvt. Ltd.
93. Mr. N.K. Malani, Sri Venkateswara Coir Products Pvt. Ltd.
94. Mr. Nitin Vyakaranam, Arthayantra
95. Ms. Devika Vardarajan, Polaris Management Services Pvt. Ltd.
96. Mr. Narne Prabhakar, Hyderabad Tulaman Ltd.
97. Mr. Jayadev Meela, Sudhakar Polymers Ltd.
98. Mr. V. Anil Reddy, Nayastrap Ltd.
99. Mr. Devendra Surana, Bhagyanagar India Ltd.
100. Mr. Ravindra Modi, Surya Masale
101. Mr. D. Nagarjuna Sarma, Imprint Travels
102. Mr. Sriram Yalamati, Matrix Equipment Pvt. Ltd.
103. Mr. Sreeram M.M, S & U MEK Engineers Pvt. Ltd.
104. Mr. Ramesh Datla, Elico Ltd.
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107. Ms. Durga Rani, Hyma Industries
108. Ms. Vijay Lakshmi, Anu Group
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112. Mr. Subramani Ramachandra, Richcore Lifesciences Pvt. Ltd.
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116. Mr. D.R. Srikantaiah, Associated Trading Corporation
117. Ms. Raj Bhasin, Bhasinsoft India Ltd.
118. Mr. M.S. Sidhu, Aparas Enterprise solutions Pvt. Ltd.
119. Ms. Uma Reddy, Hitech Magnetics
120. Mr. Shivakumar, Indigo Edge

121. Mr. Ravi Venkatesan, OnTrac
122. Dr. Krishnaswamy, Animal Biotech (Bangalore) Pvt. Ltd.
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124. Mr. Mansoor Ahmed, Tiger Tail Studios BrewHaHa
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130. Mr. M.C.R. Shetty, Porlu Packers
131. Mr. Philip Lewis, Electro Mech Corporation
132. Mr. K. Ganesh, Tutor Vista
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134. Dr. Rajeshwari, Manu Pet Clinic
135. Mr. K.N. Jayalingappa, Transphone Corporation I.T.I Ancilliary Industries Association
136. Mr. R.S.H. Raju, Bluechip Solutions
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138. Ms. Suma Krishnaswamy Global Greens
139. Ms. Padma Seshadri, Atithya Hotels
140. Mr. Muralidhar, Innova Security Investments Ltd.
141. Mr. R.C. Purohit, Bhoruka Steel and Services Ltd.
142. Mr. K. Shiva Shanmugam, Sivasakhti Engineering Company
143. Ms. Usha Nagaraj, Srimati Mahila Co-operative Bank, FKCCI
144. Mr. Babu Sathian, Process Pumps Pvt. Ltd.
145. Mr. Veerendra Shivhare, mGinger
146. Mr. Balaji Pasumarthy, Business Gyan
147. Mr. Divye Tela, Cheesecare Corporate Services
148. Mr. Priyankar Baid, P B Tech Impact Solutions, New Delhi
149. Mr. Atul Nigam, i2k Solutions, Mumbai
150. Mr. Nalin Agrawal, INREA Research, Mumbai
151. Mr. Abhishek Biswal, TRI India, Mumbai
152. Mr. Sanjay Labroo, Asahi India Glass Ltd. New Delhi
153. Mr. Pratap S. Mungi, Mungi Brothers, Mumbai
154. Mr. Ramesh Suri, Subros Ltd. New Delhi
155. Mr. Arvind Kapur, Rico Auto Industries Ltd. Gurgaon
156. Ms. Lalita Gupte, ICICI Venture
157. Ms. Bala Deshpande, ICICI Venture
158. Mr. Kanwaljit Singh, Helion Venture Partners
159. Mr. Ashish Gupta, Helion Venture Partners
160. Mr. Anand Lunia, The Seed Fund
161. Mr. Pravin Gandhi, The Seed Fund
162. Mr. Vishnu Varshney, Gujarat Venture Finance Ltd. (GVFL)
163. Mr. R. Kuppanna, SBI Chennai
164. Mr. Puneet Gupta, NEF
165. Ms. Laxmi Venkatraman, BYST
166. Ms. Laura Parkin, NEN
167. Mr. Manak Singh, TIE
168. Mr. Paul Murphy, Microsoft India
169. Dr. Subhashish Gangopadhy, IDF
170. Mr. Mohit Malik, Anoova Consulting
171. Mr. Krishnan Iyer, Sequoia Capital India
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173. Mr. Manish Sabharwal, TeamLease Services Ltd.
174. Prof. Suresh Bhagavatula, NSRCEL, IIM Bangalore
175. Mr. R.M.P. Jawahar, TREC-STEP
176. Ms. Poyini Bhatt, SINE, IIT Bombay
177. Dr. Madhu Mehta, NIRMA Labs
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179. Mr. Nitin Kundra, Entrepreneurship and Innovation Cell, IIM Bangalore
180. Prof. Ashok Jhunjunwala, TeNeT IIT Madras
181. Centre for Innovation, Incubation & Entrepreneurship (CIIE) IIM Ahmedabad
182. Prof. Subramonia Sarma, Indian School of Business (ISB)

183. Mr. Brahmananda Rao & Mr. Rajeswara Prasad, Andhra Pradesh State Finance Corporation (APSFC)
184. Ms. Ramadevi Kanneganti, ALEAP
185. Mr. S. Subba Rao, Andhra Pradesh Industrial Development Corporation (APIDC)
186. Mr. Khokon Mukhopadhyaya, Bengal Chambers of Commerce
187. Mr. Kaushik Shah, Gujarat Chambers of Commerce and Industry
188. Mr. Sampat Raman, Federation of Karnataka Chamber of Commerce & Industry (FKCCI)
189. Representatives of Tamil Nadu Adi Dravidar Housing Development Corporation (TAHDCO)
190. Mr. Mritunjoy Bandyopadhyaya Agastya Associates
191. Dr R.C. Rane Intas Pharmaceuticals
192. Mr. V.V. Sanyasi Rao, Anakapalle Merchants Association
193. Mr. Uday Bhaskar, Zen Technologies
194. Mr. Y. Rambabu, Ushodaya Enterprise
195. Dr. Pulastya Vora, CSM Services
196. Mr. K.M. Pai, Bell Ceramics Ltd.
197. Dr. Shrikant Joshi, International Advanced Research Centre for Powder Metallurgy
198. Prof. M.G.K. Murty, Centre for Environmental Adaptation
199. Mr. M. Raja Reddy, Srinivasa Industries
200. Mr. Arun Kumar D, AGI Glaspac

NKC: Members and Staff

Current Members, Advisors and Staff

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1. Sam Pitroda
2. Ashok Ganguly
3. P. Balaram
4. Jayati Ghosh
5. Deepak Nayyar
6. Nandan Nilekani
7. Sujatha Ramdorai
8. Amitabh Mattoo

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1. S. Regunathan
2. Kiran Datar
3. Kumud Bansal
4. C.N.S. Nair

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1. Amlanjyoti Goswami (Research Associate)
2. Sukhman Randhawa (Research Associate)
3. Namita Dalmia (Research Associate)
4. Megha Pradhan (Research Associate)
5. Vikas Bagri (Research Associate)
6. Deepti Ayyanki (Research Assistant)
7. Aashima Seth (Executive Assistant)

Former Members, Advisors and Staff

Members

1. Andre Beteille
2. P.M. Bhargava
3. Pratap Bhanu Mehta

Advisors

1. Ashok Kolaskar
2. Kalpana Dasgupta
3. Razia Sultan Ismail Abbasi

Staff

1. Sunil Bahri (Executive Director)
2. Mitakshara Kumari (Research Associate)
3. Rohan Mukherjee (Research Associate)
4. Shriya Anand (Research Associate)
5. Shomikho Raha (Research Associate)
6. Kaushik Barua (Research Associate)
7. Aditi Saraf (Research Associate)
8. Pallavi Raghavan (Research Associate)
9. Pratibha Bajaj (Research Associate)
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