TOWARDS A MORE INCLUSIVE AND INNOVATIVE INDIA

Creating a Roadmap for a
'Decade of Innovation'

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CONTENTS

INTRODUCTION

Innovation is increasingly being seen as the currency of the 21st century. Innovative solutions will impact not only competitive advantages in business and markets, but will provide answers to the most significant challenges facing the world we live in. Governments across the globe are making a concerted effort to design focused strategies for driving innovation. With the impressive development graph of the last two decades, India is at the right stage to galvanise its disparate efforts and policies on innovations into a more concrete national level strategy which is oriented towards shaping the future of the country.

The future prosperity of India in the new knowledge economy will increasingly depend on its ability to generate new ideas, processes and solutions, and through the process of innovation convert knowledge into social good and economic wealth. In a globally competitive world, India's challenge is to unleash its innovation potential to increase capacity, productivity, efficiency and inclusive growth. If innovation capacity is to become endemic to the eco-system of India's growth and development it has to permeate all sectors of the economy from businesses and government, to people at all levels and universities.

India today has a number of strengths: a strong R&D base; academic talent; it is a leading innovation player in certain key economic sectors such as biotechnology, pharmaceuticals, automotive components, Information Technology, software, and IT enabled services (ITES); and a stable and supportive macroeconomic climate. However, India has 300 million of its citizens living below the poverty line and huge disparities in terms of access to development initiatives. The Indian innovation strategy, therefore, has to be focused on looking beyond competitive advantage to generating inclusive growth, with opportunities for people at the bottom of the pyramid. This focus on inclusive innovation is critical if India is to create a sustainable growth agenda for the future and move away from a subsistence economy to a knowledge based economy.

Innovation Defined

Innovation involves thinking differently, creatively and insightfully to create solutions that have an impact in terms of social and economic value. Innovation is critical for creating competitive or collaborative advantage, problem solving to address the challenges of our times, improving governance, and generating intellectual value. It can redefine everything – from products, processes, and services to individuals, organisations, the

public and private sector and institutions.

Innovation fulfils needs which cannot be met by conventional products, processes, and institutional forms. It is driven by people, culture, diversity, technology, eco-system and opportunities and the interaction among these elements. Increasingly, innovation **is** going far beyond the confines of formal R&D to users, suppliers and consumers everywhere and providing solutions in government, business and non-profit organisations, across borders, across sectors, and across institutions[1]. Where, how and why innovation occurs are in flux – across geography and industries, in speed and scope of impact, and even in terms of who is innovating. Today innovation can mean new and unique applications of old technologies, using design to develop new products and services, new processes and structures to improve performance in diverse areas, organisational creativity, and public sector initiatives to enhance delivery of services. Innovation is being seen as a means of creating sustainable and cost effective solutions for and by people at the bottom of the pyramid, and is being viewed as an important strategy for inclusive growth in developing economies. Further, the innovation system is also increasingly focused on absorbing hidden innovations in the services sector, creative industries and grassroots activities.

In this context, while increased competition constitutes the most effective instrument to stimulate innovation, policy measures and innovation support mechanisms have an important role to play, especially for stimulating inclusive innovation efforts. Government policy needs to understand the new sources and dimensions of innovation to develop new instruments and strategies in response to the local environment and needs, but based on global standards. Further, Government policies can enable fundamental investments and resource commitments which can create the right innovation infrastructure. It is also important to recognise that one-size-fits-all innovation strategies are unlikely to match a country's or region's unique strengths and hence individual innovation models have to be developed for different contexts.

In the information age, Information Technology and the web add a new dimension to innovation. The Web/Internet offers unprecedented opportunities related to openness, accessibility, networking, connectivity, democratization and decentralization. Wireless services add mobility and flexibility, and the web provides video presence and virtual reality. The new ICT tools can change learning paradigms and impact sectors such as education, health and agriculture etc. In this context high speed Broadband is

[1] OECD Innovation Strategy , www.oecd.org, 2007

critical and will provide the core of the new information infrastructure needed for new age innovation. This is very critical as is evident in a study of 120 countries, where researchers found that every 10 percent increase in broadband adoption increased a country's GDP by 1.3 percent. In India the internet can increasingly be leveraged to give access to improved services to the 1 billion connected people and this can have tremendous impact on the socio-economic development of the country.

Virtual Aid

Students at Columbia University's School of Public Administration (SIPA) are promoting grassroots activism with a new technology that uses "crowd sourcing" to map out crisis information sent by text message, e-mails, and Twitter feeds. The software programme, *Ushahidi* – "testimony" in Swahili – was originally developed to map reports of violence and tragedy in Kenya after the country's elections in 2007. The programme's effectiveness and accessibility (it can be used openly by anyone with a computer) made it successful outside of Kenya's crisis. The free software's most significant success has been in Haiti, where it has been credited with saving people buried alive under the rubble. The victims were able to text their location to *Ushahidi* and receive aid from The Red Cross, which was just one of the organizations using the software after Haiti's January 12 earthquake.

ICT Enabled Justice: National Legal Mission

The Indian judicial system has 3.2 crore pending cases. To clear this backlog and reduce time to justice from 15 years to 3 years, the Government has announced the setting up of a National Legal Mission in 2010, with ICT as a key component. ICT enabled systems in courts will help to monitor pendency, accumulate accurate data to analyse and improve processes, identify bottlenecks and facilitate faster disposal. IT tools can play a critical role in reducing this significant backlog and designing efficient systems suited for the huge workload of the Indian judiciary.

Need for Innovation

Innovation can be a critical driver not only for increasing productivity and competitiveness, but for poverty alleviation through collaborative approaches and inclusive growth. More than this, innovation has always been the way people solved the significant challenges facing society. The world is increasingly facing the prospect of depleting resources and demand

outstripping supply. The global food system is struggling to meet rising demands, yet the World Bank projects a rise of 50 per cent in global demand for food by 2030. Similar gaps will be seen in water supply, and increasing energy consumption will create huge strains on the system. Asia's share of energy consumption alone is projected to double over the next 20 years – to about 48 per cent for oil and 22 per cent for natural gas. Such significant challenges can only be addressed through innovative solutions.

Today, innovations in diverse areas such as science to politics, education to business, can enable us to engineer solutions in food, water, healthcare access, education and affordable housing; find environmentally-friendly energy sources; and, expand access to knowledge that can enable a more secure future. These solutions which benefit a critical mass of people will be crucial if India is to bridge its widening disparity. In this context, the strategies and actions initiated by governments, educational institutions, industry, communities, regions and nations, especially based on innovative thinking, will become critical.

Recognising the importance of innovation, the President of India has declared this decade as the 'Decade of innovation', with a focus on inclusive growth. The Indian economy is the 12th largest in USD exchange rate terms. India is the second fastest growing economy in the world. India's GDP has touched US $1.3 trillion. However, this rapid growth has not been accompanied by a just and equitable distribution of wealth among all sections of the population. With pressures of rapid development, liberalisation and globalisation, India is facing the prospect of a fragmented and unsustainable growth curve unless innovation, especially inclusive innovation, is placed at the centre of our development strategy. The country has a huge backlog of needs to be met – in education, health, water, sanitation, urban improvements, public transportation, energy availability etc. The current approaches to solve these problems have not delivered adequately, and therefore, innovations are necessary in addressing these challenges by creating new delivery mechanisms, along with innovations in products, services and processes. To quote just one example, according to a McKinsey Study, Indian cities will need $1.2 Trillion of additional capital investment by 2030, and will have to meet the needs of 590 million people. This will require an innovative shift in urban planning, resource management and governance models at the city level.

India's R&D expenditure as per cent of GDP is about 0.8 (156 researchers/m population), China 1.2 (500 researchers/m), and USA 2.8 (4700/m). Total researchers in India are about 1.5 Lakh as compared to China's 8-10 Lakh and India produces fewer patents in relation to the size of its economy than other countries. Due to these statistics international comparisons rank India very low on the Innovation index.

Table 1: Global competitiveness: Innovation Capacity Components Index

Country	Innovation Capacity Index		Quality of scientific research institutions		University-industry research collaboration		Availability of scientists & engineers		Utility patents (per million of people)		Public procurement of advanced technology	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Brazil	27	4.0	43	5.13	50	3.6	57	4.4	58	0.5	84	3.4
China	25	4.2	37	5.12	23	4.5	52	4.5	54	0.6	20	4.2
India	35	3.8	27	5.1	45	3.6	3	5.7	57	0.5	88	3.4
Japan	2	5.9	15	5.4	21	4.6	2	5.9	3	260	42	3.9
South Korea	9	5.3	14	5.5	12	5.1	19	5.1	7	131	2	5.1
United Kingdom	14	14.0	7	5.7	9	5.1	32	4.8	18	55	32	4.0
United States	6	5.5	1	6.3	1	5.8	6	5.5	1	262	4	4.9
Note: Rank refers to the economy's global rank on each indicator among 134 economies. Scores range from 1, low, to 7 highest, except for utility patents, where the score shows the number of patents per million people.												
Source: WEF 2008.												

While we do need to increase R&D investment and efforts, this view of innovation is based on a myopic perception that restricts it to the confines of formal R&D, while as mentioned above, innovations are increasingly going beyond R&D and patentable technologies[2]. In the Indian context they are increasingly relevant for addressing needs of the people at the bottom of the pyramid and can be visible in processes, institutional changes and in new ways of doing things and providing better services to people. India needs innovation, especially innovation that goes beyond the competitive index, to accelerate its growth and to create a more inclusive model of development which is environmentally sustainable.

[2] 'Inclusive and Frugal Innovation, Stimulating the Innovation Eco-system', A. Maira, 2010

India's history is replete with pioneering innovations in diverse areas and the country has a strong and unparalleled tradition of innovation. Indian diversity has been a fertile ground for innovations in varied areas, which have drawn upon the multicultural influences present in the society, the desire for intellectual pursuit and the unique talent in craftsmanship and design.

The country's legacy in art, culture, music, architecture, performing arts, philosophy and scientific endeavours has survived over generations and produced works that have become timeless. India was home to one of the three ancient civilisations, the Indus Valley Civilisation, which housed cities such as Mohenjodaro, Harappa, Kalibangan and Lothal. These cities exemplified innovative town planning, civic amenities, efficient administrative structures, technical skills, and even the largest maritime structure ever built by any Bronze Age community (the dockyard at Lothal). Three of the great religions of the world also originated in India: Hinduism, Buddhism and Jainism, and from here spread to other parts of the world. Further, Indian mathematics made the most significant contribution of the 'decimal system of enumeration' to represent all integers, using nine digits, and a symbol for zero, dating back to the Vedic period, and also gave the world the first variant of Pascal's triangle. These fundamental innovations are the basis of modern mathematics and are a living example of the innovative mindset that existed in ancient India with its deference to the pure pursuit of knowledge and creativity.

This pursuit of knowledge was also behind the creation of legendary universities such as Nalanda and Takshashila which drew people from all over the world. These were reputed centres of learning with a variety of subjects being taught. Takshshila was the earliest centre of learning from 5th century BC and provided education in a wide variety of subjects, including arts, literature, music, philosophy, religion (both Hindu and Buddhist), law, chemistry, biology, medicine, astronomy, architecture, sculpture, history and geography. It provided instruction in vocational subjects like archery, elephant riding, agriculture, accounting and astrology. Nalanda was the foremost residential centre of Buddhist learning, especially Mahayana Buddhism from 5th century AD to 12th century AD. It attracted students from as distant places as China and South-East Asia. It was a centre for the pursuit of higher education, with well-carved out administration rules and policies, produced encyclopaedic works dealing with philosophy, grammar and logic, and employed lectures and discussions as the methods of teaching.. These pioneering precursors of modern-day universities were realised in India, much before anywhere in the world. India was also home to the innovative 'gurukul' system of education premised on the close interaction between the

teacher and student in a residential setting, a tradition that is being revived in the modern era.

India also contributed to the field of medicine through the ancient art of Ayurveda aimed at not just curing disease but also preserving health. The country has also been a fountainhead of important innovations in Science, including astronomy, chemistry and metallurgy. A thousand years before the time of Copernicus, Aryabhata (b 476 AD) in India made outstanding contributions to astronomy and mathematics including determination of the diameter of the earth and moon, the idea of the earth rotating on its own axis to explain the daily motions of the fixed stars, determining the approximate value of pi and alphabetical representation of numbers. Indian astronomy was behind the discovery of the names of the Zodiac. The 24-feet high Iron pillar in Delhi, which has remained rust free for 1500 years, is an unparalleled metallurgical achievement. Apart from this, the country's legacy in art, music and architecture is a testimony to the spirit of innovation which thrived. From Temples such as Mahabalipuram in South India, the Sun Temple at Konark, and the caves at Ajanta and Ellora to the world famous Taj Mahal, from Machievellan political and administrative treatise such as *Arthshastra*, the Vedas, Upanishads and epics such as Mahabharata (the longest single poem in the world) and Ramayana, to discoveries in linguistics and logic, India has given the world unparalleled marvels.

All this was possible because India not only possessed a culture of innovation, knowledge and creativity, but also because it was a melting pot of cultures, traditions, religions where disparate strands could be galvanised to create new perspectives and ideas. The notion of drawing from global resources was common in ancient India and was critical in creating a pool of innovative ideas in the country. Today, increasingly this global nature of innovation is being recognised and exploited for new discoveries.

This spirit of innovation was also evident in our freedom movement when Mahatma Gandhi charted a novel way of fighting the British through peaceful means. His strategy of non-violence and civil disobedience was not only instrumental in the Indian freedom struggle, but also continues to pave the way for peaceful demonstrations against authoritarianism across the globe.

After Independence, the founding fathers of the country led by the visionary Jawaharlal Nehru redefined the innovation landscape by linking science & technology, production activities and development initiatives. In 1947, Nehru, while addressing the Indian National Congress, had remarked: 'So science must think of the few hundred million persons in India'. He was clear about the need for leveraging science for solving the problems of a majority of the population. This period saw a massive growth of infrastructure for science and technology, educational institutions such as IITs and IIMs for producing high level skilled personnel, national laboratories and scientific agencies. Due

to this thrust the country was able to lay the foundation of the atomic energy programme, the space programme and enable the setting up of the large chain of laboratories under the Council for Scientific and industrial Research.

After this period while India continued to demonstrate innovation, it was often sporadic and in different sectors as opposed to a national thrust. The Green Revolution lead by M.S. Swaminathan enabled us to be self sufficient in food grain production, the White Revolution engineered by Dr. Verghese Kurien unleashed the dairy potential and made India the largest milk producer in the world, the country built one of the largest irrigation networks in the world, an impressive space programme, and made the big leap in innovation in the telecom and IT sector which allowed it to leapfrog the western development models. Despite these achievements, post-Independence our innovative breakthroughs lagged behind countries such as the US, which embarked on a period of science-based innovation to produce products such as transistors, lasers and semiconductors.

Innovation Landmarks: The Green Revolution

There have been landmark innovations in the country such as the Green Revolution where application of modern technology, introduction of high-yielding varieties of seeds, increased use of fertilizers, development and expansion of irrigation systems, and extension of credit and educational services to farmers revolutionized production and generated food security. While R&D was central, the Green Revolution was also ushered by the collective work of the scientists, extension functionaries, policy makers, the political system and above all the farmers. However, such initiatives have not been consistently visible in the development paradigm of the country. This was a team effort spearheaded by C. Subramanian, Norman Borlaug, B.P. Pal and M.S. Swaminathan. These visionaries were focused not just on enhanced food production, which was the immediate need, but attention to the resource base which would sustain it, including biodiversity, genetic resources and soil.

The White Revolution: 'Operation Flood'

India today is the world's leading producer of milk producing about 104.8 million tonnes of milk (2007-08). The groundwork for this was laid by 'Operation Flood', a massive dairy development programme launched by the National Dairy Development Board in 1970 under the chairmanship of Dr. Varghese Kurien. The aim of the programme was increasing milk production, augmenting rural incomes and transferring profits to milk producers. The core institutional innovation that enabled this was linking of rural small producers with urban consumers through producers' cooperatives by creating a National Milk Grid. This reduced seasonal and regional price variations and ensured fair market prices for the producer by eliminating middlemen. Completed in three phases, Operation Flood followed the green revolution and transformed India into the largest producer of milk and contributed significantly to the country's growth trajectory.

Transforming Telecom: The PCO Revolution

The foundations for the telecom revolution in India were laid by Sam Pitroda when he convinced the political leadership in India to set up the Centre for Development of Telematics or C-DoT, an autonomous entity to develop cutting edge technology suited to Indian needs. The focus was on improving access to telephony vs. density and the mandate was to create in a time period of 36 months a digital switching system suited to the Indian network. The culture of innovation did not confine itself to products but also processes. The C-DoT work environment was non-hierarchical, team-based and talent driven, with the right political backing. After three years, C-DoT delivered a 128-line rural exchange, 128-line private automatic branch exchange for businesses and a central exchange with a capacity of 512 lines, along with capacity for field testing of a 10,000-line exchange. The result was an indigenous solution in the form of the ubiquitous yellow PCOs which connected the remotest parts of the country to the big centres. More than this, the C-DoT experiment created a critical mass of engineers focused on developing indigenous solutions but based on international standards.

New Frontiers: India's Space Programme

India's achievements in the space sector are considerable considering it started its space programme only four decades ago with no institutional infrastructure to support the programme. From the beginning, the innovation culture in the space programme has been geared towards harnessing space technology for national development tasks. This was evident in the Satellite Instructional Television experiment (SITE), under which a series of educational programmes on health, family planning, and agriculture were telecast to over 2,500 Indian villages during 1975-76.

From launching the first Indian satellite 'Aryabhata' in 1975, the Indian Space programme spearheaded by the Indian Space Research organisation (ISRO) under the Department of Space has come a long way. Today ISRO has established two major space systems, INSAT for communication, television broadcasting and meteorological services, and Indian Remote Sensing Satellites (IRS) system for resources monitoring and management. ISRO has also developed two satellite launch vehicles, PSLV and GSLV, to place INSAT and IRS satellites in the required orbits. India's satellites, whether for remote sensing or for telecommunications, broadcasting and meteorology have performed at contemporary international standards.

Further, India's Space Missions have enabled it to build its capability in areas like astronomy, astrophysics, planetary and earth sciences, atmospheric sciences and theoretical physics. Balloons, sounding rockets, space platforms and ground-based facilities support these research efforts. In 2008 the country's space programme achieved new heights when the PSLV-CII successfully launched Chandrayaan -1, India's first mission to the moon which placed a Moon Impact Probe on the moon's surface. The unmanned lunar spacecraft made a significant contribution by detecting evidence of water across the lunar surface.

While the country has managed to craft a localised development model in telecom and IT, and made leaps in the above mentioned areas, these initiatives have remained exceptions, rather than the rule, premised on by-passes in the system and individual champions. Our innovation trajectory has been skewed and overall has been influenced by a blind desire to ape western models instead of disruptive innovations focused on Indian needs or a creative pursuit of knowledge, as was the case historically. Recent events such as the financial crisis in the west, and the collapse of the consumption based model of the US have exposed the shortcomings of the western developmental strategy in the current scenario. This is an opportune time to re-think the Indian innovation paradigm to enable it to address the

fundamental disparities and inequalities in the country. There is a need for an innovation strategy focused on providing sustainable, quality solutions for urgent challenges such as health, education, water, agriculture, livelihood and energy etc. This will require sparking the latent innovative capacity in the system and a development agenda based on inclusion.

Most discussions on innovation around the world have focused on improving efficiency and productivity in businesses, to stay ahead of the competition curve. However, nearly half the world's population lives in acute poverty. Worldwide, over four billion people form the 'bottom of the economic pyramid' (BoP), a term coined to represent those earning less than $2 per day ($1500 per person/year in local purchasing power). Especially, in a country such as India, the innovation system cannot be discussed only in terms of improving competitive advantage. In India where a large percentage of people have limited access to basic services such as food, water, housing, health and education, innovation can be a critical tool to solve challenges and create sustainable growth.

Our innovation paradigm has to extend beyond products and patents and focus on inclusive innovation for/of and by the people at the bottom of the pyramid. Innovation has to play a role not only in finding affordable, quality services and products for people at the bottom of the pyramid, but also mechanisms and platforms have to be created to scale grassroots innovations to generate sustainable livelihood and employment. Challenges such as lack of housing, healthcare, education will require innovations in processes, service delivery, design thinking and human capital as well as stronger institutional infrastructure. The biggest incentive is that the solutions developed for the poor Indians would be applicable for the 4 billion poor people worldwide. The role of user driven innovations or grassroots innovations will require understanding cultural and spatial roots of creativity in Indian society.

In this context India needs an innovation strategy geared towards creating an 'Indian model of development'. India needs more 'frugal, distributed, affordable, diverse, and malleable innovation' that produces more 'frugal cost' products and services that are affordable by people at low levels of incomes without compromising the safety, efficiency, and utility of the products. The country also needs innovation processes that are 'frugal' in terms of resources required and these products and services must also have a 'frugal' impact on the earth's resources and must be designed to be environmentally sustainable[3]. Innovations in India hence need to cast a wider net to benefit more and more people who are currently marginalised by the system.

[3] Ibid

From '*Jugaad*' to Frugal Engineering

India already has a tradition of improvisational innovation or 'jugaad' which is driven by scarce resources and customers' needs as opposed to wants. However, this informal and improvisational tinkering has to be scaled to a system based on frugal engineering geared towards Indian needs and challenges. It is this mindset and innovation agenda, premised on affordability and scale, that needs to be developed in order to have a visible impact. Such a mindset would drive disruptive innovations in sectors such as health, education, housing etc. and address the needs of the poorer segments. This kind of frugal innovation is evident in Nano, a $2000 car made in India, or the cheap ECG devices developed by Mindray in China. It is not just about re-designing products, but re-thinking processes and business models.

Innovations within the government driven by a Rights-based approach such as MGNREGA, The Right to Information Act, The Right to Education Act, etc. have given an impetus to inclusion, but much more needs to be done. Currently there is no national level strategy on Innovation focused on inclusive growth. Initiatives at the CSIR labs, which have developed technology applications for rural India are not sufficiently scaled up or commercialised. India's public research system has huge capacity to address the needs and problems of the poor, but remains underutilised in this area. The university system in India which has the critical mass of scientists and engineering PhDs is unable to use its intellectual capital adequately to solve the problems of the common people. Except the IITs and the Indian Institute of Science, the R&D record of universities has remained poor. Further, initiatives developed in academic institutions are not provided adequate infrastructure in terms of dissemination and funding for scaling. Grassroots innovation networks such as Honey Bee Network, SRISTI also need to be provided platforms for scaling up. Many of these inventors do not have a formal education and exemplify innovation that springs from frugal resources.

Table 2: Grassroots Innovations: Activities and Actors

Activities	Government	Non Government	Private
Documenting and disseminating information	National Innovation Foundation (NIF) Department of Science and Technology (DST) CSIR's Traditional Knowledge Digital Library (TKDL) Ayurveda Yoga Naturopathy Unani Siddha and Homeopathy (AYUSH) Grassroots Innovation Augmentation Network (GIAN)	Honey Bee Network (HBN) Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) Foundation for Revitalization of Local Health Traditions (FRLHT) Community Biodiversity Registers (CBRs) Kalpavriksh Gene Campaign Beej Bachao Andolan Anthra	Publications Eenadu's Annadata Adike Patrike; Malayalam Panorama Baliraja Prakurthi
Resource conservation		FRLHT CBRs Beej Bachao Andolan	
Value addition and experimentation	DST's Technology Information, Forecasting, and Assessment Council (TIFAC) CSIR NIF GIAN	SRISTI Rural Innovation Network (RIN) Magan Sangrahalaya Centre for Innovation, Incubation and Entrepreneurship (CIIE) at IIM-Ahmadabad	
Commercialization	CSIR NIF GIAN	SRISTI GIAN	Aavishkaar
Dissemination	NIF	HBN and network collaborators SRISTI Centre of Science for Villages (CSV)	

Activities	Government	Non Government	Private
Finance	DSIR Techno-entrepreneurs Promotion Programme (TePP) DST Science and Society Programme	SRISTI RIN NIF GIAN	Aavishkaar
Intellectual property rights protection programmes and services	NIF	SRISTI	
Source: Mathur and Sinha 2006			

Further, private sector has to be harnessed in this endeavour as well. Efforts to develop products that meet the needs of the poor and underserved – while also creating viable business propositions – need to be pursued more systematically[4]. As argued by Prahalad, large companies can use their considerable technological, organizational and marketing capabilities to create and deliver products and services for people at the bottom of the economic pyramid – those with incomes of less than $2 a day – and make a profit doing so[5]. Low cost eye and heart surgeries, low cost phone services, and Nano, are examples of high quality products and services that are low in costs and hence affordable. Prahalad and Mashelkar in their recent paper in Harvard Business review entitled 'Innovation's Holy Grail'[6] have shown how companies in India have achieved this by disrupting business models, modifying organisational capabilities and creating and sourcing new capabilities.

The World Resources Institute identifies the following business strategies for the BoP[7]:

- Focus on the BoP with unique products, services or technologies that are appropriate to BoP needs and require completely re-imagining the business.

[4] 'Unleashing India's Innovation Potential: Towards Sustainable and Inclusive Growth', M. Dutz, Editor, 2007

[5] 'The Fortune at the Bottom of the Pyramid', C K Prahalad, 2004

[6] C.K. Prahalad and R.A. Mashelkar, Harvard Business Review, July-August 2010

[7] Engineering Solutions for the base of the Pyramid, ASME, 2009

- Localise value creation through franchising, agent strategies that involve building local eco-systems of vendors or suppliers, or by treating the community as the customer.
- Enable access to goods and services – financially (through single use or other packaging strategies that lower purchase barriers) or physically (through novel distribution strategies or deployment of low cost technologies).
- Foster unconventional partnerships with governments, NGOs or groups of multiple stakeholders to bring the necessary capabilities to the table.

Emerging markets such as India are uniquely poised to drive disruptive innovations across sectors to meet the needs of their populations, especially people at the base of the pyramid. In fact, emerging markets are prompting a re-think on the very nature of innovation. People in the West equate it with technological breakthroughs leading to new products taken up by the elites, which eventually trickle down to the masses. But in these new markets incremental improvements to products and processes as well as breakthrough innovations are catering to the middle or the bottom of the economic pyramid[8]. They offer smarter ways of designing products and organising processes to reach the billions of consumers who are just entering the global market from cheap mobile handsets, to mobile money and hand-held ECGs.

Designing Solutions: Embrace Incubator

Originally designed by students in Stanford's Design for Extreme Affordability class, the Embrace incubator is designed to work in a rural healthcare centre or at home. It's portable, uses no electricity and has no moving parts. The sleeping bag like design incorporates a phase change materials to regulate a premature or low birth weight baby's temperature. The device works for over four hours at a stretch without intervention, after which it can be re-heated. It is easy to sterilize, and thus reusable across babies. Embrace will sell for $25 in India later this year.

Affordable Healthcare: *Narayana Hrudayalaya*

In India, Dr Devi Shetty is driving innovation in healthcare by applying mass-production techniques and Henry Ford's management techniques. His Narayana Hrudayalaya Hospital in Bangalore has 1,000 beds, and his team of

[8] 'The world turned upside down', A special report on innovation in emerging markets, The Economist, 17th April 2010

40 cardiologists perform around 600 operations per week.
The sheer number of patients not only allows the surgeons to acquire world-class expertise in specialised operations, but also brings down the cost of surgery. The hospital charges an average of $2000 for open-heart surgery, compared with $20,000-100,000 in America, with excellent success rates. Dr. Shetty has now expanded the scope of work by developing 'clinics on wheels' which are sent to nearby rural hospitals to test for heart disease, and has created a health insurance scheme with local self-help groups which charges a premium of 11 cents a month.

The Government has an important role to play in promoting inclusive innovation by creating the right systems for driving innovation focused on the needs of the bottom of the pyramid and by promoting, diffusing and scaling grassroots innovations. Systems have to be developed for value assessment, effective commercialisation, financing, incentivising and pro poor IPR.

The Department of S&T in the Ministry of S&T is the central body that deals with the promotion of S&T and Innovation. But, apart from this department, the Department of Scientific & Industrial Research (DSIR) was created in 1985, with a mandate to oversee indigenous technology promotion, development and transfer. DSIR is also responsible for coordinating the activities of the Council of Scientific and Industrial Research (CSIR) and two public enterprises, namely National Research Development Corporation (NRDC) and Central Electronics Limited (CEL). The NRDC provides consulting service to academia and industry for the protection of their IPRs and the transfer of technologies. The Technology Development and Demonstration Programme (TDDP) of DSIR aims at supporting activities related to technology absorption, adaptation and demonstration, including capital goods development, by involving industry and R&D organizations. Under the programme, innovative technologies are scaled from the proof of concept stage to the pilot plant/pre-commercial stage by the industry. The projects involve research, design, development and engineering and are executed by industry, overseen by experts from university/laboratory.

Currently there are several Government initiatives to promote Innovations. Notable amongst these are the NMITLI (New Millennium India Technology Leadership Initiative), TePP (Techno-Entrepreneurs Promotion Programme), the National Innovation Foundation, TDB (Technology Development Board), HGT (Home Grown Technology Programme), TDDP (Technology Development and Demonstration Programme), GIAN (the Grassroots Innovation Augmentation Network) and SBIRI (the Small Business Innovation Research Initiative) etc.

However, these schemes are fragmented, supervised by different government agencies and operate on a limited scale and have a limited impact. Also, most of the schemes such as SBIRI, HGT are focused on innovation by industry and

the support mechanisms for funding focused on creating products and services for the BOP and for scaling grassroots innovations are limited.

The Government can do much more by playing a more enabling role in creating an innovation eco-system to respond to the challenges of the 21st century, with a focus on inclusive growth. Building a strategy for inclusive innovation will require thinking in areas of knowledge creation and commercialisation, knowledge diffusion and absorption, skills and education, re-engineering processes and delivery, information infrastructure needs, human resource strategy within the government, and innovation finance.

Indian IPR Landmarks

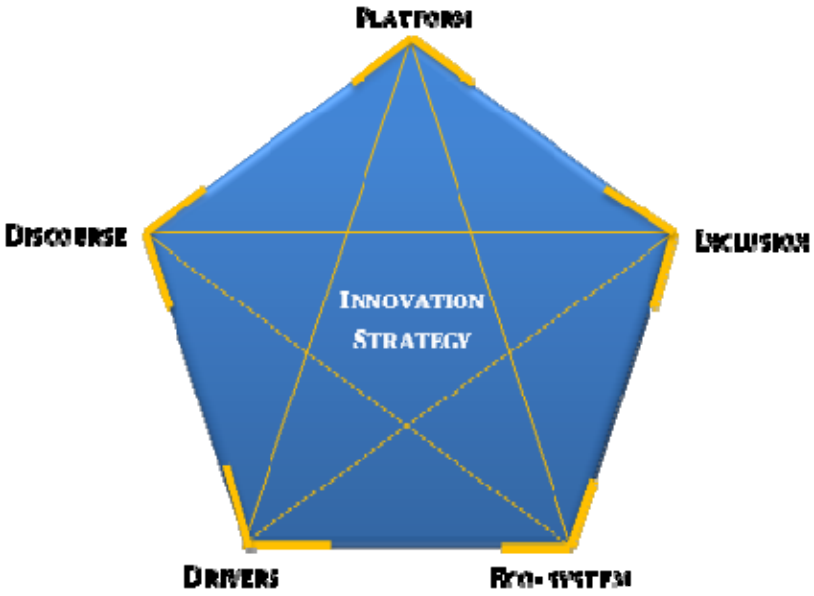
The Patents Act of 1970 offered only a process patent for food, medicine or drug substances and specifically excluded product patents for the same. The Patents Act, 1970 was amended for a second time in 1999, and again in 2002 and 2005. The Patent (Third Amendment) Act, 2005, extended product patents to products from all industry sectors, including pharmaceuticals. It also set the term of patent protection to 20 years to meet the TRIPS deadline for January 1, 2005. This closed the option of reverse engineering that largely contributed to the growth of the Indian pharmaceutical industry.

Now the Government has proposed The Protection and Utilisation of Public Funded Intellectual Property Bill 2008 which provides for the protection and utilisation of intellectual property originating from public-funded research. At present, universities and autonomous research institutions that are government funded cannot commercialise the fruits of their research. The Bill would alter the existing IP rules by allowing academic institutions, rather than the government, to patent publicly funded research, and would reward institutions and inventors with a share of the royalties and licensing fees generated from the commercial products that result.

STRATEGY: TOWARDS INCLUSIVE INNOVATION

With the Government declaring 2010 as a Decade of Innovation, there is a need to create a roadmap for innovation for the country. The Office of Adviser to the Prime Minister on Public Information Infrastructure and Innovations will take the lead in creating such a roadmap, but with a focus on inclusive innovation, keeping in mind the unique needs of India and its challenges of demography, disparity and development.

To create a comprehensive strategy, innovation will be addressed through a focus on:



1. Platform

A broader platform for innovations implies that it can re-define innovation to mean new and unique applications of old technologies, using design to develop new products and services, new processes and structures to improve performance in diverse areas, organisational creativity, and public sector initiatives to enhance delivery of services. These widespread innovations in products, services, processes and across verticals collectively create a strong and robust innovation society. Innovation should be ***widely distributed*** over the whole spectrum of economic activity, that is, across sectors (not just "high tech"),

and types of innovations (not just formal R&D projects). A broader platform for innovations will include

- Products
- Services
- Organisations & Innovations
- Processes
- Research and Development
- Science & Technology
- Governance
- Social and Cultural
- Mindset
- National/ State/ Sectoral Councils

Focus would especially be on creating policies at the Government level which can have a cascade effect on the innovation economy by facilitating innovations at the right points, as well as easing service delivery. Such disruptive innovations in public policy would analyse process re-engineering for service delivery, accountability initiatives, and the HR strategy of the Government.

2. Inclusion

India has unique needs and challenges. On the one hand the country's GDP is growing at an average of 8-9 % per year, and on the other hand there are 300 million people living below the poverty line with insufficient access to services such as food, health, education for a substantial section of the population. This inequality is likely to worsen unless special efforts are made to address the problems of the bottom of the pyramid. To bridge this divide our innovation strategies need to generate inclusive growth and sustainable and quality solutions for the bottom of the pyramid.

The core of our strategy will focus on using innovation as a tool to eliminate disparity and meet the needs of the many in the best possible manner. As discussed earlier, India needs more 'frugal innovation' that produces more 'frugal cost' products and services that are affordable by people at low levels of incomes without compromising the safety, efficiency, and utility of the products. Further, efforts have to be undertaken to scale grassroots innovations to create sustainable livelihoods and ignite innovative capabilities. The innovative abilities of people at low income groups are constrained by insufficiently developed skills, inadequate public services, and an inability to access markets and assets on fair terms and handle associated

risks[9]. The focus on innovation aimed at inclusive growth can enable India to be a rich source of solutions for developing nations across the globe.

This focus on Inclusive innovations will require:

- Awareness
- Access
- Affordability
- Availability
- Scalability
- Sustainability
- Quality
- Pervasive Growth
- Innovations for/by the people
- Innovations for the Bottom of the Pyramid

3. Eco-system

A strong innovation eco-system is critical for creating an innovation society. An innovative eco-system must facilitate the birth of new ideas and also provide platforms for the successful exploitation of these ideas. It is a dynamic system shaped by the interactions within and across multiple players such as Government, firms, schools/education and research institutions, finance, individual innovators, customers/users, NGOs and media. This horizontal layer interacts with and influences the innovation activity across verticals such as health, education, urban sustainability etc. Understanding the innovation eco-system is important to capture the knowledge flows within an economy, identify gaps, and propose policies and practices that can overcome these constraints. India's innovation eco-system must be challenged and inspired to respond to aspirational goals that will enable the country to meet its inclusive and ecologically sustainable growth agenda[10]. For instance with 550 million below the age of 25 there are huge demands on the education system to provide quality education to a large percentage of population if we are to ensure our demographic dividend does

[9] 'Unleashing India's Innovation Potential: Towards Sustainable and Inclusive Growth', M. Dutz, Editor, 2007

[10] 'Inclusive and Frugal Innovation, Stimulating the Innovation Eco-system', A. Maira, 2010

not become a liability. But, currently quality supply of education lags far behind demand. Bridging this gap will require innovative thinking in pedagogy, education delivery, using technology for teacher training to bring about a paradigm shift in the education sector, and all this in turn will require challenging the eco-system. Stimulating the innovation eco-system will require thinking on:

- Incentives & Awards
- Innovation Clusters at Universities
- Innovative Business Clusters
- Innovation in MSMEs
- Organisational autonomy & flexibility
- Policies & Programmes
- New Institutions & Infrastructure
- Risk/ Venture Capital
- IPR/ Patents
- Web & ICT tools

4. Drivers

To successfully carve out an innovation strategy that benefits the needs and challenges of the Indian system it has to be driven by some key ideas and goals. It should be multidisciplinary and collaborative to meet the needs of the new information and knowledge economy which is increasingly expanding the actors involved in innovation within and across national boundaries. The innovation strategy should be driven by a focus on Generational Change vs. Incremental Change to create a paradigm shift in innovation capacity and delivery; it should be based on the premise of supporting durability as opposed to disposability to make the most frugal use of resources; it should sufficiently address the needs vs. demand dichotomy, especially the needs of people at the bottom of the pyramid and not just demand for high-tech products by industry and business. The innovation strategy should also focus on creating environmentally sustainable solutions that view nature as a source of nurture and not as an inexhaustible resource to be used indiscriminately. The innovation strategy should also focus on creating locally relevant solutions, but which are globally competitive and use global resources as well. This requires new ways of thinking about innovation, where global resources can be employed to satisfy the needs of one. Finally, attention must be given to the edge of economic activity where most of the breakthrough innovations are generated as opposed to the core. So, to

summarise, the key drivers of the innovation strategy are:

- Multidisciplinary
- Collaborative
- Disruptive
- Generational Change vs. Incremental Change
- Durability vs. Disposability
- Need vs. Demand
- Nature as Nurture
- Locally Relevant
- Globally Connected & Competitive
- Focus at the Edge

5. Discourse

Lastly, our Innovation strategy will aim to expand the discourse of innovation to give room to alternative dialogue, which often creates bypasses in the system to improve the current way of doing things. The aim is to involve many divergent voices, views, mode of doing things to impact the end result qualitatively and quantitatively. The room for divergent discourse is especially critical in Government and organisational processes. There will be an effort to expand the space for discourse on innovations through:

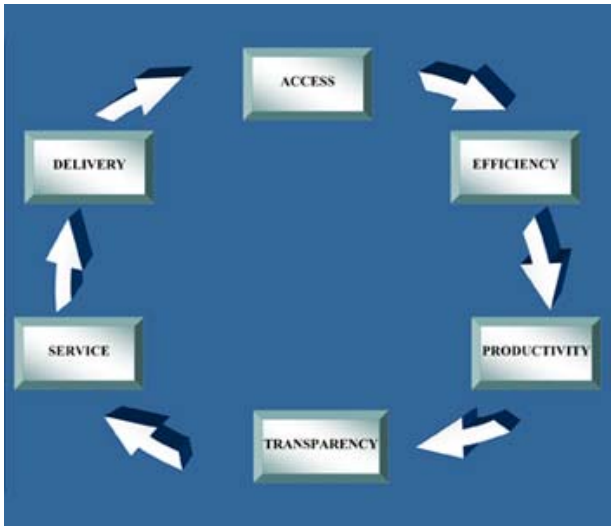
- Discussions
- Debates
- Seminars
- Conferences
- Best Practices
- Alternative Dialogue
- Re-thinking
- New Ideas
- Media
- Innovation Portal

The five-pronged focus outlined above will foster innovations by:

- **Democratising Information**
- **Identifying and empowering domain experts at National, State & District levels**
- **Ensuring institutional autonomy, freedom, flexibility, accountability and transparency**
- **Increasing community and public participation at all levels through consultative exercises**
- **Improving Governance & Planning**

Role of Technology

The use of technology will be critical in our innovation strategy. It enables something to be done in a completely novel way and impacts diverse areas such as science, health, agriculture, education and creative industries. It is also a critical tool for problem solving when there are multiple demands on the system, and it is also an entry point to increase:



To spur the innovation eco-system to meet the challenges of inclusive growth and development, the Office of Adviser will look at the following accelerators or initiatives:

1. Innovation Councils

The aim is to create a framework, at a national level and at regional and sectoral levels, where activities to support innovation are focused on devising strategies for inclusive growth, developing co-operation between the different actors involved, are geared towards the needs of different places, spatial levels and sectors, with mechanisms for coordination across administrative boundaries and measuring impact. This includes a roadmap for inclusive innovation at national, regional and sectoral levels.

To prepare a Roadmap for Inclusive Innovation for the decade 2010 -2020 the Office of Adviser will create a National Innovation Council (NIC), State Innovation Councils (SIC) and Sectoral Innovation Councils. This cross-cutting system will provide mutually reinforcing policies and recommendations to boost innovation performance in the country.

The National Innovation Council will create a framework for

- Evolving an Indian model of innovation with focus on Inclusive growth
- Delineating policy initiatives within the Government, required to spur innovation
- Developing and championing innovation attitudes and approaches
- Creating appropriate eco-systems and environment to foster inclusive innovation
- Exploring new strategies and alternatives for innovations & collaborations
- Identifying ways and means to scale and sustain innovations
- Encouraging central and State Governments to innovate
- Encouraging universities and R&D institutions to innovate
- Facilitating innovations by SMEs
- Encouraging all important sectors of the economy to innovate
- Encouraging innovation in public service delivery
- Encouraging multidisciplinary and globally competitive approaches for innovations

The Council will also take the lead in coordinating innovation efforts across platforms through helping various State level and Sectoral Innovation Councils. NIC will provide the core framework under which the state and sectoral councils will operate and devise strategies for innovation and there will also be platforms for coordination and linkages of the varied Councils with the National Council. The Members of the Council will be chosen by the Adviser from eminent people in the field to represent a wide cross-section.

The State Innovation Councils (SIC) will deliver NIC's mandate at the state level. They will:

- Collaborate with the State Government to innovate
- Encourage local Universities, Colleges, SMEs, R&D institutions
- Provide SWOT analysis of the innovation in the State
- Identify, promote & reward talent & success stories
- Organise seminars, lectures, workshops to create awareness
- Help build innovation eco-system in the State
- Organise Risk capital
- Prepare Innovation Roadmap 2010-2020 for the state

Lastly, the Sectoral Councils will Create Innovation strategies for each sector. They will also provide a framework of functioning and standards for scalability in the sector.

The key verticals will be:

• Health	• ICT
• Education	• Biotech
• Energy	• Nanotech
• Food	• Genetics
• Environment	• Materials
• Water	• Space
• Sanitation	• Ocean
• Transport	• Defense
• Commerce	• Creative Industries
• Manufacturing	• Design
• Products	• Organization
• Public Services	• Government

After due deliberations and interactions, recommendations and Working Group Reports will be submitted to the Prime Minister.

The success of this process will require coordination among various stakeholders such as Government Ministries, the Planning Commission, the

Scientific Advisory Council of the Prime Minister, PMO, NIC, State governments, academic and research community, industry organisations, grassroots organisations, think tanks, and multilateral agencies.

2. Inclusive Innovation Fund

In order to create a platform for encouraging commercialisation efforts that focus on solutions aimed at generating inclusive growth, we propose to establish a Rs. 5000 crore (US $1 Billion) Inclusive Innovation Fund. This Fund will be structured as a 'Fund of Funds' with seed capital leveraged from the Government and built up by investment from the private and public sector enterprises and banks as well as by challenging VCs to raise money. This fund will encourage VCs and angel investors to support efforts for designing solutions for people at the bottom of the pyramid with a focus on livelihood opportunities, skills and sustainable services. The Fund will not be restricted to Technology leading to IPR (patents, commercial rights) but would include breakthrough initiatives in Health, Education, Environment, capacity building, infrastructure etc. The Fund will identify and Focus on 'Pockets of Innovation' across the country and will cater to small and medium-sized companies as opposed to big business. Investment approvals will be granted based on norms and process guidelines framed by the Fund with a transparent eligibility and evaluation criteria, and a focus on social returns being reflected in investment decisions. The Fund is crucial as the country has the availability of a relatively large population of potential problem solvers and this will provide them with the right confidence and backing.

Existing funding options, especially made available by the Government are not sufficient, and the schemes are fragmented and hence can only have limited impact, while a large fund is required to do many projects given the potential scale of Indian Innovation efforts and also to provide the right incentive structure.

International experiences show that Government push is crucial for developing the venture capital market. Israel's Yozma programme invested in 10 venture capital funds, along with private players. Shortly after its establishment, the funds created by Yozma helped raise close to $200 million. Yozma also had an exit strategy at inception and its success allowed it to terminate its activities early on. Since then the venture capital market in Israel has boomed.

In December 2008 Ireland announced a 500 million euro 'innovation fund' designed to attract co-financing from foreign venture capitalists. Like Yozma, the Irish fund aims to lure foreign VCs through a series of state backed venture capital funds that partner up with private sector funds.

In 2009 the UK Government announced a Venture Capital Fund of £150

million ($246 million) as a 'Fund of Funds' to kick start British technology investment and the ailing business sector. The Fund would start with an initial investment of 150 million pounds from the Government and £175 from the private sectors. The UK Innovation Investment Fund (UKIIF) will operate through two Fund of Funds structures, which means that it will not invest directly in companies, but rather in a small number of specialist technology funds that have the expertise and track record to invest directly in companies with high growth potential. The aim is to create a £ billion Fund with a life of 12-15 years.

Venture Funds are recognized globally as the most suitable form of providing risk capital for the growth of innovative technology and breakthrough ideas. Venture capital is an important source of equity for start-up companies. Traditionally, venture capital in India was an extension of the developmental financial institutions like IDBI, ICICI, SIDBI and State Finance Corporations (SFCs). The first origins of modern Venture Capital in India can be traced to the setting up of a Technology Development Fund (TDF) in the year 1987-88, through the levy of a cess on all technology import payments. TDF was meant to provide financial assistance to innovative and high-risk technological programmes. In 1988, Technical Development and Information Corporation of India (TDICI) (now ICICI Venture) and Gujarat Venture Fund Limited (GVFL) were formed[11]. The mid 90s saw the entry of Foreign Venture Capital Funds (FVCFs) and post the success of these funds there has been an emergence of a number of India-centric FVCFs. There is almost a complete lack of seed stage Venture funding for the technology sector and early stage funding through Government institutions is loan or grant oriented with no mentoring. There is no special focus on specific technologies and disbursement procedures are cumbersome. There is also no large scale funding for innovation initiatives focused on producing socially useful outcomes for the poorer people and for scaling grassroots efforts. In this context, the Inclusive innovation Fund will be a critical driver of new solutions in challenging areas.

3. Innovation Clusters

Creating hot spots or clusters of innovation will be critical to drive growth and development. The spark behind innovation is inherently regional – where research, business, risk capital and creativity come together to turn ideas into products, processes and services. Driving the innovation agenda nationally would require strengthening the regional capacity for innovation. Consequently it is proposed to identify 20 innovation clusters across the country to develop and support innovation, especially inclusive innovation.

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[11] 'Indian Innovation System: Perspective and Challenges', Technology Exports, A Gupta and P K Dutta, 2005

These will enable the interconnections that link intellectual, financial, human and creative capital as well as unleash underutilized capital. This requires an Innovation Roadmap that focuses federal and state, public and private funding on creating and sustaining regional anchors throughout the innovation economy.

Innovation clusters create institutions that foster knowledge transfer, collaboration and support for start-ups. They combine and accelerate the deployment of key elements of the innovation eco-system by[12]:

- building on cutting-edge, multidisciplinary research
- providing the training ground for next-generation innovators
- creating a crossroads between researchers and businesses
- linking innovators with early-stage funding, both public and private, and with experienced innovation mentors

Various actors can be brought together not just at physical clusters but also virtual ones. The Open source innovation model allows co-creation and is increasingly being applied to policy making, education and collaboration-based work platforms. The Open Innovation model being developed by Professor Brahmachari at CSIR is working on developing a new affordable tuberculosis drug in a global collaborative effort using an open source approach. This allows the use of global resources to co-create solutions for the needs of one (in this case people at the bottom of the pyramid).

Strategies for regional enhancement through creation of collaborative enterprises and clusters are being discussed by Governments across the world. The United Kingdom is applying this through the creation Regional Development Agencies (RDAs) to deliver tailored business support products at a regional level.

The U.S. Department of Commerce's Economic Development Administration (EDA) funds a number of EDA University Centres designed to promote linkages among higher education institutions and local economic development and business organizations. New York and California have created centres of excellence that combine public and private funding for emerging technology areas. In the Greater Rochester, NY, area, leading private-sector firms and higher education institutions, along with national, state and local funders, have created the Infotonics Technology Centre, an institution that supports applied research in local IT and optics firms. And,

[12] 'Innovate America', 2004, National Innovation Initiative Final Report

above all, the US has been home to the most successful business cluster in the form of Silicon Valley.

Successful clusters promote intense competition along with co-operation. The intense competition between Microsoft and Apple and now between Google and Apple has been known to drive record innovation in a very short time. Clusters can enhance productivity, attract investment, promote research, strengthen the industrial base, and develop specific products or services, and become a focus for developing skills and for 'brain gain'. Further clusters can also have spillover effects which can contribute to innovative capacity.

4. National Innovation Portal

There are many examples of successful innovations and several organisations are collecting examples of innovations. This includes various Government Ministries, NGOs and academic institutions. SRISTI, an NGO, through the Honey Bee Network is documenting grassroots innovations and over 100,000 grassroots innovations are available in the database. SRISTI has also developed www.Techpedia.in as a resource for student projects. The Ministry of Urban Development has developed an Indian Urban Space Foundation in partnership with an NGO to focus on innovations in urban planning (http://www.indiausp.org/). IIT Delhi has also partnered to create an open innovation portal to link industry, innovators and academia (http://www.fitt-iitd.org). There are many such efforts, but there is lack of awareness and access about these efforts among the concerned stakeholders. In this context there is a need to create an India Innovation Portal which would galvanise information related to innovations and innovators in a single repository as well as act as a platform for idea exchange. Such a portal could include a database on innovations and innovators which is made accessible to the prospective innovators and policy makers as well as lead to cross-fertilization of ideas and knowledge flows. It could also act as a platform for developing industry-academia partnerships as well for facilitating national and global collaborations. It could also act as a directory for all events related to innovations, disseminate information on innovations across sectors such as education, health, energy, urbanisation, infrastructure and public service delivery and in states, trace and facilitate virtual innovation clusters, support open innovation and incentivise innovations by publicising awards and available schemes. Similar portals on core sectors such as water, energy, environment, biodiversity have been successfully facilitated by the National Knowledge Commission.

5. Multiple Roadmaps

The core ideas, strategies and recommendations devised at the national, state and sectoral levels will be crystalised in the form of Roadmaps. These Roadmaps will be the guiding pointers and will provide action points and

policy inputs to the government for innovation focused on inclusive growth at the national level, state levels and in each identified sector. Apart from this, the roadmaps will delineate interventions to spur innovation in each sector and in other domains of the innovation eco-system including education, firms, finance etc. These roadmaps will be created at the national level by the National Innovation Council, at the state level by the State councils and in each sector by the Sectoral councils or sub groups identified by the Sectoral councils.

6. Innovation Eco-system

Innovation does not happen in a vacuum but is the result of a complex interplay of dynamics among various players such as Government, Firms, Schools/ Education and Research Institutions, Finance, Individual Innovators (Education policy at Schools), Customers/users, NGOs/ grassroots organizations, and Media. The policies and activities in these domains, as well as the interaction among these players influence the innovation eco-system. Another layer of the eco-system is the activities of the various verticals such as health, education, agriculture, urban sustainability and the interplay between these verticals and the key players. The Office of Adviser can act as a facilitator for stimulating the innovation eco-system. An understanding of the eco-system is crucial to map knowledge flows, identify the gaps in the system and design specific policies and initiatives to stimulate the system. A crucial aspect of stimulating the innovation culture would involve delineating policies at the Government level to spur innovation, identifying and reducing current problem spots and inefficiencies, and providing due incentives. This will also include fostering innovation in public service through designing better delivery systems for citizens, a more competent HR strategy that captures talent within the government system, and organizational and process changes. These ideas would be captured and disseminated through the National Innovation Portal. Such initiatives would also be undertaken in other key domains of the innovation eco-system. A detailed discussion on the eco-system is presented in the next section.

7. Collaboration, Training & Support

All the above-mentioned initiatives would provide the right mechanisms for collaboration, training and support to drive innovation. The Councils will bring key stakeholders together to analyse problems and recommend solutions, the clusters -- physical and virtual -- will create support systems and infrastructure for innovators, the Innovation Fund would provide the right resources and incentives, the Innovation Portal would provide a platform for collaboration, sharing and support by creating right synergies whether with financial institutions or between industry and academia. These linkages, knowledge exchanges and support mechanisms in the system will

enable ideas to be transformed into innovative outputs.

8. Focus on Core Competencies

The Office of Adviser would also focus on driving innovations in key sectors where India has a competitive edge to further strengthen the benefits and value in these sectors. Strategies and policies would be recommended to further spur innovations in high growth sectors such as biotechnology, pharmaceuticals, automotive components, textiles, finance, Information Technology, software, and IT enabled services (ITES).

9. Awards and Competitions

The Office of Adviser will also facilitate an incentive structure to promote innovations by instituting national/state/district awards and competitions. These awards and competitions will be focused on providing incentives for specific innovations rather than rewarding excellence in general. These specific innovations would be selected on parameters defined by the National Innovation Council, with the primary focus being on inclusive innovation, and driven by current needs and challenges whether in energy, urban sustainability, environment, public service delivery etc. Further such awards should go beyond rewarding S&T and extend to arts, humanities, the creative space and grassroots organisations. They should also acknowledge the impact of services and creative industry. Such awards and competitions will provide a platform to leverage the large population of problem solvers that we have in the country but who do not have access to the right channels. Awards and contest in the innovation sphere are increasingly igniting young minds and organisations the world over to engineer cutting edge solutions whether it is the Marico Innovation awards, and the NIF awards in India, or DARPA and the X Prize Foundation in the US. Recently, the District of Columbia in the US initiated an 'Apps for Democracy' contest challenging citizens, NGOs and private sector to develop new software applications to make the government data more accessible and useful for both public and government. These competitions not only enable us to draw from the latent talent in public but also create a sort of innovation laboratory in the public space which can be translated into concrete policy initiatives.

10. Outreach

Outreach activities will be critical in conveying our message to the public and also in involving various stakeholders to spur innovation efforts across the country. This will include national and regional meetings with stakeholders, conferences at all levels, seminars, workshops and an annual report on innovation published by our office. Apart from this there will be a website of the office which will talk about innovation, and as discussed earlier there will be a dedicated innovation portal to create a knowledge community in the

field. The Office will also use newsletters, audio visual means, online platforms such as Facebook, twitter and YouTube, and initiatives such as Innovation fairs and innovation days to disseminate its message.

11. International Collaborations

Ideas and innovations are enriched and refined through collaborations and interactions that often transcend national boundaries. In the era of globalisation any national level strategy that does not take stock of the activities and breakthroughs taking place across the globe will not be able to cultivate a strong national innovation culture. The Office of Adviser will develop platforms for collaboration and engagement with other countries to understand their views, ideas and strategies on creating an innovation eco-system. These cross-cultural exchanges will stimulate and add value to our views on innovation. These collaborations could be in the form of inter-ministerial exchanges, bilateral exchange forums or through facilitating linkages at the grassroots level.

Innovation is not a linear progression but is based on the interplay of various actors and policies. This interaction determines the context in which a nation's innovation eco-system gets constructed. An innovative eco-system must facilitate the birth of new ideas and also provide platforms for the successful exploitation of these ideas. The strategic direction and quality of the innovation eco-system drives value creation and the nation's development agenda. According to Lundvall, 'the Innovation system consists of the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge…and are located within or rooted inside the borders of a nation state'[13]. India needs to stimulate its innovation eco-system not only to develop new products and services, but solutions for the country's inclusive growth strategy.

In the last century, the United States has been a hotbed of breakthrough innovations because of its dynamic innovation eco-system. It has managed to provide a high quality of talent pool, incentives in terms of IPR (The Bayh Dole Act), risk capital, an infrastructure that anticipates future innovation and an environment for entrepreneurs and innovators to take risks. All other economies which have been successful in terms of innovation such as Finland and Israel have also built strong innovation eco-systems. In the book 'Start up Nation', the authors discuss the idea of conduciveness for innovation in Israel and sees an entire eco-system consisting of government policy, private initiative, start up culture, a domestic venture capital industry, cultural factors and mindset, military investment in R&D, and space for failure.

An OECD study on Innovation strategy has highlighted five pillars of analysis in the innovation eco-system. The three interdependent elements which enable innovation to thrive are markets and governance, human capital and global dimensions. Two additional aspects that cut across these elements are the changing nature of innovation and a framework for measurement of impact and gaps.

Innovation is the result of a complex set of relationships among key actors in the system such as:

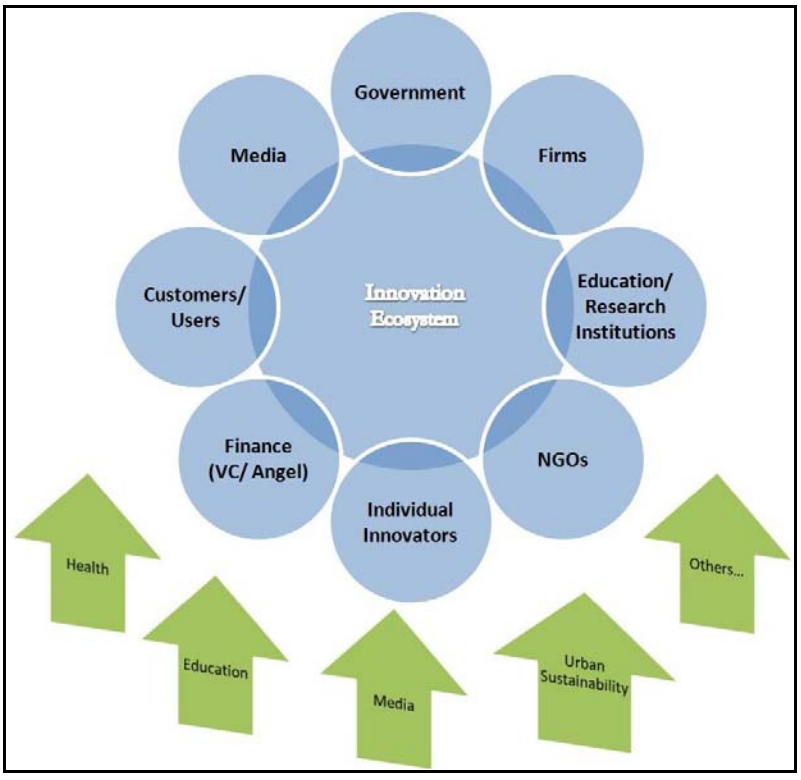
- Government
- Firms

[13] National Innovation Systems, OECD, 1997

- Schools/ Education and Research Institutions
- Finance
- Individual Innovators (Education policy at Schools)
- Customers/users
- NGOs/ Civil Society & grassroots
- Media

The policies and activities in these domains as well as the interactions among these players influence the innovation eco-system. The innovation eco-system is also shaped by the activities in various vertical sectors such as health, education, agriculture, urban sustainability etc. which in turn are nurtured by the activities/ policies of the key players. The creation, application, diffusion and adoption of knowledge in the system among these players is what enables the growth of innovation. Understanding the innovation eco-system is important to map knowledge flows within an economy, identify bottlenecks, and propose policies and practices that can overcome these constraints.

Innovation Eco-system



1. Government

Government has a critical role to play in the innovation eco-system and must create the conditions that will stimulate individuals and enterprises to innovate and take the lead in the next generation of knowledge creation. This can be done through creating right policies to develop human capacity and talent, favourable investment climate and enabling infrastructure both physical and social. The Government can drive innovation through appropriate education policy and skill development; by improving governance and re-engineering public service delivery by innovating within its own structures; by creating new markets through procurement policies and legislation; by delineating a national level strategy through a roadmap for Inclusive Innovation; facilitating connections between universities, manufacturers, users and regulators; driving high quality R&D as well as basic research; providing a mechanism for funding business innovations at all levels, especially SMEs; promoting Innovative policies & places; facilitating exchange of innovations between public and private sector; providing infrastructure and initiating a nation wide innovation movement.

The OECD Innovation strategy identifies five interrelated priorities for government action which together can create a strategic approach to promoting innovation:

- Empowering people to innovate
- Unleashing innovation in firms
- Creating and applying knowledge
- Applying innovation to address global and social challenges
- Improving the governance of policies for innovation

NKN: Changing the Education and Research Landscape

The Indian Government has sanctioned Rs. 5,990 crore over 10 years to build a high-speed communication network to connect researchers in 1,500 educational institutions. The architecture of the network, recommended by the National Knowledge Commission in 2006, will have a high-speed bandwidth of 10 gigabytes per second (gbps) and more.
The National Knowledge Network (NKN) would help in collaborative research for applications in areas such as health, education, agriculture and e-governance, the government said in a statement on Thursday. It will create new education-related applications, databases and delivery of services to the users on demand and go a long way in changing the research landscape in the country and eventually delivery of public services. The network would enable use of specialized applications that allow sharing of high-performance computing facilities, e-libraries, virtual classrooms and very large databases.

Innovation Universities

The Indian Government has announced the setting up of 14 Innovation Universities. Each University would focus on one area or problem of significance to India and build an eco-system of research and teaching around different related disciplines and fields of study, and search for solutions that are globally valid and in the process develop education at undergraduate and higher levels. Such areas/problems of relevance could be the challenges of urbanization, environmental sustainability, public health, design etc. These universities will be innovative not only in terms of course content, selection process and assessment, but also in delivery modules.

Innovation within Government: National Advisory Council

The Government has recently revived the National Advisory Council (NAC), a think tank which will be a Government-civil society interface to drive the key social sector schemes and promote the inclusive growth agenda. This political innovation in its earlier stint was responsible for recommending the setting up of NREGA, the flagship programme of the Government. Such platforms within the Government can enable discussions among wider stakeholders and drive new ideas, solutions and delivery mechanisms to augment Government programmes.

Paperless Governance: E Office

Under the aegis of the Department of IT, the National Informatics Centre has designed a e-office software to replace paper files in the Government of India with a virtual filing system. To enable smooth transition, and engineer a change in the Government mindset, the software has been created with a user friendly design interface which replicates in the virtual world, the look and feel of the file in the real world. This innovative system will not only enable a move towards paperless government, but also improve efficiency in the system by generating transparency and speed by countering the time taken for the physical movement of files in Indian government offices. The project is currently at the pilot stage in certain Government departments.

2. Firms

Firms play a critical role in generating and incubating innovative products and services. A firm's propensity to innovate will depend on Incentives in the system such as Intellectual property rights, demand for innovative products

from the consumers, monetary incentives in terms of capital markets, tax incentives for R&D and a conducive macroeconomic climate. Further, a firm needs inputs to innovate in term of pool of talented and skilled human capital produced by the education system, specialised expertise, ideas and basic research from academic and research institutions to build innovation intensity; and availability of seed and risk capital to underwrite the innovation process. Lastly, a firm should also have the capability and capacity to innovate which requires creative organisational structures, technological competencies, systems for skills and training of its workforce, and management geared towards understanding markets and needs. Firms do not act in isolation, but cooperate with other firms and depend on knowledge flows from universities and research laboratories[14]. Special attention has to be paid to the constraints faced by MSMEs, and building their innovation capacity.

3. Schools/ Education and Research Institutions

The availability of a pool of skilled manpower is a pre-requisite for an innovation economy. This critical mass will generate ideas, convert them into usable products and define new solutions. But the presence of skilled human capital is dependent on the education system and the research capabilities of a nation. This is especially critical in India's context where there are 550 million below the age of 25.

In its Communication of 10 November 2005 the Commission on European Communities has identified the key competencies necessary for living and working in a modern innovation-oriented society. These include entrepreneurial skills in the wider sense, as well as literacy, scientific and mathematical competence, languages, learning to-learn skills and social and cultural competences. They also include digital literacy, which is important for a wider uptake of ICT and its innovation potential. These are the requirements of a new knowledge economy and the education system must respond by producing six sigma individuals geared towards innovative and analytical thinking. This can be ensured by innovative policies and the right environment at the school and university level, including emphasis on art, culture and creativity, as well as policies for promoting a robust research eco-system. This requires thinking on issues of expansion, quality and access in the school and higher education system and new models of education delivery. Innovation in schools and universities also needs to be viewed from wider perspective that goes beyond S&T to promoting creative involvement in art, culture and design. For enhanced research output, the education

[14] 'From Jugaad to Systematic Innovation', Rishikesh T. Krishnan, 2010

system should be equipped to generate more quality PhDs and encourage at the school level a greater interest in subjects such as Maths and Science.

A conducive research sector requires long-term spending on education and cutting edge Research universities, industrial R&D Centres, and Government Laboratories with well maintained modern facilities, infrastructure, and liberal funding working together towards defined objectives. This must be supported by an enabling IPR regime and IT framework for data, information and knowledge collaborations. Academic reforms and better infrastructure should go hand in hand with nurturing and sustaining a research environment. This involves mechanisms for greater academic cooperation 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 and focused engagement towards making universities a natural home for research as well as teaching.

A strong R&D sector is important not only for competitive growth but more importantly for addressing key strategic issues such as low-cost universal health care, clean water supply, efficient energy use, clean environment, urban management, agricultural and rural development and others.

India Higher Education and Research Scenario

India has the third largest education system in the world with 471 universities and 22,064 colleges. However, there are serious concerns of expansion, quality, and access. Our GER of around 12% is very low compared to the world average of 23.2%, 36.5% for countries in transition, 54.6% for the developed countries, and 22% for Asian countries. 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.

India's research output and industry-academia interaction is also inadequate, with a few exceptions such as the IITs and the Indian Institute of Science. India's output of science graduates, especially PhDs, is also low. India produced nearly 7,000 PhDs in science and engineering in 2003/04. While India produces twice as many engineers as the United States does, its pool of PhDs is less than one-tenth that of the U.S. pool. Even in areas for which India is noted, such as information technology, the annual output of PhDs is low.

Moreover, 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.

India compares poorly in its share of world research publications, remaining almost static at about 2 per cent during 1993–2003, while China increased its share from about 1.3 per cent to about 4.5 per cent in the same period,

South Korea from 0.4 per cent to about 2 per cent and Brazil from 0.6 per cent to 1.5 per cent. India's poor performance in research is also highlighted by comparisons with other countries.

In 2006, India had 119 researchers in R&D per million people, while China had 715, South Korea had 3723, US had 4628 and Japan had 5300. The National Knowledge Commission has given comprehensive recommendations to improve the education and research systems in the country (www.knowledgecommission.gov.in).

India has a well developed science and technology infrastructure, but R&D expenditures are concentrated in only a few areas. India's major public R&D networks include the Council of Scientific and Industrial Research, the Indian Council of Agricultural Research, the Indian Council of Medical Research, the Indian Space Research Organization, the Defence Research and Development Organizations, the Atomic Energy Research Establishments, the Indian Institutes of Technology, the Indian Institutes of Management and the Indian Institutes of Science. The public sector accounts for 70–80 percent of total R&D investment (0.8 percent of GDP), with the bulk of it concentrated in mission-oriented R&D in defence, space and energy by the Department of Defence (25 percent), Department of Space Research (17 percent) and Department of Atomic Energy (9 percent)[15]. Less than 20 percent of public support for R&D is for civilian applications, and within industrial R&D expenditure, nearly 40 percent is for drugs and pharmaceuticals. However, income from patents remains minimal.

Cambridge Enterprise: Industry-Academia Interaction

Cambridge Enterprise (CE) operates simultaneously as a department of the University of Cambridge, and as a limited company, wholly-owned by the University. It combines the functions of consultancy, technology transfer, and seed fund investment. The stated objective of Cambridge Enterprise is to help University of Cambridge inventors, innovators and entrepreneurs make their ideas and concepts more commercially successful for the benefit of society, the UK economy, the inventors and the University. Through Cambridge Enterprise, the University manages its own seed funds which invest in new businesses created by the academic staff. In the last decade, the seed funds have made 47 investments in early-stage companies employing a total of 1,700 people; and 36 of those companies have, between them, raised £456 million in further investment, and £19.5 million in grant funding.

[15] 'India 2039: Climbing the Global Technological Ladder', Vinod Goel & Ramesh Mashelkar, Asian Development Bank, 2009

4. Finance

Easy access to financial support plays a key role in stimulating the innovation eco system and for taking a product/ idea from the 'birth phase' to the 'survival' or 'up scaling the prototype phase' to finally the 'growth stage' which involves commercial production. Commercial development of innovative products requires linkages between the innovators and those who have the entrepreneurial capacity to implement these ideas as well as those who have the capacity to finance them. This requires availability of financial support for early-stage technology development, deepening early stage venture capital, pro poor finance, and strong financial availability for technology absorption by MSMEs.

Venture capital funding is crucial, but it must be seen as part of a spectrum of funding that an enterprise may tap at different stages of its life cycle from different class of finance providers. This entire range of options for risk capital finance is critical for stimulating innovation[16]. Early stage financing of innovation requires specialized investors with the skills to evaluate and directly manage the risks, or governments with broader public objectives that may benefit the economy as a whole. To promote innovation finance there is a need for Government support not only in terms of availability of funds, but facilitating regulations especially in the tax regime, investment guidelines and creation of mechanisms such as a 'Fund of Funds' with Government and private capital, especially focused on promoting inclusive innovations initiatives overlooked by the market.

The Impact of Yozma in Israel

Before the introduction of venture capital in Israel, there were only two sources of funding. First, Israeli start-ups could apply to the Office of the Chief Scientist (OCS) for matching grants. Second, Israeli companies could apply for the Binational Industrial Research and Development (BIRD) grants. In 1992 the government decided to establish the "Yozma" programme which was meant to jump-start the venture capital market in Israel. In this programme the Government invested $100 million to create 10 venture capital funds. Each fund had to be represented by three parties: Israeli venture capitalists in training, a foreign venture capital firm, and an Israeli investment company or Bank. The incentive offered to the private players was the issuing of options to buy Yozma's shares in these funds in 5 years time at a predetermined price. Yozma managed to attract prominent foreign multinational investors (the likes of Advent of Boston, GAN of France,

[16] 'Inclusive and Frugal Innovation, Stimulating the Innovation Eco-system', A. Maira, 2010

Daimler-Benz of Germany, the China Venture Management of Taiwan, etc.), which brought along not only their financial resources but most importantly their expertise. Shortly after its establishment, the funds created by Yozma helped raise close to $200 million. Contrary to other government programmes, Yozma had at inception a fixed life expectancy of 7 years. In fact, though, its rapid success allowed it to terminate its activities early on: in 1997 its direct investment portfolio was privatized, and thus its mission came to an end. Since then the venture capital market in Israel has boomed, with 45 Israeli venture capital funds (Israel Venture Association). Today, Israel has the highest density of start ups in the world and more Israeli companies are listed on the NASDAQ exchange than all companies from the entire European continent[17].

5. Innovators

At the centre of the innovation eco-system is the individual innovator who is the epicentre of innovation activity. A ***single*** innovator may trigger a dynamic process by which old structures, however entrenched they might have been to begin with, need to innovate as well in order to survive the fierce competition that ensues. Therefore an important goal for innovation policy in developing countries is to encourage first time innovators in static markets, and prevent old time dominant firms from denying them a foothold. This requires strengthening of all elements of the innovation eco-system from the education policy and research system; Government policies, incentives and funding which support innovators and entrepreneurs from inception of the idea to marketing the end product; a healthy network of Venture capital and angel funding; mechanisms for scaling grassroots innovations; to creating clusters for promoting innovation and a platform for making all this information and help available to the stakeholders and beneficiaries.

6. Customers/Users

Customers and users are a very integral part of the innovation eco-system. Innovation was earlier supported by supply side policy initiatives where a linear innovation model was employed focused on R&D investment and commercialisation. However, innovation is now being driven by users who encourage innovators to design new, improved products to meet advanced needs and is not just focused on higher spending in R&D. Individual users, businesses or government are all critical in shaping innovation. These needs are driving not just radical and disruptive innovations, but incremental and hidden innovations as well. New features and functionality, new channels, new levels of ease of use, new businesses, and new pricing models are as

[17] 'Start-up Nation: The Story of Israel's Economic Miracle', D. Senor and S. Singer, 2009

critical as the hope for a big breakthrough. Innovation is shaping consumer expectations as well as responding continually to the changing demands and experiences of consumers. Value today is increasingly being determined by one consumer-cocreated experience at a time whether it is availability of low cost mobile payment options to personalised platforms such as iGoogle. This requires new ways of thinking about innovation, where global resources can be employed to satisfy the needs of one[18]. The role of standards that Government imposes in products, processes and services also play a critical role in driving innovation focused on consumers by recognising public needs. Standards of products/services laid out by government on energy efficiency, safety, water conservation, provide impetus to innovation. By recognising consumer needs and expectations, standards create a positive user experience and provide more appropriate, cost effective and efficient products for the end user. They are also important to address the gaps where the market fails, especially in areas such as renewable technologies, smart grid, and fuel efficient vehicles. The guidelines set by the Indian Government's National Action Plan on Climate Change will fulfil India's climate change objectives of adaptation and mitigation. The focus on climate change, adaptation and mitigation, energy efficiency and natural resource conservation through eight national missions will provide impetus in these areas and lead to development and use of new technologies beneficial for consumers. The National Solar Mission will enable a decentralised distribution of energy and more affordable solar power, which will empower people at the grassroots.

Thinking about innovation from the user's perspective is especially crucial for India, where the needs of the bottom of the pyramid have largely been ignored or have not been addressed sufficiently. Creating low cost, efficient and sustainable solutions for them would require a dynamic shift in how innovation works and how it is perceived.

7. NGOs

The NGO sector must also play its part in shaping the innovation eco-system through filling in the gaps which the government and industry have still not addressed. NGOs can play their part in expanding the discourse on innovation by giving voice to the marginalised, by creating platforms for helping grassroots innovators and diffusing information to people who do not have the right kind of information access. In India work in this area is being done by the Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI), Gujarat Grassroots Innovations Augmentation Network (GIAN), Sustainable-Agriculture & Environmental Voluntary Action

[18] 'The New Age of Innovation: *Driving Co-Created Value Through Global Networks'*, C K Prahalad, 2008

(SEVA), Rural Innovations Network (RIN). Further non-profit initiatives such as SELCO, and activities of organisations such as Barefoot College, Basix, Teach for India and numerous others working in diverse areas are pushing new frontiers.

8. Media

With increasing access to the internet and the ICT revolution, along with wider penetration of media, there is tremendous scope for using these channels to disseminate information on innovation and create platforms for participation. Innovative activities entail by necessity the need for information symmetries and new media can be an important tool in creating these. Radio, Television, new medium such as Facebook, twitter, youtube can provide new and unique platforms for engaging innovators and for information sharing and collaboration beyond national boundaries. For instance, to advance the reach of its work in developing countries, Architecture for Humanity has established the Open Architecture Network, an online database and platform which enables architects, designers, engineers and builders to share plans, details and experiences around sustainable housing and building projects. It has 8000 registered users and 1000 projects.

Increasingly the leap from voice to data services will see greater penetration of broadband which can become an important enabler in disseminating information on innovation to groups which have been out of the fold till now. The availability of diverse media tools will also spawn innovation in other areas such as service delivery.

Media can play a critical role in the innovation eco-system by creating awareness about the innovation programmes available, building linkages between innovators and funders and developing mechanisms for innovators to connect.

CONCLUSION

Innovations require not just inputs and capacity but also a political economy of reform. This involves creating a constituency for innovation where Government, academia, industry and the citizenry are all participants in the innovation movement. It is about creating an innovation eco-system not only concerned about creating high-tech products, but about enhancing the quality of life for everybody by creating sustainable solutions and changing processes and mindsets. The time is right for India to blaze its own trail by creating a model of Inclusive Innovation specific to the country's needs and development goals.

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22. Does Government promote or hinder Innovation?" Economist Online debate, March 2010

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APPENDIX: LIST OF INNOVATION ORGANISATIONS

Innovation Ecosystem in India

A. Incubators

1. NS Raghavan Centre for Entrepreneurship Learning (NSRCEL), IIM Bangalore
2. Entrepreneurship Cell, IIT Kharagpur
3. Centre for Entrepreneurship Development, SP Jain Institute of Management & Research
4. C-TIDES, IIT Madras
5. TeNeT, IIT Madras
6. Entrepreneurship Development Cell, IIT Delhi
7. Entrepreneurship Cell, FMS Delhi
8. Abhiyan, IIM Lucknow
9. E-Cell, IIM Kozhikode
10. Centre for Entrepreneurship and Innovation, IIM Calcutta
11. The Wadhwani Foundation
12. The ICFAI Centre for Entrepreneurship Development, Hyderabad
13. MICA Entrepreneurship Development Centre, Ahmedabad
14. Wadhwani Centre for Entrepreneurship Development, ISB Hyderabad
15. Technology Innovation Management and Entrepreneurship Information Service (TIME IS), New Delhi
16. National Institute of Industrial Engineering, Mumbai
17. Entrepreneurship Development Cell, IIT Roorkee
18. NSIC Technology Business Incubator on Information Technology, New Delhi
19. National Chemical Laboratory (NCL) Innovations, Pune
20. National Chemical Laboratory (NCL) Innovation Park, Pune
21. Society for Innovation and Development (SID), Indian Institute of Science, Bangalore
22. Villgro Innovation Foundation, IIT Madras

23. Grassroots innovations augmentation network (Gian) – Ahmedabad and IIT Guwahati
24. Foundation for Innovation and Technology Transfer (FITT), IIT Delhi
25. IIT Madras Research Park
    i. Incubation Centre for Garment Manufacturing, National Institute for Entreprenuership & Small Business Development (NIESBUD), Noida, Uttar Pradesh
    ii. Rural Industry Program, Indian Institute of Entrepreneurship, Guwahati, Assam
    iii. Cluster Development Activity, Indian Institute of Entrepreneurship, Guwahati, Assam
    iv. IndiaCo, Pune, Maharashtra
    v. Society for Research and Initiative for Sustainable Technologies and Resources, Indian Institute of Management, Ahmedabad, Gujarat
    vi. Telecommunications and Computer Networks group (TeNeT), Indian Institute of Technology (IIT), Chennai, Tamil Nadu
    vii. National Innovation Foundation (NIN), Ahmedabad, Gujarat
    viii. Advance Materials Technology Incubator, The International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad, Andhra Pradesh

B. Government Programs and Projects

1. National Science and Technology Entrepreneurship Development Board (NSTEDB), Department of Science & Technology, Ministry of Science & Technology
    a. **Entrepreneurship Development Cells (EDC's) under the NSTEDB**
        i. Sreenidhi Institute of Science & Technology (SNIST), Hyderabad
        ii. Jawahar Lal Nehru College of Engineering, Jawahar Lal Nehru Technological University, Hyderabad
        iii. Entrepreneurship Development Cell, Osmania University, Hyderabad

iv. Entrepreneurship Development Cell, Cotton College, Guwahati, Assam

v. Jawaharlal Nehru College, Pasighat, Arunachal Pradesh

vi. Netaji Subhash Institute of Technology, Delhi

vii. Mudra Institute of Communications (MICA), Ahmedabad

viii. Bhavnagar University, Bhavnagar, Gujarat

ix. Maharishi Markandeshwsar Engineering College, Ambala, Haryana

x. Seth Jai Prakash Mukund Lal Institute of Engineering and Technology, Radaur, Haryana

xi. BM Institute of Engineering & Technology, Sonipat, Haryana

xii. University Institute of Engineering & Technology (UIET), Kurukshetra University, Kurukshetra, Haryana

xiii. University of Kashmir, Srinagar

xiv. Visvesvaraya Technological University, Belgaum, Karnataka

xv. NMAM Institute of Technology, Nitte, Karnataka

xvi. M. S. Ramaiah Institute of Technology, Bangalore

xvii. RV College of Engineering (RVCE), Bangalore

xviii. Dr. G.R. Damodaran College of Science, Coimbatore

xix. University of Kerala, Trivandrum

xx. Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

xxi. Textile & Engineering Institute, Kohlapur, Ichalkaranji, Maharashtra

xxii. Entrepreneurship Development Cell, TatyaSaheb Kore Institute of Engineering & Technology, Kohlapur, Maharashtra

xxiii. EDC National Institute of Industrial Engineering, Mumbai, Maharashtra

xxiv. Shri Sant Gajanan Maharaj College of Engineering, Buldhana, Shegaon, Maharashtra

xxv. National Institute of Science & Technology, Berhampur, Orissa

xxvi. Malviya National Institute of Technology, Department of Management Studies, Jaipur, Rajasthan

xxvii. Sikkim Manipal Institute of Technology, Rangpo, East Sikkim, Sikkim

xxviii. Bannari Amman Institute of Technology, Erode, Satyamangalam, Tamil Nadu

xxix. PSNA College of Engineering & Technology, Dindigul, Tamil Nadu

xxx. Sri Venkateshwara College of Engineering, Sriperumbudur, Tamil Nadu

xxxi. Arulmigu Kalasalingam College of Engineering, Krishnankoil, Tamil Nadu

xxxii. Coimbatore Institute of Management & Technology, Coimbatore, Tamil Nadu

xxxiii. Kumaraguru College of Technology, Coimbatore, Tamil Nadu

xxxiv. SSM College of Engineering, Coimbatore, Tamil Nadu

xxxv. Mother Teresa Women's University, Kodaikanal, Tamil Nadu

xxxvi. B.S. Abdur Rahman Crescent Engineering College, Chennai, Tamil Nadu

xxxvii. Stella Maris College, Chennai, Tamil Nadu

xxxviii. St. Xavier's College, Kolkata, West Bengal

b. **Innovation and Entrepreneurship Development Centre (IEDC) under the NSTEDB**

i. Amal Jyoti College of Engineering, Kottayam, Kerala

ii. Sagar Institute of Researhch and Technology, Bhopal, Madhya Pradesh

iii. GH Raisoni College of Engineering, Nagpur, Maharashtra

iv. Adhiparasakthi Engineering College, Kancheepuram, Melmaruvathur, Tamil Nadu

v. PSGR Krishnaammal College for Women, Coimbatore, Tamil Nadu

vi. Vinayak Mission's Kirupananda Variyar Engineering College, Salem, Tamil Nadu

c. **Science & Technology Entrepreneurship Development (STED) Project under the NSTEDB**

i. Implemented by A&N Consultancy Centre (ANCON), Port Blair, Andaman & Nicobar Islands at Ferrargunj

ii. Implemented by Indian Institute of Entrepreneurship, Guwahati, Assam at Bongaigaon

iii. Implemented by NB Institute for Rural Technology (NBIRT), Guwahati, Assam at Morigaon

iv. Implemented by Indian Institute of Entrepreneurship, Guwahati, Assam at Goalpara

v. Implemented by Entrepreneurship Development Institute of India, Gandhinagar, Gujrat at Nalbari

vi. Implemented by Centre for Rural Technology (CRD), Noida, UP at Guwahati, Assam

vii. Implemented by Centre for Bhartiya Marketing Development (CBMD), New Delhi at Karimnagar

viii. Implemented by Asian Society for Entrepreneurship Education & Development (ASEED), New Delhi at Arrah, Bhojpur

ix. Implemented by Madhya Pradesh Consultancy Organisation Ltd. (MPCON), Bhopal, Madhya Pradesh at Janjgir-Champa, Chattisgarh

x. Implemented by Agnel Charities (Agnel Seva Sangh), Salcete, Goa at South Goa

xi. Implemented by Gram Vikas Sansthan (GVS), Vadodara, Gujarat at Vadodara, Gujarat

xii. Implemented by Manthan Educational Programme Society (MEPS), Ahmedabad, Gujarat at Bharuch, Gujarat

xiii. Implemented by Rural Development Foundation (RDF), Anand, Gujarat at Khanvel, Gujarat

xiv. Implemented by Rural Development Foundation (RDF), Anand Gujarat at Dangs, Gujarat

xv. Implemented by SAHYOG, Ahmedabad, Gujarat at Mehsana, Gujarat

xvi. Implemented by Manthan Educational Programme Society, Ahmedabad, Gujarat at Surendranagar, Gujarat

xvii. Implemented by Manthan Educational Programme Society, Ahmedabad, Gujarat at Narmada District,

Gujarat

xviii. Implemented by Haryana Delhi Industrial Consultants Ltd. (HARDICON), New Delhi at Panipat, Haryana

xix. Implemented by Energy Research Application (ERA), New Delhi at Rewari, Haryana

xx. Implemented by Energy Research Application (ERA), New Delhi at Jhajjar, Haryana

xxi. Implemented by Himachal Consultancy Organization Ltd. (HIMCON), Shimla, Himachal Pradesh at Hamirpur, Himachal Pradesh

xxii. Implemented by Society for Advancement of Village Economy (SAVE), Una, Himachal Pradesh at Una, Himachal Pradesh

xxiii. Implemented by Jammu & Kashmir Entrepreneurship Development Institute (J&K EDI), Srinagar, J&K at Budgam, J&K

xxiv. Implemented by Krishi Gram Vikas Kendra, Ranchi, Jharkhand at Saraikela Kharsawan, Jharkhand

xxv. Implemented by Centre for Development of Entrepreneurship of Karnataka (CEDOK), Dharwad, Karnataka at Belgaum, Karnataka

xxvi. Implemented by Centre for Development of Entrepreneurship of Karnataka (CEDOK), Dharwad, Karnataka at Uttar Kannada, Karnataka

xxvii. Implemented by Centre for Entrepreneurship Development of Karnataka (CEDOK), Dharwad, Karnataka at Bijapur, Karnataka

xxviii. Implemented by Kerala Rural Development Agency (KRDA), Kollam, Kerala at Kollam, Kerala

xxix. Implemented by Swadeshi Science Movement (SSM), Cochin, Kerala at Ernakulam, Kerala

xxx. Implemented by Professional Assistance for Development Action (PRADAN), New Delhi at Hoshangabad, Madhya Pradesh

xxxi. Implemented by Professional Assistance for Development Action (PRADAN), New Delhi at Sidhi, Madhya Pradesh

xxxii. Implemented by MPCON Limited, Bhopal, Madhya Pradesh at Harda, Madhya Pradesh

xxxiii. Implemented by MITCON Consultancy Services Ltd., Pune, Maharashtra at Kolhapur, Maharashtra

xxxiv. Implemented by MITCON Consultancy Services Ltd., Pune, Maharashtra at Nanded, Maharashtra

xxxv. Implemented by Institute for Entrepreneurship Development, Orissa (IEDO), Bhubaneswar, Orissa at Khurda, Orissa

xxxvi. Implemented by Centurion Group of Institutes represented by Centurion School of Rural Enterprise Management (CSREM), Paralakhemundi, Orissa at Bhubaneswar, Orissa

xxxvii. Implemented by North India Technical Consultancy Organisation (NITCON), Chandigarh, Punjab at Mukatsar, Punjab

xxxviii. Implemented by Regional Centre for Entrepreneurship Development (RCED), Chandigarh, Punjab at Amritsar, Punjab

xxxix. Implemented by R K Sansthan, Sawaimadhopur, Rajasthan at Dausa, Rajasthan

xl. Implemented by RK Sansthan**,** Sawaimadhopur, Rajasthan at Dungarpur, Rajasthan

xli. Implemented by R. K. Sansthan, Sawaimadhopur, Rajasthan at Bundi, Rajasthan

xlii. Implemented by Sikkim Consultancy Centre (SICON), Gangtok, Sikkim at Rangpo-Sington, Sikkim

xliii. Implemented by Centre for Social Development (CSD), Ammandivilai, Tamilnadu at Kanyakumari, Tamil Nadu

xliv. Implemented by Tanstia FNF Service Centre (TFSC), Chennai, Tamil Nadu at Kanchipuram, Tamil Nadu

xlv. Implemented by Tiruchirapalli District Tiny & Small Scale Industries Association (TIDITSSIA), Tiruchirapalli, Tamil Nadu at Tiruchirapalli, Tamil Nadu

xlvi. Implemented by Entrepreneurship Development Institute of India (EDI), Lucknow, Uttar Pradesh at Gorakhpur, Uttar Pradesh

xlvii. Implemented by Entrepreneurship Development Institute of India (EDII), Lucknow, Uttar Pradesh at Firozabad, Uttar Pradesh

xlviii. Implemented by Centre of Technology &

Entrepreneurship Development (CTED), Sultanpur, Uttar Pradesh at Sultanpur, Uttar Pradesh

xlix. Implemented by Entrepreneurship Development Institute of India, Ahmedabad, Gujarat at Rae Bareli, Uttar Pradesh

l. Implemented by Centre of Technology & Entrepreneurship Development (CTED), Jagdishpur, Uttar Pradesh at Faizabad, Uttar Pradesh

li. Implemented by Entrepreneurship Development Institute of India (EDI), Lucknow, Uttar Pradesh at Udhamsingh Nagar, Uttarakhand

lii. Implemented by Entrepreneurship Development Institute of India, Roorke, Uttarakhand at Roorke, Uttarakhand

liii. Implemented by Science Association of Bengal (SAB), Kolkata, West Bengal at Sandeshkhali, West Bengal

liv. Implemented by Vivekananda Institute of Biotechnology (VIB), Parganas, West Bengal at Patherprotima, West Bengal

lv. Implemented by West Bengal Consultancy Organisation Ltd. (WEBCON), Kolkata, West Bengal at Cooch Behar, West Bengal

lvi. Implemented by NB Institute for Rural Technology (NBIRT), Agartala**,** Tripura at West Bengal, Bihar and Jharkhand

d. **Science & Technology Entrepreneurship Parks (STEPs) under the NSTEDB**

i. By NSIC Technical Services Centre, Rajkot, Gujarat in Rajkot, Gujarat

ii. By National Small Industries Corporation Limited, New Delhi in Gujarat

iii. STEP-Birla Institute of Technology, Ranchi, Jharkhand

iv. JSS Technical Institutions Campus, Mysore, Karnataka

v. National Institute of Technology, Karnataka

vi. Science & Technology Entrepreneurs Park (BEC-STEP), Bagalkot, Karnataka

vii. Science and Technology Park, University of Pune, Maharashtra

viii. Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh

ix. Thapar University, Patiala, Punjab

x. Guru Nanak Dev College of Engineering, Ludhiana, Punjab

xi. TREC-STEP, NIT Campus, Tiruchirappalli, Tamil Nadu

xii. PSG-STEP, Coimbatore, Tamil Nadu

xiii. Harcourt Butler Technological Institute, Kanpur, Uttar Pradesh

xiv. Indian Institute of Technology , Roorkee, Roorkee, Uttarakhand

xv. Indian Institute of Technology, Kharagpur, West Bengal

e. **Technology Business Incubators (TBI) under the NSTEDB**

i. ICICI Knowledge Park-Life Sciences Incubator, Hyderabad, Andhra Pradesh

ii. ICICI Knowledge Park-Life Sciences Incubator, Turkapally – Village, Hyderabad, Andhra Pradesh

iii. Agri Business Incubator, Patancheru, Andhra Pradesh

iv. University of Hyderabad, Hyderabad, Andhra Pradesh

v. Indian Institute of Chemical Technology, Hyderabad, Andhra Pradesh

vi. Technology based Incubator Society (TBI), University of Delhi, Delhi

vii. Shriram Institute for Industrial Research, Delhi

viii. National Design Business Incubator, National Institute of Design (NID), Ahmedabad, Gujarat

ix. Nirma Labs, Nirma University, Ahmedabad, Gujarat

x. Centre for Innovation Incubation and Entrepreneurship (CIIE), Indian Institute of Management, Ahmedabad, Gujarat

xi. Technology Business Incubator , Entrepreneurship Development Centre, Mudra Institute of Communications Ahmedabad, Gujarat

xii. Society for Innovation and entrepreneurship in Dairying, National Dairy Research Institute, Karnal, Haryana

xiii. Composites Technology Park, Bangalore, Karnataka

xiv. E health-TBI, Bangalore, Karnataka

xv. Manipal Institute of Technology, Innovation Centre, Karnataka

xvi. National Institute of Technology, Calicut, Kerala

xvii. Technopark TBI, Technopark Campus, Trivandrum, Kerala

xviii. Amrita TBI, Kerala

xix. Amrita Vishwa Vidhyapeetham, Amritapuri Campus, Clappana, Kerala

xx. Society for Innovation and Entrepreneurship, IIT Bombay, Maharashtra

xxi. MITCON Biotechnology Business Incubation Centre, Pune, Maharashtra

xxii. Venture Centre, National Chemical Laboratory, Pune, Maharashtra

xxiii. D.K.T.E. Society's , Textile & Engineering Institute, Ichalkarnaji, Maharashtra

xxiv. KIIT Centre for Innovation and Entrepreneurship – KIITCIE, Bhubaneswar, Orissa

xxv. Birla Institute of Technology and Science (BITS), Pilani, Rajasthan

xxvi. Kongu Engineering College, Perundurai, Tamil Nadu

xxvii. Vellore Institute of Technology -TBI(VITTBI), Vellore, Tamil Nadu

xxviii. Technology Business Incubator, Centre for Biotechnology, Anna University, Chennai, Tamil Nadu

xxix. University of Madras, Chennai, Tamil Nadu

xxx. IITMs, Rural Technology and Business Incubator, IIT Madras, Tamil Nadu

xxxi. Centre for Industrial Consultancy and Sponsored Research, Indian Institute of Technology Madras, Tamil Nadu

xxxii. Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu

xxxiii. Periyar Technology Business Incubator, Periyar

Maniammai University, Vallam, Tamil Nadu

xxxiv. St. Peter's Engineering College TBI, Chennai, Tamil Nadu

xxxv. J.S.S. Academy of Technical Education, Noida, Uttar Pradesh

xxxvi. Amity Technology Incubator, Delhi

xxxvii. Amity Business Incubator, Noida, Uttar Pradesh

xxxviii. Krishna Institute of Engineering & Technology, Ghaziabad, Uttar Pradesh

xxxix. SIDBI Innovation and Incubation Centre , Indian Institute of Technology, Kanpur

xl. Malviya Centre for Innovation Incubation & Entrepreneurship, Institute of Technology , Banaras Hindu University, Varanasi, Uttar Pradesh

xli. Ekta Incubation Centre, West Bengal University of Technology, Kolkata, West Bengal

xlii. Indian Institute of Technology, Kharagpur, West Bengal

2. Technology Development Board, Department of Science & Technology, Ministry of Science & Technology
3. Drug Development Promotion Board (DDPB), Department of Science & Technology, Ministry of Science & Technology
4. Instrumentation Development Programme, Department of Science & Technology, Ministry of Science & Technology
5. Technology Systems Development Program, Department of Science & Technology, Ministry of Science & Technology
6. National Agriculture Innovation Project, Indian Council of Agriculture Research, Delhi

C. Government Schemes

1. Scheme of Entrepreneurship Development Centres through Partner Institutions, National Institute for Entrepreneurship and small Business Development (NIESBUD), Ministry of Micro, Small and Medium Enterprises, Noida, Uttar Pradesh
2. New Millennium Indian Technology Leadership Initiative (NMITLI) Scheme, Department of Science & Technology, Ministry of Science & Technology
3. Technology Promotion, Development and Utilization Programme (TPDU), Department of Scientific & Industrial Research, Ministry of Science & Technology

a. Technology Development and Innovation Programme (TDIP)
    i. Technology Development and Demonstration Program (TDDP)
    ii. Technopreneur Promotion Programme (TePP)
b. Industrial R&D Promotion Programme [IRDPP]
c. Technology Management Programme [TMP]
d. International Technology Transfer Programme [ITTP]
e. Consultancy Promotion Programme [CPP]
f. Technology Information Facilitation Programme [TIFP]
g. Technology Development & Utilization Programme for Women [TDUPW]

4. Innovation in Science Pursuit for Inspired Research (INSPIRE), Department of Science & Technology, Ministry of Science & Technology
5. Drug Development Promotion Board (DDPB), Department of Science & Technology, Ministry of Science & Technology
6. Instrumentation Development Programme, Department of Science & Technology, Ministry of Science & Technology
7. Inter-Sectoral Science & Technology Advisory Committee, Department of Science & Technology, Ministry of Science & Technology
8. Participation of Youth in Real-Time Observation to Benefit Education (PROBE)
9. Technology Systems Programme, Department of Science & Technology, Ministry of Science & Technology
10. The following programs exist under the National Science and Technology Entrepreneurship Development Board (NSTEDB)
    a. Technology Based Entrepreneurship Development Programme (TEDP)
    b. Entrepreneurship Awareness Camp (EAC)
    c. Entrepreneurship Development Programme (EDP)
    d. Faculty Development Programme (FDP)
    e. Open Learning Programme in Entrepreneurship (OLPE)

D. Law and Policy

1. Science and Technology Policy 2003, Department of Science & Technology, Ministry of Science & Technology

2. The Patent (Third Amendment) Act, 2005
3. The Micro, Small and Medium Enterprises Development Act, 2006
4. The National Innovation Act of 2008
5. The Utilisation of Public Funded Intellectual Property Bill 2008[19]
6. National Design Policy

E. Centres

1. Centre for Research on Innovation and Science Policy, Hyderabad
2. Centre for Scientific & Industrial Consultancy, Indian Institute of Science, Bangalore
3. All India Council for Technical Education (AICTE), Delhi
4. NASSCOM, Delhi
5. Bharti Centre for Entrepreneurial Initiatives, Bharti Foundation, Gurgaon, Haryana
6. National Resource Centre under Integrated Handloom Cluster Development Programme
7. National Institute for Entrepreneurship & Small Business Development, Noida, Uttar Pradesh
8. Entrepreneurship Development Institute of India, Ahmedabad, Gujarat

F. Networks

1. Indian Innovators Association
2. National Entrepreneurship Network (NEN), Mumbai, Maharashtra
3. Rural Innovations Network, Chennai
4. Jagran
5. Indian STEP's and Business Incubator's Association (ISBA), University of Puna, Maharashtra
6. Incubator Network Asia
7. Ashoka, Delhi
8. Honey Bee Network, Indian Institute of Management, Ahmedabad, Gujarat

[19] The Bill has been referred to the Parliamentary Standing Committee on Science & Technology, Environment & Forests (Chairperson: Dr V. Maitreyan), which is scheduled to submit its report by the constitution of the 15th Lok Sabha

G. Venture Capital Funds

1. Central Government controlled development finance institutions
    i. ICICI Venture Funds Ltd.
    ii. IFCI Venture Capital Funds Limited (IVCF)
    iii. SIDBI Venture Capital Limited (SVCL)
2. State Government controlled development finance institutions
    i. Gujarat Venture Finance Limited (GVFL)
    ii. Kerala Venture Capital Fund Pvt Ltd.
    iii. Punjab Infotech Venture Fund
    iv. Hyderabad Information Technology Venture Enterprises Limited (HITVEL)
3. Public banks
    i. Canbank Venture Capital Fund
    ii. SBI Capital Markets Limited
4. Private sector
    i. IL&FS Trust Company Limited
    ii. Infinity Venture India Fund
5. Overseas venture capital fund
    i. Walden International Investment Group
    ii. SEAF India Investment & Growth Fund
    iii. BTS India Private Equity Fund Limited