



Report of the Expert Committee on Innovation and Entrepreneurship

August 2015, NITI Aayog, New Delhi

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Government of India
NITI Aayog
(CIT&I Division)

Sansad Marg, New Delhi
Date: April 2, 2015

Office Memorandum

Subject: Constitution of an Expert Committee on Innovation & Entrepreneurship.

1. The Hon' ble Finance Minister in his Budget Speech 2015-16 announced the Government' s intention to establish the Atal Innovation Mission (AIM) in NITI and stated that initially a sum of Rs. 150 crores would be earmarked for this purpose. The overarching purpose of this mission is to promote a culture of entrepreneurship and innovation in India. In the years to come, entrepreneurship and innovation is expected to be an ever more important source of growth and job creation. New technology also has the potential to find solutions to pressing economic and social problems. The government sees the AIM as critical to expediting the entrepreneurial process in India. Key objectives of the AIM will be:

- a. To create an umbrella structure to oversee innovation eco-system of the country;
- b. To provide platform and collaboration opportunities for different stakeholders;
- c. To study and suggest best and novel practices to be adopted by different stakeholders in the innovation chain;
- d. To provide policy inputs to NITI Aayog and various Government Departments and Organizations.
- e. To create awareness and provide knowledge inputs in creating innovation challenges and funding mechanism to government; and,
- f. To develop new programmes and policies for fostering innovation in different sectors of economy.

2. The Government' s commitment to catalysing the entrepreneurial process is evident from its establishment of the SETU (Self Employed and Talent Utilization). SETU (as stated in paragraph 50 of the Finance Minister' s Budget Speech) will be a Techno-Financial, Incubation and Facilitation Programme to support all aspects of start-up businesses and other self-employment activities, particularly in technology driven areas. As stated in the Budget Speech (2015-16), initially a sum of Rs. 1000 crores would be set aside for the purpose.

3. Accordingly, NITI Aayog has constituted an Expert Committee for working out the detailed contours of the Atal Innovation Mission (AIM) and SETU to achieve the stated objective, with the following composition:

(i)	Prof. Tarun Khanna	Chairman
(ii)	Dr. Rukmini Banerji	Member
(iii)	Shri Binod Kumar Bawri	Member
(iv)	Shri Vallabh Bhansali	Member
(v)	Shri Pramod Bhasin	Member
(vi)	Prof Vijay Chandru	Member
(vii)	Shri Mukesh Chatter	Member
(viii)	Shri Ashish Dhawan	Member
(ix)	Dr. Swati Piramal	Member
(x)	Shri Manish Sabharwal	Member
(xi)	Prof. Goverdhan Mehta	Member
(xii)	Prof. Devang Khakhar	Member
(xiii)	Prof Ashish Nanda	Member
(xiv)	CEO, NITI Aayog	Member
(xv)	Dr. C. Muralikrishna Kumar	Convener

4. The Terms of Reference of the Expert Committee are as follows:

- i. To review the existing initiatives aimed at promoting innovation and entrepreneurship in India, especially those efforts that result in widespread job growth and the creation of globally competitive enterprises;
- ii. To make short and medium term recommendations for actionable policy initiatives aimed at creating an innovation and entrepreneur-friendly eco-system such elements as creation of world-class innovation hubs and digital SMEs, and innovation driven entrepreneurship in such sectors as education and health;
- iii. To address any other related issues.

5. The Expert Committee will be serviced by the Communications, Information Technology & Information Division, NITI Aayog. The Committee will submit its report within 3 months.

6. The Chairman may co-opt additional members to the Committee as may be required for achieving the overall objectives.

7. The meetings of the Expert Committee would be held in NITI Aayog, New Delhi.

8. For attending meetings of the Expert Committee, the Chairman and Members would be entitled to Travelling Allowance & Dearness Allowance as under:

- i. Officials would draw TA/DA as per their entitlement from their respective Ministry/ Department/ Institution.
- ii. Non-officials from India will be entitled to TA/DA as admissible to Grade-I Officers of Government of India (travel by economy/ executive class as per entitlement by Air India) and this expenditure will be borne by the NITI Aayog. Members unable to travel from abroad may participate via videoconferencing.

9. This issues with approval of Vice Chairman, NITI Aayog.

R.K Gupta
Research Associate (CIT & I)

Foreword

Late in the spring of 2015, I was privileged to be asked to chair a committee on Entrepreneurship and Innovation, constituted under the auspices of NITI Aayog. The committee was pulled together in rather short order—a testimony to the good spiritedness of my colleagues who were willing to carve out time from their incredibly busy schedules—and we met formally to initiate the work on May 1, 2015, in the NITI Aayog offices in New Delhi.

Subsequently, there has been a whirlwind of activity, a near-continuous virtual-meeting to brainstorm and write the report these past months, punctuated by occasional physical meetings in New Delhi, Bangalore, and Boston (my adopted home).

We took care to ensure the committee was drawn from very diverse walks of life, to include entrepreneurs (with track records of building for-profit and social enterprises), financiers, scientists and academics, heads of academic institutions and, finally, several who have experience liaising with government. Each member has, in turn, helped us access an incredibly broad network of individuals not on the committee, both in India and in parts of the Indian diaspora, who have all unfailingly and generously given of their time.

Through all this, my colleagues in NITI Aayog, led by Arvind Panagariya and his able team, and, informally, colleagues in the Prime Minister's Office, have been nothing short of spectacular.

Our approach has been to take a big-tent view of entrepreneurship, to think of the innovation and creativity that underlie successful entrepreneurship in a variety of walks of life, far-transcending the exciting but ultimately rather limited remit of current entrepreneurial hotspots in information technology and e-commerce. These hotspots have given us much to be proud of, the “re-Bangalorization of the world” as the media sometimes puts it, but we cannot rest on these (limited) laurels. This has meant that our report is intentionally broader than past reports that have tended to emphasize venture capital and private-equity as handmaidens of entrepreneurship. There is an important role for such financing, and we suggest how to nurture it. However, at the end of the day, such financing is but one of multiple factors that need attention.

That said, we surely stand on the proverbial shoulders of giants. The committee laboured hard to acquaint itself with the myriad reports related to entrepreneurship produced by prior government committees and bodies, as well as numerous superbly qualified groups from the private sector and civil society. We are mindful of learning from these, as well from some other groups of people working in parallel in India on, for example, skill-development and securities markets issues.

Finally, consistent with India's desire to reimagine its future as a world leader, we seek to learn from the experiences of others and to contribute to these. So the reader will find an openness to experiments from far and wide. Chile, China, Israel and the United States, are sites of some of these that receive mention in these pages.

All this has led us to a conceptual model of an Entrepreneurial Pyramid that offers a prioritization of the many efforts that will propel entrepreneurship forward. First, we recognize that success breeds success, so, in the interests of building a constituency for change, we must identify actions that yield short-term payoffs. The so-called ‘top layer’ of our pyramid model does this. In particular, it identifies a dramatic upgrading and broadening of the incubators that pepper the Indian landscape already, a commitment to using competition and prizes to encourage grass-roots innovation, and the initiation of a symbolic but also substantive national entrepreneurship movement. The use of novel methods to stimulate innovation—including a special focus on science and technology—will affect the social inclusion that is sorely needed to empower the disenfranchised.

From there, we sequentially identify longer-range actions that will yield longer-term and more systemic payoffs, and will amplify the efforts of subsequent short-term initiatives. There is no use pretending that these investments—often in the form of public goods that have received short shrift from Indian society in recent decades—will yield results immediately, but there's also no option but to embrace the need for these changes.

Through all this, we repeatedly emphasize the importance of some behavioural traits that we'd all do well to embrace—a bias to action, a willingness to be accountable with output rather than input metrics, an openness to ideas from wherever they emerge, and a partnership ethos, the last especially important to overcome the huge trust deficit that exists between the public and private sectors. These 'can-do' attitudes will, we are confident, ensure that our report does not gather dust in some cabinet.

As the Honourable Prime Minister said in his Independence Day address on August 15, 2015, to the people of India, “Startup and Stand-up”. I couldn't agree more. Let's do it *sans* partisanship and with team spirit.

A handwritten signature in black ink, appearing to read 'Tarun Khanna', written in a cursive style.

Tarun Khanna
New Delhi and Cambridge

Acknowledgements

On the behalf of the committee, the chairman would like to thank the following organizations that contributed to this report:

- Aavishkaar Venture Management Services
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- InnAccel
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- Pratham India
- Seedfund India
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- The Global Education & Leadership Foundation
- The KAMMA Incorporation
- The National Science & Technology Entrepreneurship Development Board (NSTEDB)
- Think India

The Chairman would also like to thank the many experts from industry, academia, and government who attended and contributed to the brainstorming sessions organised by the NITI Aayog in New Delhi; IIM Bangalore professor Chirantan Chatterjee, and HBS professors Prithwiraj Choudhury, Ramana Nanda, and William Kerr, for their valuable inputs; and Radhika Kak (HBS - IRC) and Aarthi Gunnupuri for helping with the research and drafting of this report.

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Executive Summary

The purpose of this paper is to put forth expert committee recommendations to boost entrepreneurship and innovation in India. Recommendations are outlined within the AIM pyramid framework - a tool to holistically address the entrepreneurship challenge. As one moves from the base to the pinnacle of the pyramid, initiatives are designed to deliver more immediate payoffs. Conversely, the base symbolises actions with long gestation periods, but with profound effects. The fundamental premise here is that all layers of challenges to entrepreneurship need to be systematically addressed to bring about systemic change. In that sense, this report more comprehensively examines the entrepreneurship challenge than most recent analyses, which tend to focus primarily on the role of venture capital and private equity in promoting entrepreneurship.

Over the last few years, many expert committees and key government agencies such as the Planning Commission, the Department of Biotechnology, the Department of Scientific & Industrial Research and the National Innovation Council have released reports relevant to entrepreneurship and innovation in India. The committee recognises the contribution of these reports and their many excellent recommendations (see Appendix A for a literature review). However, despite exceptional ideas and the best of intentions, many of these recommendations were either not taken on board, or not implemented with full vigour. Therefore it is important to have good recommendations backed by good governance and an outcome-driven and measurement-based culture, the impact of which could be revolutionary.

The formulation of the Atal Innovation Mission (AIM) could be a defining moment in India's economic history, and the idea must be unfettered and allowed to flourish. To ensure that AIM kick-starts immediate innovation while setting into motion long-term changes, the committee has devised a pyramid framework that has allowed the report to include recommendations ranging from the short- to the long-term, which could have a transformative impact on the economy on this country. The committee also emphasizes the need to establish clear systems to monitor implementation, execution, and impact. Accountability and good governance form the backbone of successful policy. The government intends to set up a monitoring committee under the NITI Aayog. This is a welcome development, and can play a key role in ensuring execution of planned projects if implemented effectively.

The committee also recognizes the urgent need for disruptive change; that bold reforms are the order of the day. India needs to generate 115 million non-farm jobs over the next decade, to gainfully employ its workforce and reap its "demographic dividend". Given this context, encouraging and promoting self-employment as a career option for young people will be of highest importance. The culture of entrepreneurship should be inclusive and focus on a variety of enterprises, such as young & innovative technology firms, upcoming manufacturing businesses and rural innovator companies. Entrepreneurs should also be encouraged to help solve pressing socio-economic problems. There is a dire need to find financially viable solutions for the challenges of the disenfranchised. This will be of paramount importance, so as to ensure long-term social and economic stability, India needs a model that

pulls along the 350-400 million people that currently reside outside mainstream society.¹ Social inclusion not only fulfils higher altruistic purposes, but can also be financially viable. Furthermore, measures taken to enhance social inclusion would inevitably result in the opening up of a significant new market.

The first section of this report dwells on the role and importance of entrepreneurs in society. Entrepreneurs play an important role in the economic development of a country. Successful entrepreneurs innovate, bring new products and concepts to the market, improve market efficiency, build wealth, create jobs, and enhance economic growth. The ability of entrepreneurs to create jobs is certainly relevant to India, given the need for incremental new jobs. While we celebrate the success of several new ventures in e-commerce, information technology and mobile telephony, these will not likely suffice to deliver our aggregate growth expectations. The agricultural sector remains moribund, the rural economy neglected, and vast sectors starved of capital and talent, constrained as these are by our collective underinvestment in the requisite supporting institutions. Similar institutional inadequacy challenges bedevil investments in so-called social enterprises as well. India will have to encourage creation of new SMEs focused on manufacturing and innovation, while spurring rural innovation and growth. Hence, putting entrepreneurship at the forefront of the economic agenda is the need of the hour.

The second section of the report explains the AIM pyramid framework and its components in detail. The committee used this framework to make short, medium, and long-term recommendations to boost innovation. The pinnacle of the pyramid represents areas where action can be taken relatively quickly to deliver almost immediate payoffs. The middle of the pyramid highlights medium-term issues—those that are not simple enough to be solved immediately, but that can be addressed within a 5-7 year time frame if remedial steps are taken now. The base of the AIM pyramid symbolizes changes which are likely to have long gestation periods, but will lead to a profound transformation in the entrepreneurial fabric of the country.

In the third section of the report, we examine the current state of entrepreneurship in India, within the context of the AIM pyramid framework. The top layer identifies low-hanging fruit. If these are addressed, immediate results follow. These include: a lack of incentives for innovation at the national level, a lack of efficient business incubators, and insufficient access to capital. The intermediate layer sheds light on more structural challenges to innovation like an archaic education system, lack of work-related skills amongst the youth, and a disabling business environment. The base layer deals with fundamental challenges to entrepreneurship related to culture and mindset, which might well take a generation to address, assuming we start now.

In the fourth section of the report, we put forth short, medium, and long-term recommendations proposed by our expert committee to accelerate the entrepreneurship agenda. In the short-term, the committee proposes: introducing competitions and prizes as tools to encourage innovation, encouraging corporates to fund research and development at the university level, improving the efficiency of business incubators, and fostering a national entrepreneurship and innovation movement. In the medium-term, the committee proposes using digital platforms to encourage innovation, reforming the educational system to encourage creativity and upskilling workers to make them more employable, improving the ease of doing business, and strengthening intellectual property rights. Finally, the committee also proposes a number of measures to change cultural biases and attitudes towards entrepreneurship in the long-term, including attaching entrepreneurship to large scale economic and social programs, promoting new high-potential sectors via the government's "Make in India" campaign, fostering a culture of coordination and collaboration, attempting to redefine cultural notions of success, and tying entrepreneurship with the social inclusion agenda.

In the fifth section, we outline a structure for a proposed "AIM organisation" -a body to catalyse and energize the entrepreneurship agenda. This organisation must be empowered to deliver against its mandate and not be hamstrung by an array of vested interests that have bedevilled the laudable efforts at implementation of the reports of past committees.

Finally, in the last section, the committee uses the example of the bio-economy as one which has tremendous potential for innovation and growth. The potential of this sector to transform the economic outlook is akin to that of the software industry in the early 1990s. Experts say that biotechnology may have an even greater impact in a shorter period of time. The expert committee makes recommendations to unleash the potential of this sector. These include introducing competitions and prizes to bring forth innovations, adapting and re-orienting course curricula at the school and college level to enhance skill in biotechnology, and supporting early-stage ventures in this area. While these recommendations are substantive in their own right, given the likely importance of the sector in the next generation, their more parochial purpose here is to serve to illustrate the pyramid model in the report.

For this report, the committee has gathered data on a range of issues pertaining to entrepreneurship and innovation from several excellent government and non-governmental agencies, academic institutions, and consulting firms.¹ The committee is particularly grateful for their research and findings. It has also taken insight from experiments and developments taking place in many other countries. To substantiate and supplement publicly available data, the committee commissioned a few small-scale surveys to seek information on specific areas of entrepreneurship. Comprehensive findings from these surveys are presented in the appendices at the end of the report.

Numerous companies, non-profits, government departments, and individuals gave generously of their time to prepare this report speedily. For this the committee expresses its heartfelt gratitude.

¹Not all data provided and used in the report has been validated by the expert committee.

Why is Entrepreneurship Critical to India's Development?

Entrepreneurs play an important role in the economic development of a country. Successful entrepreneurs innovate, bring new products and concepts to the market, improve market efficiency, build wealth, create jobs, and enhance economic growth. De novo firms that unleash creative destruction shift surpluses from rent-seeking large producers to consumers and broader society. Joseph Schumpeter, one of the greatest economists of all time, put innovation at the heart of economic theory and capitalism. He proposed that innovation was the process by which economies were able to break out of their static mode and enter a path of dynamism. It was his theory of “creative destruction” that first highlighted the importance of innovators in revolutionizing the economic structure, leading to the creation of new products, services, and markets, and the decay of the old. Just as boosting entrepreneurship can lead to growth and job creation, failing to promote entrepreneurship can lead to stagnation, and social and economic inertia.

Bringing about innovation has never been as important as today, as the global economy shifts away from the industrial economy towards the innovation economy. Traditional manufacturing is becoming increasingly commoditized while intellectual property is the need of the hour. What is heartening is that recent economic theory suggests that government investment in R&D, knowledge-creation, and technological progress does have a role to play in fuelling innovation, productivity, capital creation, and therefore growth.ⁱⁱ This thinking highlights the scope for appropriate government policy and investment to enable entrepreneurship and innovation.

Many studies and data show the importance of entrepreneurs in creating jobs and up-skilling. In the United States of America (US), new businesses were responsible for creating on average one million jobs annually as compared to 300,000 by ten year old firms.ⁱⁱⁱ In fact, companies less than a year old have created an average of 1.5 million jobs per year over the past three decades in the US.^{iv} Israel saw its unemployment rate fall from 9% in 2000 to 5.5% in 2011 as new businesses grew 23% over the same period.^v In contrast, Japan has lost two decades partly due to stagnation in entrepreneurial activity. Up and re-skilling is another important service that new firms can provide. As the global economy moves towards automation, firms will require a very different skill-set from what workers currently have. The education system can only do so much. Agile de novo firms can play a role in providing workers with the skills required in the new economy. More efforts need to be made to encourage startups. India ranks in the fourth quartile among the G20 countries in a ranking of ecosystems that boost entrepreneurial activity.^{vi} A recent survey of Indian entrepreneurs revealed that only 18% of respondents felt that the government had taken satisfactory measures to nurture startups as compared to 37% in China.^{vii} Similarly, a survey of entrepreneurial ecosystems found that only 37% of Indian respondents believed that there was an availability of factors conducive for innovation.²

While supporting young firms in technology and other new-age innovative sectors is important, India also needs to develop an ecosystem that encourages innovation at more mature enterprises across the industrial spectrum—across the existing manufacturing, export, and rural and social enterprise sector. This segment has the capacity to generate a large number of jobs. For instance, in the EU, 60% of jobs on average across the region are accounted for by SMEs.^{viii} The success of the Mittelstand in Germany highlights that small and mid-sized family-run businesses can lead to job creation in an economy. Indeed, roughly 80% of jobs come from SMEs in Germany. In Korea, 90% of jobs are generated by SMEs. In India, the SME sector employs only 40% of the countries workforce, and is plagued by low productivity. This segment needs a boost. Diego Comin has conducted interesting research on scaling up SMEs in Malaysia, which could provide a blueprint.^{ix}

The ability of entrepreneurs to create jobs is particularly relevant to India given its employment crisis. India's demographic dividend has been much touted-while a substantial portion of post-independence India's population consisted of young children, by 2020, 63% of India's population will be of working age.^x McKinsey estimates that India's working-age population will grow by 69 million between 2012 and 2022.^{xi} Cashing in on this dividend will require India to create 69 million additional appropriate jobs, as well as jobs for those that are currently unemployed. Estimates indicate that to pursue an inclusive reform agenda, India needs 115 million additional non-farm jobs in the next decade.^{xii} Creation of new businesses will therefore be an important avenue for absorption of these workers. Therefore, developing and sustaining a vibrant entrepreneurial fabric is one policy option that

²Pillars measured included accessible markets, human capital, funding & finance, regulatory frameworks & infrastructure, education and training, major universities as catalysts and cultural support.

should be part and parcel of any economic development plan. India has seen a wave of successful entrepreneurship previously, which started during the time of the Swadeshi movement. Amongst these entrepreneurs were Jamshedji Tata who founded the first iron and steel company, P.C. Roy who founded Bengal Chemical Works, V.O. Chidambaran Pillai who founded the Steam Navigation Company, and Khwaja Hamied who founded Cipla, a pharmaceutical company. These firms have played an important role in alleviating the employment crisis over the years.

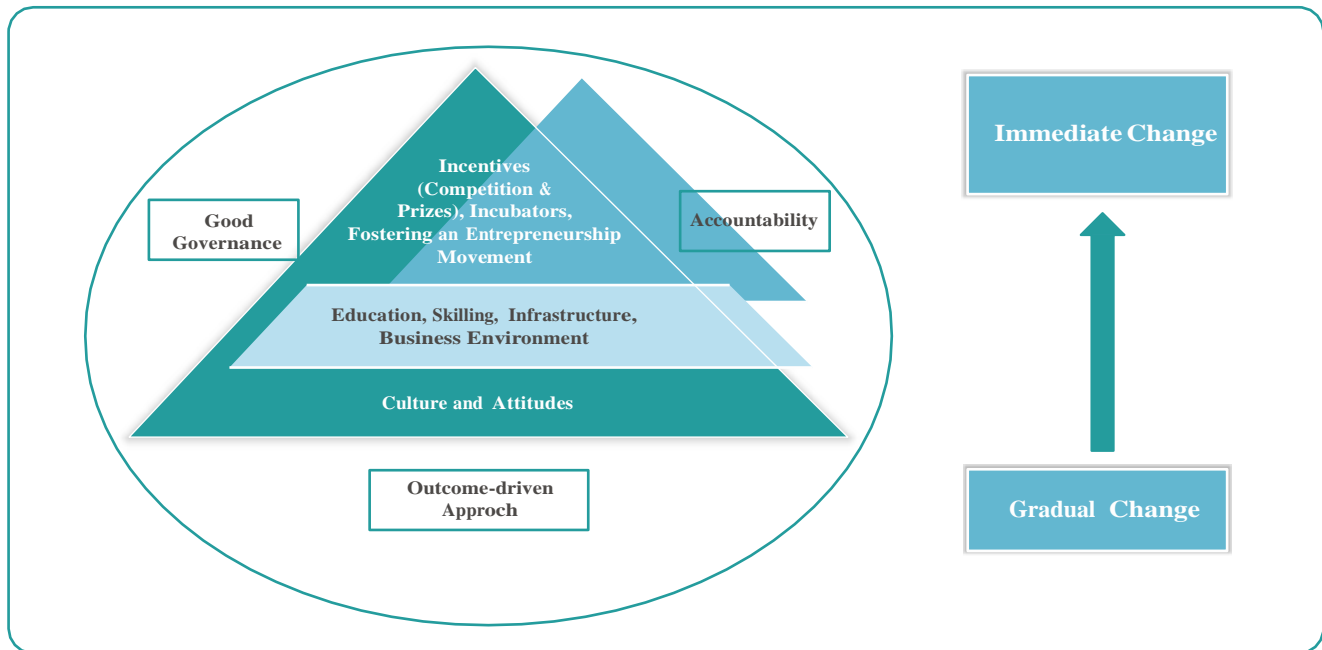
The entrepreneurial culture in India is picking up. Bangalore has been listed within the world's 20 leading startup cities in the 2015 Startup Genome Project ranking. It is also ranked as one of the world's five fastest growing startup cities.^{xiii} Nevertheless, much of this entrepreneurship is limited to the IT, e-commerce, and m-commerce sector. Furthermore, the number of entrepreneurial ventures remains small relative to India's population. Only 0.09 companies were registered for every 1,000 working age person—among the lowest rates of G20 countries in 2011.^{xiv} The Global Entrepreneurship monitor that tracks entrepreneurial activity, found that new business ownership rate for India in 2013 was the same as in 2008.^{xv} To create new jobs, India must move beyond its reliance on IT achievements and the industrial conglomerates that drove earlier post-liberalization growth. For example, India needs to develop technological capabilities to serve the requirements of its core industries—capital goods used in manufacturing industries are mostly imported, as are electronic goods.

There is tremendous scope to boost entrepreneurship in India. Some sectors immediately provide opportunities for growth. For example, the auto components sector is expected to see substantial growth as India moves from being the world's seventh largest automobile manufacturer in 2014 to the fourth largest in 2015.^{xvi} Sectors like IT infrastructure, biotechnology, healthcare and education, too are poised to grow several times in size over the next couple of years.³ There is huge scope in the field of social inclusion. Bringing the economically disenfranchised (including the dalits, scheduled castes, scheduled tribes, and other backward castes) and women into the economic mainstream^{xvii} not only serves a higher purpose; there is also a strong economic and social justification for the same. It would lead to greater stability in society in the years to come (a benefit across all socio-economic strata), and would also open up a significant new market for firms to tap. As such, it would substantially increase the proportion of the economy able to engage in productive activity. Of course, these projections are predicated on “business as usual” assumptions regarding entrepreneurial growth of new enterprises; were the latter to take off, the growth might be much greater, especially in sectors like life sciences and automobiles with a global “wind in the sails”. Government policy that favours innovation can have significant impact on growth and job creation in the economy, as indicated by economists that show innovation and productivity to be endogenously generated. Furthermore, India has a latent science and engineering talent pool, which may be particularly advantageous in a context where fewer graduates in Western countries are opting for STEM (Science, Technology, and Engineering Majors) coursework. Indeed, representatives from Google, General Electric, and IBM have noted that conducting world-class R&D in India is seen as a major opportunity to serve both domestic and international markets.^{xviii} This strength should be capitalised to generate indigenous intellectual capital.

³ India's growing IT infrastructure is another huge opportunity for tech-focused businesses, especially those that used app-based platforms since smart phone penetration in India is expected to grow 45% in 2014 from 117 million users in 2013. India's biotechnology sector is expected to grow 2.5 times over 2011 to 2015; health care is projected to grow 7 times from 2010 to 2020: Higher education is poised to grow five times by 2020.

The AIM Pyramid Framework for Entrepreneurship

Figure 1: The AIM Pyramid Framework to examine entrepreneurship



The AIM pyramid framework examines entrepreneurship within the context of short, medium, and long-term obstacles and opportunities. The fundamental premise here is that all layers of challenges to entrepreneurship need to be systematically addressed to effect systemic change. The pinnacle of the pyramid represents issues for which there are relatively quick fixes, wherein measures taken today should deliver almost immediate payoffs. The middle of the pyramid highlights medium-term issues—those that are not simplistic or superficial enough to be tackled immediately, but that can be addressed within a 5-7 year time frame if remedial steps are taken now. The base of the pyramid presents measures to tackle fundamental impediments to innovation. These are likely to have long gestation periods, but will likely lead to profound changes in the entrepreneurial fabric of the country. The AIM pyramid presents a multi-layered framework to tackle the entrepreneurship agenda in a holistic sense. Most recommendations rely on collaboration between the public and private sector to unleash full entrepreneurial potential of the country. This is further highlighted through the fact that the AIM Pyramid is encased in a Good Governance circle, which the committee strongly feels is the backdrop of a successful entrepreneurial and innovative economy. A Development Monitoring and Evaluation Office is soon to be set up under the NITI Aayog to monitor progress on the government's flagship programs. This is certainly a welcome step if implemented and executed effectively.

A. The Top Layer: This layer seeks to highlight measures with quick payoffs that can expedite the development of an entrepreneurial and innovative culture in India. It consists primarily of measures designed to provide support to early stage startups and to encourage innovation in the manufacturing and rural sector. First-time entrepreneurs have difficulty initially due to the lack of mentoring facilities, and technical and financial support. This problem is also present in the manufacturing-based SME sector and amongst rural enterprises, many of which are focused on traditional arts and crafts and have great export potential. A lack of incentives also plays a role in inhibiting would-be entrepreneurs. Various steps can be taken to encourage early-stage ventures. This includes encouraging new entrepreneurs through competitions and prizes for innovation, encouraging corporates to fund research and development at the university level, enhancing the scope and efficiency of business incubators, and celebrating and recognizing the importance of entrepreneurs at the national level. Measures taken at the policy level could provide the catalyst to unlock private sector potential. Israel, for instance, presents a great example of how public-private partnerships (PPP) can effectively encourage entrepreneurship. Amongst other measures, the Israeli government introduced partial loss guarantees on venture capital funds, with crucial accounting mechanisms in place, that have enabled new ventures to come to market.

B. The Intermediate Layer: The intermediate layer consists of fundamental factors that come in the way of entrepreneurship. These institutional inadequacies prevent the consummation of productive enterprise—for example, absence of entities that can help assess and locate talent handicap growing enterprises searching for managers and engineers, and have long been the subject of policy interest. Amongst others, these voids consist of gaps in physical infrastructure, and in the soft infrastructure required to enforce contracts expeditiously. More generally, they can be thought of as deficiencies in the intermediation structure necessary to enable buying and selling in product, labour, and capital markets.⁴ Measures taken to effectively improve the institutional framework of the economy have the potential to significantly alter the entrepreneurial landscape over the medium term.

Various measures can be introduced to address medium-term challenges. These include embracing digital platforms to encourage the public and private sectors, reforming the archaic education system and putting emphasis on work-related skills, improving the ease of doing business by simplifying regulations, and putting more emphasis on a stringent intellectual property rights regime. Setting the foundation of a strong business environment would unleash private sector investment and entrepreneurship.

C. The Base Layer: The base layer consists of deep-rooted cultural impediments to entrepreneurship. Tackling these obstacles will require fundamental changes in societal thinking. This may only be possible with generational change.

The biggest cultural obstacle to unleashing entrepreneurial potential is middle-class India's scepticism about entrepreneurship. Notwithstanding the exuberance around the IT, e-commerce, and m-commerce sector at the moment, in the “mainstream” of the economy, there continues to be suspicion, even distaste, evinced by the idea of entrepreneurship. Of course there are certain sections of Indian society (Gujaratis, Marwaris, Parsis) which have long track records of success in entrepreneurship. Hence it would be unfair to generalize across communities. Nevertheless, there is room for much greater percolation of the entrepreneurship spirit through the interstices of Indian society. Young creative individuals are often held back from starting new ventures due to inherent scepticism amongst family members. Given this cultural context, any blueprint that intends to effectively encourage entrepreneurship must promote and embrace a risk-taking and creative mindset. A related cultural obstacle to innovation is the limited tolerance for failure in Indian society. Experimentation and failure are integral parts of creating and building new ventures. Therefore, a societal tolerance for failure as part-and-parcel of the learning process needs to be inculcated. Failure should not be *per se* chastised.

Apart from the overarching theme of a generalized aversion toward risk-taking and failure in India, other more subtle cultural impediments also present a challenge to entrepreneurship and innovation. These include: a general sense of apathy and untimeliness in law enforcement, aversion to change within the bureaucracy, the culture of rent-seeking at several layers of governance, a cultural skepticism toward intellectual property rights, and a general, pervasive and deeply corrosive sense of mistrust between the government and the private sector. These factors slow down the private sector in India. Other cultural impediments include a general de-prioritization of soft skills in favor of hard technical knowledge, and a bias by employers against graduates hailing from non-elite institutions or non-engineering backgrounds, amongst others. Given this cultural context, even measures enlisted within the intermediate layer may take longer to implement and see impact. Conversely, addressing these mindset issues consistently and with gusto over the years to come will enhance the efforts of the middle and top layers of our pyramid.

⁴The idea of ‘institutional voids’ is explored at length in Tarun Khanna & Krishna G Palepu’s book (with R. Bullock), “Winning in Emerging Markets: a Road Map for Strategy and Execution,” Harvard Business Press, 2010.

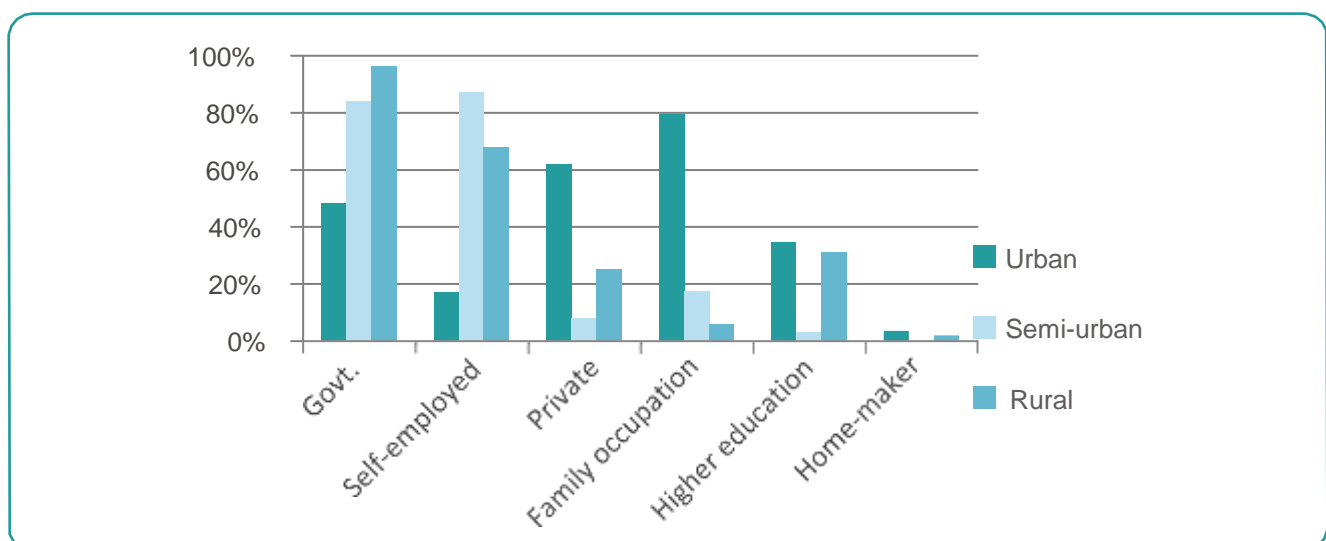
The State of Play

The Top Layer: Inadequate Support to Early-Stage Startups

1. Lack of incentive structures for entrepreneurship: Incentives have long been used as a tool to encourage innovation in the developed world. Grand Challenges for instance, have a long history, dating all the way back to the 1700s, when the British Crown announced a “Grand Prize” for finding a way to measure longitude. In recent times, Grand Challenges have been on the rise after the Ansari X-Prize, which called for innovation in spaceflight, was introduced in the US in 1996. In 2014, the British Government announced Grand Challenges—to promote innovation in science and technology.^{xix} In the US, through the challenge.gov platform, the Federal Government has run over 400 competitions through 75 agencies.^{xx} More recently, in China, state-backed groups and institutes use the challenge-approach to widen the debate on innovation and find solutions to problems. China Association of Construction Enterprise Management, for instance, gives over 100 awards annually for innovation in construction.^{xxi} China’s Ministry of Education oversees several national competitions in areas ranging from advertising to electric design to cloud computing.^{xxii} The US also has several reality TV shows that focus on business plan competitions, including “The Profit”, “Project Runway”, “Shark Tank”, “Crowd Rules”, and “The Apprentice”. Conversely, India traditionally has not had structures and incentives in place to encourage innovation. As our patent system is cited as relatively weak and ineffective, there is room to use competitions and prizes as tools to encourage entrepreneurship.

In India’s context, competitions could be used in particular to expedite rural development and social inclusion. Though this mechanism is by no means an infallible method to encourage entrepreneurship, it can help in incentive-creation for entrepreneurship in the absence of a fully functional patent system.^{xxiii} We have a strong scientific knowledge base that should be harnessed to solve the country’s most dire socio-economic problems. If India is able to successfully achieve this, the model can be replicated across the developing world. There is a strong case to use local talent to develop solutions to rural problems.⁵ Organisations like the Honey Bee Network are focused on finding and encouraging innovations stemming from rural regions. It has documented several hundreds of these over the years. Adequate training, mentorship, access to capital and a supportive ecosystem could unleash a rural “startup” boom. Further, rural youth are also keen on self-employment. A survey conducted on 195 economically backward students revealed that rural youth are also strongly inclined towards entrepreneurship—87% of respondents from semi-urban areas and 68% of respondents from rural areas expressed interest in self-employment, versus only 17% in urban areas (see Figure below and Appendix D for more details).

Figure 2: Responses from a survey conducted on economically-backward youth: The question asked was “Which of the following areas of work do you see yourself engaged in after 3 years?*



*Survey respondents were allowed to choose multiple options

⁵ With the assistance of an extensive volunteer base, Ahmedabad-based Honey Bee Network has mobilized more than 170,000 ideas, innovations and traditional knowledge practices from around 545 districts. The Network is driven by the philosophy that economically poor people should not be treated as sink of public aid or merely as bottom of the pyramid consumers, rather as a source of ideas, innovations and institutional arrangements with which formal public and private institutions can engage.

2. Lack of adequate business incubators to support early-stage ventures: Incubators play an important role in supporting early-stage startups. Typically, they provide infrastructural support, a platform for networking, management assistance, and other support services. In comparison with traditional measures used to promote industrial development, incubation is found to positively impact the economy and create jobs with much less investment.^{xxiv} An NYU Stern School of Business economic impact study found that in a span of five years, three incubators linked to the Polytechnic Institute of New York University, generated \$251 million in economic activity and created 900 jobs (in 2013).^{xxv} In South America, a dynamic business incubator has put a relatively small country on the global map of innovation and enterprise building—the activity and curiosity generated by the state-promoted Startup Chile has been unprecedented.^{xxvi} Israel and Singapore have also made much progress in this arena (see Figure below).

In India, the concept of business incubation is still at a nascent and experimental stage and focussed on urban areas. Much can be done to strengthen the scale, scope, and efficiency of business incubators. One area where there is a clear need for support is in mentoring and networking—a survey (commissioned by the committee) conducted on several traditional clusters in India reveals that approx. 50% of respondents feel the need to improve formal networking within their sector through associations, and to enhance their ability to work cooperatively with the government. Approximately 60% of respondents stated that access to global markets needed to be strengthened—another area where incubators can help. Surveys also highlight that widespread investment, rather than focussed investment in urban areas, is needed to trigger entrepreneurship (see Appendix B).

Our incubators have tended to operate as silos. Though they are housed within Universities in some instances, none of them build on meaningful links with the research climate in the universities, neither really benefiting from the research, nor contributing to it. Nor are the incubators adequately connected to the established corporates, so their identification of needs suffers from inadequate exposure to ‘real world’ problems, and the ability of the incubators to generate productive insight relevant to existing firms is rather limited. Finally, the incubators do not learn from one another’s experience. The end result is that, as an ensemble, the incubators that we have punch way below their weight. By investing dramatically in them—not just in the per incubator allocations, but also in the institutional linkages that prevent them from each operating in isolation—we can dramatically upgrade their contribution.

Conversely, we must introduce a degree of accountability, those incubators that prove unequal to their mandate must cease to draw on society’s resources. The committee was bedevilled in its attempt to collect meaningful output measures, and concluded that there are insufficient incentives currently for incubators to hold their own proverbial feet to the fire. Underperformance therefore persists.

Figure 3: Examples from the World

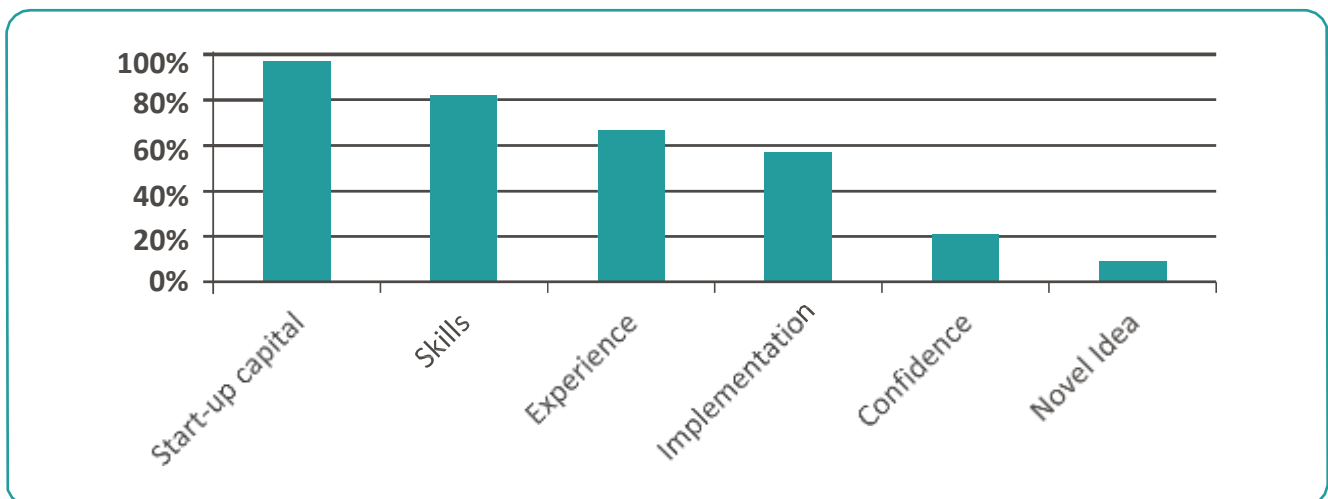
Chile	Startup Chile is a program created by the Chilean Government, that seeks to attract early stage, high-potential entrepreneurs to bootstrap their startups in Chile, using it as a platform to go global. The end goal of the accelerator program is to convert Chile into the definitive innovation and entrepreneurial hub of Latin America. The program, which was launched in 2010, provides Rs. 24 lakhs (\$40,000) to entrepreneurs who move to Chile for six months and start a new business. At its inception, it was one of the few initiatives in the world that offered bootstrapping entrepreneurs financial support without taking equity. The program has since inspired similar initiatives, including Startup Peru and Argentina’s Incubar. Although, retention numbers are poor and nearly 80% of participating entrepreneurs left Chile after the first six months, Startup Chile is helping foster an entrepreneurial spirit in the country: only 10% of the initial applicants to Startup Chile were Chileans. Now, 29% of the entrepreneurs are citizens of the country.
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Figure: Examples from the World

Israel	The government's YOZMA program helped boost the VC industry in Israel, by using Rs. 180 crores to set up 10 private sector venture funds. It also spent Rs. 40 crore as direct investments in high-tech enterprises. Further the government required each fund to partner with a foreign VC and an Israeli investment company or bank. The funds had the option to buy out the government's share after five years. In addition to this catalytic funding, the government also exempt non-Israeli investors in a VC fund from capital gains tax and allowed pension funds, endowment funds and High Net worth Individuals, among others, to invest in startups. The Israeli government also absorbs a percentage of losses that institutional investors may suffer from VC investments. To boost R&D, the government gives grants to companies that employ immigrants with advanced degrees as well as returning residents.
Singapore	The government has introduced a tax deduction of up to 50% on the investment for approved angel investors that commit a minimum of Rs. 37 lakhs. This is subject to a maximum limit of Rs. 93 lakhs with a holding period of two years.

3. Inadequate access to capital and insufficient impact assessment: Access to patient capital is a critical ingredient for startup success. In India, entrepreneurs struggle to obtain funding. Entrepreneurs spend an average of four-to-five times more effort raising funds as their American counterparts.^{xxvii} Access to funds is even more constrained for the economically deprived and for women. In a survey conducted on economically backward youth, 97% of respondents stated that access to capital was a barrier to entrepreneurship (see Figure below, and Appendix D for more details). In 2012, female entrepreneurs had access to only 27% of needed debt capital from formal lenders, versus a 70% corresponding figure for male entrepreneurs.^{xxviii}

Figure 4: Factors limiting entrepreneurship for the economically-backward*



* Survey respondents were allowed to choose multiple options

One issue is that much of invested private equity and venture capital (VC) funds are directed towards the e-commerce sector. As a result, large swathes of entrepreneurs struggle to secure capital.

Another issue is the lack of funding available at the seed funding and angel stage. Angel investments in India comprise only 7% of early-stage investing as compared to 75% in the US. VCs in India tend to prefer later-stage type funding i.e. companies that are already generating revenues, which would ideally attract PE investments. They also prefer to make large investments in a handful of companies, in the range of Rs.3 crores to Rs.5 crores. Consequently, smaller startups, that need funding in the range of Rs.25 lakh to Rs.50 lakh, are often overlooked. One key reason for inadequate PE/VC investment is tough regulatory restrictions on domestic investors. Consequently, the industry as a whole is heavily funded by foreign capital. While foreign VC investors have no specific tax exemption, many investors avail the benefits of the Double Taxation Avoidance Agreement (“DTAA”), which India has with several countries. While foreign capital is welcomed for the VC/PE industry, an excessive reliance on these investments may simply mimic solutions that exist in the developed world and not necessarily encourage businesses and innovations that offer solutions to India’s needs. Further, foreign investments tend to be procyclical, varying with macroeconomic conditions. This is a risky phenomenon, as was shown through the experiences of Asian economies during the East-Asian crisis. The absence of corporate venture capital (CVC) firms accentuates the problem. CVCs are an important source of financing. Apart from capital, they also offer expertise, reputation and technical knowledge when they invest in startups that have synergies with their companies. Research has shown that where such synergies exist, corporate venture capital can be more efficient than independent venture capital.^{xxxix} While Indian corporates have entered venture funding, such as Future Ventures, the investment arm of Future group, such instances are few.

Debt funding is difficult to come by. Banks tend to lend very conservatively, and demand cash flow or collateral for financing. These are two assets most young entrepreneurs do not possess. The International Finance Corporation (IFC) estimated that in 2012 there existed close to a \$58.6 million (Rs.352 crores) of debt gap for MSMEs.^{xxx} Venture debt recognizes entrepreneur’s need for flexibility, and provides cash flow between rounds of investment, without requiring the dilution of equity. However this avenue of funding is underdeveloped in India.⁶

Inadequate government funding of research and entrepreneurship is also an issue. Government-funded research can lead to technological breakthrough. A substantial set of commercialized innovations have stemmed from the work of publicly funded research institutions and universities in the US.^{xxxi} For instance, Google was based on an algorithm developed as part of a research project supported by the National Science Foundation. The Internet and the GPS were breakthroughs by teams initially pulled together by the Defence Advanced Research Projects Agency.^{xxxii}

Over and above the need for more capital, there is also a need to ensure that funds invested are generating impact. As with other areas of governance, there is perhaps inordinate emphasis on reaching numerical targets and too little emphasis on ensuring that funds are utilized well. Purely illustratively, consider the 2% CSR target imposed on large corporates by recent modifications to the Companies Act. If complied with, this law has the capacity to generate \$2.5 billion per annum—a sizeable corpus that can be used (at least partially) to fund new ventures. But there is vast amount of wastage already inherent in the dispensation of CSR funds. One is that firms have little to no knowledge on related activities of other organizations. This leads to a redundant duplication of efforts. Information sharing via an e-platform could result in augmentation of existing efforts, and therefore greater impact. Furthermore, rather than disparate small investments made at the firm level, a more effective strategy could be to pool firm CSR resources and direct them to established Impact Investors. These agencies have developed skill and expertise in lending to new ventures through years of experience, and would arguably be best placed to deploy resources efficiently, and monitor impact.

The Intermediate Layer: A Disabling Environment for Innovation

1. Gaps in Education and Work-Readiness: The Indian education system is perhaps among the most unprepared for the new innovation economy. A World Bank report suggests India is seen as a country facing skills shortage caused by a lack of skills development and an unresponsive education system.^{xxxiii} A survey of entrepreneurial eco-systems found that only 22% of Indian respondents believed that education and training were adequate in the country, the lowest score amongst all the regions surveyed.⁷ The Global Innovation Index 2014 ranks India as the lowest among all the BRIC nations,^{xxxiv} and pinpoints India’s state of education as its most acute challenge.

⁶ While institutions like the Small Industries Development Bank of India, KKR Financial services, the non-banking financial company arm of PE fund Kohlberg Kravis Roberts, Silicon Valley Bank India Finance have begun providing venture debt in India, much more needs to be done.

⁷ Comparative countries included the US, UK, Australia, Mexico, Australia, Mexico, Pakistan, Singapore, Spain, Ireland, Switzerland.

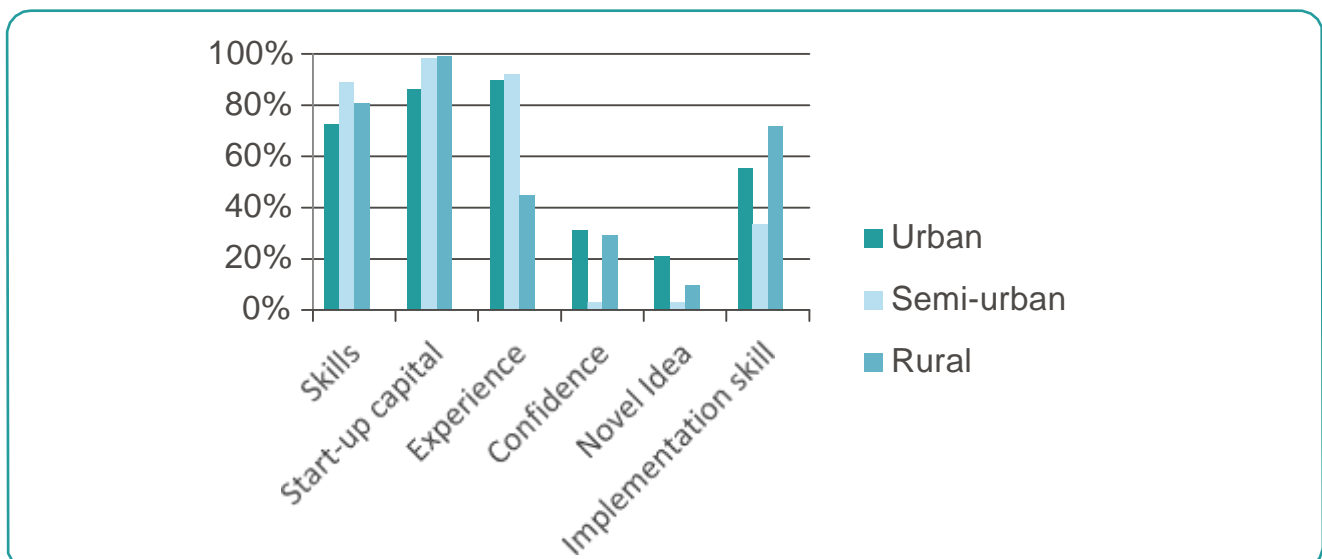
The biggest problem is that the Indian school system is geared towards a rigid overly prescribed curriculum and an emphasis on rote memorization. Soft skills—collaboration, interpersonal engagement, creativity and critical thinking—are ignored in favour of single-minded test preparation. In a survey of Indian teachers, 92% of respondents were of the opinion that due to exam preparation, students have reduced focus on academic, cognitive as well as vocational skills. Supporting the results, a survey of Indian graduates revealed that no more than 25% could apply abstract concepts to solve a real world problem in the fields of finance and accounting. In comparison, while US students do not fare that well in mathematics and science,⁸ they have access to a more diverse and multi-disciplinary curriculum that cultivates creativity, risk-taking and a broader perspective on job possibilities. Experts say that by the time students in India reach higher education levels they lack the creativity, critical thinking skills and open-mindedness required to become successful innovators and entrepreneurs. Think about the now-iconic iPhone. Its design required not just “hard” engineering knowledge, but also a “softer” aesthetic sense to redefine the way individuals worldwide engage with the ubiquitous device in their pockets. India’s rigid system makes it overly difficult for such intellectual symbioses to occur.

A 2008 National Knowledge Commission survey revealed that one in three entrepreneurs considered it “somewhat difficult” or “very difficult” to find employees with the right skills. According to the government’s own analysis, of the 12 million universities and technical college graduates produced every year, only 10% have the skills needed to join the workforce. According to a survey by Aspiring Minds, 47% of graduates are not employable in any sector of the knowledge economy—less than 20% engineers are employable for software jobs and 7.5% are employable for core engineering jobs.^{xxxv} This deficit in employability is accompanied by a significant demand for manpower of

on average 18.4 million people per sector.^{xxxvi} To address this gap, the government under its National Skill Development Mission has set a target of training 500 million people by 2022. Though this target in theory marks a step in the right direction, effective and timely monitoring will be required to ensure compliance. Progress towards this numerical target should be monitored on at least an annual basis, and industry experts should be roped in to assess the quality of skill development on a yearly basis.

The problem is compounded by the fact that only a small number of elite institutes, like the Indian Institute of Management, Bangalore; Indian School of Business and SP Jain Institute of Management & Research, offer coursework in entrepreneurship. The limited number of faculty with either practical or academic experience with entrepreneurship makes it difficult for young entrepreneurs to find mentors. This explains why 70% of respondents in a survey across manufacturing sectors agreed that access to relevant knowledge needs to be strengthened. Simultaneously, over 80% of economically backward youth highlighted the need for technical and entrepreneurship training to allow them to become self-starters (see Figure below, and Appendix D for more details).

Figure 5: Factors that would enable economically-backward youth to become entrepreneurs, by location*



*Survey respondents were allowed to choose multiple options

⁸ As per the 2012 PISA results for 65 countries, for 15 year-old US students, the average mathematics literacy scores were lower than 29 other countries and the average science scores were lower than 22 other countries (see <http://nces.ed.gov/>).

2. A Disabling Business Environment: India's business environment is decidedly unfriendly and not conducive to corporate investment. In the World Bank Ease of Doing Business Survey for 2015, India ranks last amongst BRIC countries, and 142 out of 189 countries.^{xxxvii} Lack of institutional and infrastructural support could be the reason that only 28% of respondents in a survey of over 25 manufacturing and export sectors stated that they felt they were globally competitive (see Appendix B).

One of the issues is a complicated tax regime arising from India's federal structure. Twenty-eight states levy 28 sales taxes and have different procedures to obtain a sales tax license. Any business that covers more than one state must navigate multiple tax systems. While the proposed Goods and Services Tax (GST) would go a long way in simplifying business administration, its future is far from certain.^{xxxviii}

Another issue is the time and cost required to shut down a failing business. Even companies that have minimal assets take on average about six months to close down under the so-called "fast track" procedure. Because of the number and expense of procedures, many owners choose to keep their defunct businesses alive on paper. This is costly in the long-term. The government has set up a committee to consider bankruptcy laws that allow entrepreneurs to easily close down unviable businesses. Progress here is urgent.^{xxxix}

India's intellectual property regime is weak, and a deterrent to innovation. India ranks at the bottom of the US Chamber of Commerce's Global Intellectual Property Center's ranking of 25 countries, in terms of its intellectual property environment.^{xl} This perception is largely driven by weak enforcement of intellectual property rights, rather than the laws themselves. Experts estimate that it takes on average five to seven years to process a patent application, and in some cases even more than a decade, as compared to two years in the United States.^{xli} India had 201 patent examiners in 2012-2013. This is not enough to deal with the quantity of patents. In 2005, there were 56,171 pending patent applications; this has increased to 194,000 in 2013.^{xlii} A weak IPR regime on patents and trademarks reduces incentives for entrepreneurs to invest in innovation and research. The number of patents filed in India is rising, but the numbers from other countries such as China and Korea are rising exponentially. According to a World Intellectual Property Organization (WIPO) study, India's patent application numbered 1400 at the same time that China filed 24,000, Japan 45,000 and the US 63,000.^{xliii} Even in traditional areas of strength like chemistry, China's patents have far exceeded that of India's.

India also needs a regulatory framework that favours innovation. In every field that requires licenses the laws are old and obsolete, many of which were written over 50 years ago. There is no regulatory pathway to facilitate Indian scientists and regulators working on new technologies. For example, in the case of new medicines, there is often an insistence on replicating studies done abroad which sometimes increase the cost unnecessarily.

In short, India needs an innovation strategy. Countries like Korea, Canada, Israel are focussing on cutting-edge technologies and encouraging both private and public sector research. These include semiconductors and molecular imaging (Korea), rare metals (China), biomaterials (Canada), and Information Technology (Israel) to name a few. India is behind the curve on this front.

Labour laws are complex and cumbersome. Currently there are 44 central labour laws and 160 state laws pertaining to labour. There are many overlaps in jurisdiction. The Industrial Disputes Act is particularly rigid as it requires that companies employing more than 100 workers obtain government permission to fire a worker or close down a plant. Inflexible labour laws are a deterrent to doing business in India, and serve as a disadvantage versus South-East Asian countries.

Finally, India's well-documented infrastructure deficit creates barriers for entrepreneurship. While 21st century startups are not often associated with brick-and-mortar, they require infrastructure—road, rails, and internet—that join them to their markets. Amongst the most significant issues are connectivity, low bandwidth availability, and the lack of electricity in cities and towns outside of major metro areas or satellite towns. Typically, businesses have to incur additional costs to overcome these infrastructure deficits. For instance, frequent power outages need to be countered by investment in expensive diesel-powered electric generators to run manufacturing units, factories, shops and even offices. Land acquisition is a notoriously time-consuming and costly process, and makes it difficult for new companies to set up in India, and existing companies to physically expand their operations. Rural microenterprises find it costly and sometimes impossible to transport their goods to more urban areas, due to poor physical infrastructure.

Apart from these issues, business leaders often complain of a slow and inefficient bureaucracy, which leads to delays in decision-making and implementation. This serves as a deterrent to public-private partnerships.

While this litany of problems affects all firms, larger established corporates have the wherewithal to roll with the proverbial punches; for de novo entrepreneurs, these collectively sound the death knell far too often.

The Base Layer: A Cultural Context that Favours Stability over Risk-Taking

1. A cultural affinity for stability: The prevailing culture in middle-class India emphasizes stability and job security over risk-taking. Students have been conditioned to pursue high status and well-paid positions with reputable national and multi-national corporations as these are the main indicators of success. The salary and stability of such jobs are perceived as critical for young (especially male) professionals preparing for marriage and older professionals who are beginning to consider the costs of caring for elderly or retired parents. Therefore, young workers or students prefer not to turn to the risky and financially uncertain world of entrepreneurship. In an employment survey, only 6% of engineers had startup companies as their first job preference.^{xliv} In a survey conducted on economically-backward youth, 60% of respondents stated they would prefer the security of steady income from a job, even though most felt that they could earn more money if they succeeded as an entrepreneur. Nearly all who said they would not choose entrepreneurship as a career, stated the fear of monetary risks as a hindrance. Almost 70% cited family pressure to seek stable employment as a deterrent (see Appendix D).

This cultural bias plays out in a disproportionate preference for careers like engineering and management. In 2011-2012, of the total students enrolled in higher educational institutions, 17.5% were enrolled in commerce/management and 16% in engineering as compared to only 1.8% in law and 3.6% in education.^{xlv} India also needs urban planners, demographers, architects, artists, movie producers and many others. The Indian education system does not promote these careers on the same footing as more traditional careers. Neither is there a system of talent assessment and associated counselling that could steer young people towards different educations.

This notwithstanding, there are sections of Indian society, like the Gujaratis, the Marwaris, and the Parsis, that are culturally disposed to entrepreneurship. Many “business families” within these communities have built businesses that span the globe. However, even these successful families are sometimes averse to adopting modern techniques of financing or modern management techniques; this inadvertently impedes their growth.

2. Stigma over failure: The prevailing culture in the country tends to stigmatize failure. As a result, 60% of entrepreneurs that have failed with their first venture return to large companies instead of trying out new ideas or improving the original.^{xlvi} The World Economic Forum survey of entrepreneurial eco-systems found that only 17% of Indian respondents stated that the so-called “cultural support pillar” was available in the country. This was the *lowest* score amongst all the regions surveyed.^{xlvii}

3. Bias against hiring non-engineers and those from non-elite universities: Many graduates face discrimination based on the ranking of universities they graduate from and the assumptions made by the labour market about such graduates. Job candidates for engineering positions from a tier-3 college are 24% less likely to get the job than a tier-1 student of equal merit. Should the tier-3 candidates get the job, they will receive substantially lower salaries. There also tends to be a bias against hiring non-engineers. This creates an inequality in the job market and reduces firms’ access to a large set of meritorious students.^{xlviii} Indeed, in 2014, 41% of employable graduates in accounting hailed from colleges outside the top 30% of ranked schools.^{xlix} Similarly, 70% of employable engineers graduate from lesser-known colleges.¹

In diametric opposition to this bias, research on software firms in India has demonstrated that employees hired from remote geographic areas actually outperform employees hired from non-remote locations. Further, survey results from the Koramangala start-up cluster in Bangalore (a survey commissioned by the expert committee), showed that 85% of entrepreneurs came from lesser-known colleges, whilst only 16% came from elite universities. 44% of entrepreneurs hailed from non-engineering backgrounds. Some companies are realizing this, and proactively devising systems to leverage this high-ability under-utilized talent.ⁱⁱ Encouraging entrepreneurship among this subset of meritorious students could be one solution to the employability problem.

4. Loss of top talent to other countries: Top talent from India has traditionally sought overseas opportunities both for education and jobs. India needs to devise mechanisms to leverage its diaspora to enhance knowledge inflows and attract talented Indians working abroad. This is especially important as return migration is often concentrated among the most successful and highly educated migrants.ⁱⁱⁱ Recent optimism surrounding India's growth prospects has brought back some highly skilled talent to the country, but not in big enough numbers to create impact. Bringing about reverse migration will be a long-term theme as it involves offering would-be returnees not only attractive opportunities and pay, but also a western-style lifestyle. Significant effort will be required to improve urban infrastructure (roads, transportation, education), and the perceived "liveability" of cities.

5. Trust deficit between the government and private sector: Business and government have to work hand-in-hand to deliver economic growth and employment. Unfortunately in India, a culture of mistrust between the public and private sector has developed due to years of non-cooperation. Corporates complain of a general sense of apathy and untimeliness in law enforcement, aversion to change within the bureaucracy, the culture of rent-seeking at several layers of governance, and an erratic and mercurial political context. For instance, sectors like real-estate, defence, and manufacturing require a multitude of licenses, which adds unnecessary cost and time to complete. The licensing department has no incentive to simplify procedures as the opaque requirements allows for graft. On their part, policymakers and bureaucrats complain that even meeting with senior executives from big corporate houses bring forth allegations of corruption and crony capitalism. Hence, despite their desire to help, officials are wary of being seen as partial to business, lest they be accused of wrongdoing. This fear has assumed such proportions that senior business leaders in India now complain of a total lack of engagement with policymakers. A lack of collaboration between industry and the government is damaging for investment and growth. This relationship must change to one of cooperation and collaboration to achieve mutually beneficial goals. In this regard, recent successful efforts to bridge the sense of mistrust must be celebrated and encouraged.

Committee Recommendations

Committee recommendations range from the shortest-term measures that can be quickly taken to encourage entrepreneurship, to those that are most foundational, that will manifest over the long haul, but will increase the efficacy of short-term efforts over time. We emphasize that measures at each layer of the AIM pyramid will need to be undertaken to fundamentally and sustainably boost entrepreneurship in India.

Top Layer: Providing Adequate Support to Early-Stage Ventures

1. Introducing Competitions to Solve Pressing Economic and Social Problems: Incentivising technology breakthroughs can lead to disruptive innovation and viable (low-cost) solutions to tough developing-world problems. Introducing prizes and competitions could encourage more young creative minds to go down the path of entrepreneurship, and provide a foothold even for entrepreneurs that do not win. For instance, through the course of UTV Bloomberg’s “The Pitch”, Zipdial, a company that made it to the final round, secured funding from Mumbai angel investors, despite not winning the competition. There is plenty of evidence that entrepreneurial talent and capability does exist. The indigenous development of the Simputer, a handheld low-cost alternative to a personal computer, is one such example of this. Simputers have already been used effectively to automate land record procurement processes in Karnataka, for e-education in Chattisgarh, and more recently for tracking of traffic offenders by the police. India’s Mars mission—ten times less expensive than the corresponding US mission—was another example of India’s technological capability. Costs were maintained by prioritizing home-grown components and technologies over expensive foreign imports.

In India, innovation is particularly needed to expedite the sluggish rural development process. About 74% of India’s population lives on the fringes of economic development, mired in deep-rooted multigenerational poverty.ⁱⁱⁱ They are most vulnerable to the lack of good infrastructure, electricity, clean water, quality healthcare, and education; even as problems related to rapid development, like waste disposal and pollution continue to rise. While scientific innovation and technology offer solutions to many of the problems plaguing India and much of the developing world, these solutions are often unaffordable to the citizen or the government. For instance, a small percentage of India’s population uses Reverse Osmosis (RO) and other filtration systems for clean water but these are out of reach for the majority of the country. Similarly, the technology to build roads and seamless electricity grids exist but is prohibitively expensive for the government to invest in all at once; meanwhile millions remain excluded and vulnerable.

Among India’s Most Pressing Problems: Water, Hygiene, Housing, Electricity.

- 594 million people or over 50% of India’s population defecates in the open.^{liv}
- 21% of India’s communicable diseases are water related.^{lv}
- 77 million households use kerosene for lighting, while 44% of households in rural India lack access to electricity.^{lvi}
- Only 19% of the rural population lives in pucca houses.^{lvii}

The committee recommends a “Grand Prizes” approach to finding ultra-low-cost solutions to India’s most intractable problems. Incentivized innovation has worked around the world in stimulating innovation. In the US, XPrize is giving tens of millions of dollars to those who can provide solutions to major technological challenges. For instance, the Automotive XPrize, run from 2007 to 2010, was successful in getting teams to build vehicles that were minimally 100MPGe efficient, producing less than 200g/mile of CO₂, and built for the mass market. In India, the Infosys Prize of Rs. 65 lakh, given for outstanding achievement in research in six categories⁹ to contemporary researchers and scientists, is a good example.

⁹ The six categories are: Engineering and Computer Sciences, Humanities, Life Sciences, Mathematical Sciences, Physical Sciences, and Social Sciences.

Through the Incentivize Innovation in India (i3) programme, the AIM plans to announce a challenge and a Grand Prize (substantial monetary rewards) for ultra-low-cost solutions. The spirit of the scheme is to encourage the use of technology to empower the disenfranchised. Grand Challenges and the associated Grand Prizes could also have a ripple effect on innovation and problem-solving in the country. The substantial cash prize will be greater motivation for researchers, students, and even amateur innovators in the country to find solutions for the nation's most pressing challenges. The corporate sector could be roped in to substantially supplement the prizes associated with whichever competitions it finds relevant.

AIM Funds to Boost Entrepreneurship Through “Grand Challenges”:

In his budget speech, the Hon'ble finance minister allocated Rs. 150 crores for the AIM. The committee's recommendations for utilization of these funds are based on an assumption that the AIM budget can be turned into an annual allocation. The committee also recommends that the aggregate funds for AIM be revised upwards over time.

The committee recommends that the AIM budget be used entirely to award up to 12 grand prizes annually. The topics for such prizes, such as those suggested on page 27, and in Appendix E of the report, are to be set by the governance structure described in Section V of the report. AIM will seek input from the appropriate ministries, including the Ministry of Science and Technology to vet the decision to run specific Grand Challenges. Each challenge should carry a prize of between Rs. 10 cr and Rs. 30 cr for achieving a significant precisely-defined target over a precisely defined target over a precisely defined time horizon. The AIM should also consider setting aside part of the prize money to place orders for the products and services that are generated by winners. This would contribute towards creation of a market for winners' products, thereby bringing their innovations to life.

These amounts are deemed adequate to attract the best talent worldwide to dedicate its energies to the requisite innovation. The committee believes that talent from all over the world should be welcomed to work on problems relevant to India's social and economic development. Any team with at least one Indian citizen or NRI will qualify; this lowers the odds of excluding significant pools of talent that have hitherto no connection with India, but might have the knowhow that can be put to use.

The plan is to provide the prize money in two progress-contingent phases. In the first phase of each challenge, five or fewer promising proposals will be shortlisted and they will share 25 percent of the prize money assigned to that challenge. The remaining 75 percent will only be given at successful completion of the challenge. It will take much of a year to finish phase 1. An implication is that, in the first AIM allocation, only a quarter of the allocated funds will be dispersed in year 1, with the remainder dispersed in subsequent years contingent on success. It should be noted that many challenges are unlikely to be solved in the stipulated time, by the very nature of their ambition and intractability. Therefore, some method will be devised to bank the parts of the prize money that is unclaimed for appropriate reinvestment into the country's innovation fabric.

Another method to scale funds available for such competitions is to implement schemes similar to the Small Business Innovation Research (SBIR) program in the US. Through this program, 11 federal agencies in the US set aside 2.5% of their extramural R&D budget exclusively for SBIR awards. Each year these agencies identify various R&D topics representing scientific and technical problems that require innovative solutions. These topics are then released to the public for proposals from interested small businesses. Through this program, the SBIR aims to competitively award grants to small high-technology firms which are technically sound and commercially promising but unproven ideas. Funding generated is significant, and is sometimes scaled up by being used in conjunction with venture capital and angel funding. Though similar such schemes exist in India, they could be better implemented and monitored to ensure impact.

Illustrative Examples of Potential “Grand Challenges”:**Problem:** Economically-viable electricity usage**Challenge:** DESIGN A BATTERY FOR INDIA

A novel and environmentally safe energy storage that delivers about 150 Wh for minimum six hours, at half the cost of a typical corresponding lead-acid battery, and has at least 5 times the life cycle of the prevalent lead-acid batteries. Other than routine maintenance, the battery should essentially be maintenance free. This will enable economically viable off-grid electricity usage without having to wait for the government’s distribution grid to be built. A poor rural household will be able to operate two bulbs, a fan, a TV, a small refrigerator and charge a mobile phone. This will directly impact the quality of education and study hours of rural students. The battery should also be linearly scalable for larger loads. With incremental power one will be able to build cold storage units requiring 24x7 electricity, thus reducing the large scale produce wastage. Small scale industries such as dairy, food processing, machinery repair, handicraft, ancillary units will be enabled. All of these will substantially enhance the average income of a rural household. Usage of lead acid battery in inverters commonly used in urban households could also be replaced thereby reducing the highly toxic lead contamination.

This challenge is expected to be solved within 18 to 24 months.

Problem: Cheaper Solar Panels**Challenge:** CAN YOU MAKE SOLAR CHEAPER?

A panel that costs 33% of the existing widely used solution while maintaining the same specifications in terms of power delivered, durability, and more. Solar panels combined with the battery described above would go a long way to make solar power economically attractive and primed for large-scale adoption.

This challenge could take 2 to 3 years.

Problem: Pure Drinking Water**Challenge:** CLEAN DRINKING WATER FOR EVERYONE

A fast, cheap way to purify drinking water is a must. A solution would have to be able to deliver 10 litres of potable water for under 2 rupees. A solution would not only remove 99%+ pathogens; it must also remove pollutants, which often end up in the water supply due to fertilizers and pesticide run-offs, and various other reasons. Centralized solutions so far have high procurement, maintenance, and delivery costs, thus individualized solutions such as a tablet that can be dissolved in 10 liters of water is a preferred choice.

This challenge is expected to be solved within 18 to 24 months.

For a more elaborate list of 13 Grand Prize and Challenges, refer to Appendix E.

2. Harnessing Corporate Funds to Finance R&D: In the knowledge economy, universities as a source of knowledge have become far more important than in the past.^{lviii} In recent years, they have acquired a crucial “third mission,” of contributing to economic development after teaching and research.^{lix} Among the developed countries, the United States is feted for offering entrepreneurs many structural advantages, among them close linkages with universities. Many universities have incubators, technology parks, and venture funds within their sprawling campuses.^{lx} Similarly, in Cambridge, UK, engagement of the faculty with industry has spawned many “millionaire dons”.^{lxi} The private sector can be tapped to fund research and development at universities. The expert

committee proposes various recommendations to build links between large corporates and research at universities. These include:

A. 1% of corporate profit could be directed towards research labs in universities and/ or industry-university collaborative research. The government could provide some tax benefits against this. Monitoring of this rule should focus not only on the absolute amount channelled into universities, but also on the efficiency of spending, that is, it needs to be output-rather than input-oriented. The idea here is that universities become the breeding ground for new technology/ ideas that can be used by the corporate sector. Firms would implicitly be outsourcing R&D financing development of products/ services that can be bought by them. In that sense, this financing

would be perceived as absolutely core and fundamental to a firm's operations, rather than as a CSR-related activity. Though the actual development of R&D may take some time, beginning the involvement of the corporate sector in the financing of universities could be achieved relatively quickly.

B. Encouraging top Indian firms to set-up research and education wings at universities

C. Introducing a "Make in Universities" program which would involve setting up 500 tinkering labs with one 3D printer per institute and trained people to operate this, across the country, including in smaller cities, to boost the spirit of production and collaboration. This concept could be introduced in competition format. Corporates would stand to gain as winning in such competitions would create brand value within the university that it contributes to.

D. A percentage of corporate profit could be directed towards corporate venture capital funds, for the purposes of investment in start-ups and/or incubators. The government could offer tax credits against this.

E. All contracts with foreign defence companies above \$5B should include a clause for 5% of contract value to be directed to establish research centric universities with strong emphasis on its core product areas in particular and broadly focused on the related areas in general. Aggregated contracts with companies below \$5B should include a clause for 5% of the contract value to be directed to establish a research center associated with a university, focused on the corresponding product space. In the committees view, in order for such a scheme to be implemented effectively in India, the responsibility of setting-up, staffing, and managing these institutes should also be that of the company for at least 10 years. This would allow India to develop a number of top-class research institutes with high-quality faculty within a few years, and would kickstart the process of industry-university collaboration in a meaningful way. Companies should also clearly define ex-ante how these funds should be used, and guidelines should be as specific as possible to prevent misuse of funds. The practice of encouraging foreign investors to partake in local R&D development is not entirely new. Over the past two decades, for example, western multinationals operating in China have come under increased pressure to undertake technology transfer to local personnel as a quid pro quo for accessing their domestic market. In India, Bosch's Rs. 140 crore investment in a research center at the Indian Institute of Science is an example (though it is not a defence company). The purpose of this investment is to promote applied research in a range of new-age areas, including but not limited to cyber security, mobility solutions, renewable energy, and the like.

3. Improving the Efficiency of Incubators: Some progress has been made in developing the business incubation industry in India. Since the late 1980s, the National Science & Technology Entrepreneurship Development Board (NSTEDB), under the Department of Science & Technology, has invested about Rs 100 crores in incubators across the country. Privately-owned incubators have recently emerged, located mostly in tier-1 cities like Bangalore and Mumbai. The Startup Village in Kerala, which won a national award for technology and business incubation in 2014, is the country's first PPP (Public-Private Partnership) technology incubator.¹⁰ However this is not enough.

Much more can be done to improve the efficiency and scope of incubators. Firstly, more funds need to be channelled into incubators. The total value of investments in incubators remains miniscule in relation to demand. While the efforts of existing incubators, especially those set up with public money, are much to be celebrated, creating 40,000 jobs (see table below) over 30 years is an embarrassingly low target with which it is hard to be satisfied. Secondly, more emphasis needs to be put on monitoring the efficiency and impact of incubators. It is not enough to simply create these clusters. Active supervision and revision is required to ensure value creation. The AIM organization should have the mandate and governance to deliver.

*Figure 6: Major outcomes of the Incubators backed by the NSTEDB since 1982¹¹ (all figures are approximate)
Evaluated at 12 to 36 months.

Start-ups promoted each year	500
Technology jobs created since launch	40,000
Companies/graduates since launch	800
Turnover of graduates & incubatees	Rs.4000 crore
Total Value of Companies*	Rs.1500 crore

¹⁰Stakeholders: The National Science and Technology Entrepreneurship Development Board, The Department of Science and Technology of the Government of India, and Kochi Technopark and MobME Wireless.

The committee makes the following recommendations on business incubators:

A. Increasing the Amount of Funding Going into Business Incubators: The total amount of funding going into business incubators is miniscule in relation to demand for financing. A target of up to INR 200 crore per year should be set for public investment in incubators in the initial years. Efforts should also be made to rope in private sector funding. CSR funds, for instance, could be at least partially directed to incubators. Apart from the need for more funding, there is also a need to monitor efficiency of spending and impact. We discuss this in more detail in the following points.

B. Creating Virtual Incubators: Curated sites should be set up to provide entrepreneurs with access to advisors, mentors, and experts. These sites should also include information on how to access funding, how to navigate the regulatory landscape, and e-education. The purpose is to raise the odds that even those in remote/ inaccessible areas to launch their own businesses.

C. Keep Incubators Up to Date: Incubators must be able to provide services and facilities most in demand with current market and business conditions. Key decision-makers and managers must routinely study and survey the needs of the entrepreneurs, as these are constantly evolving, and offer the best they can to help the incubated ventures succeed. For example, while a few years ago, high-level guidance was most sought after by entrepreneurs, at present, young startups are increasingly seeking specific, actionable assistance and skill development, such as creating sales proposals, hiring strategy, introduction to influencers and investors. One way to kick-start these linkages would be to connect incubators with pre-existing networks of entrepreneurs – for example, through TiE or NASSCOM – so as to exchange ideas and build partnerships.

D. Link Funding with an Institutionalized Annual Ranking: Incubators must be ranked every year according to a set of stringent guidelines, whilst offering space for failure and risk-taking. Increased funds and resources help incubators provide better facilities. However, greater resource commitment must be linked to performance, which could be identified through annual rankings recommended here.

E. Exit Non-Performing Incubators: Incubators that perform poorly beyond a certain timeframe must be shut down to channel resources that enable relatively successful incubators to do even better. A formal ranking process and annual reviews will help identify these non-performers.

F. Introduce Specialized Sector-based Incubation Services: Since different sectors throw up unique challenges, the one-size-fits-all approach does not work when it comes to incubation. For example, currently, e-commerce ventures receive greater interest and funding offers. Therefore incubators focused on e-commerce must strive to improve the quality and mortality of these start-ups. On the other hand, sectors like social inclusion, healthcare, education and clean technology do not attract sufficient attention and incubators should work on increasing awareness, and getting more entrepreneurs & investors involved, which will also boost innovation across these crucial sectors. Separate incubators are required to help the manufacturing SME sector innovate.

G. Mould a Supportive Incubation System to Encourage Disruptive Innovation: Incubators must strike a balance between offering stable environments for incremental innovations but also permitting creative and disruptive innovation. To encourage this, rules and procedures must be minimal, while offering a supportive and empathetic system.

H. Strengthening Links between the Corporate Sector and Incubators: Currently, incubators operate in silos rather than within an overall ecosystem. This dilutes impact. To maximise impact, links between incubators and the corporate sector need to be strengthened. The corporate sector should be encouraged to provide more finance and support for start-ups, via incubators. This money could partially come from corporate venture capital funds. This could serve a dual purpose. Start-ups would get access to much needed funding and mentoring, while corporates would implicitly be supporting ventures that could later add value to their own business. For example, Indian pharmaceutical companies could have an interest in supporting drug discovery firms. This system is well established in the US, where corporate buy-outs present an important source of funding for technology/products generated by incubators.

SETU Funds Should Be Used to Upgrade Incubators and Set-Up Tinkering Labs:

In his budget speech, the Hon'ble finance minister allocated Rs. 1000 crores for Self Employed and Talent Utilization (SETU). This is a one-time allocation, intended to jump-start skilling for the better utilization of talent.

The SETU funds should be used to jumpstart innovation through two concrete initiatives at scale. We recommend, for example, that half of the Rs. 1000 crores be spent in upgrading the system of incubators already in place in the country. Within six months, a system can be created to survey and rate the incubators on objective criteria, of the sort the committee has not been able to obtain to its satisfaction currently. At AIM's discretion, though always transparently, criteria should be spelled out to codify this rating function, and then to award the majority of the Rs. 500 crores to the best ten incubators, publicly or privately funded, with the proviso that they will be held accountable for the efficacy with which the funds are spent. Subsequent years' allocation of AIM funds should similarly be used to continue to rate the incubators and to reward those producing exemplary results.

The remaining Rs. 500 crores SETU money should be used to set up Tinkering Labs. These are centers that will permit aspiring entrepreneurs to experiment to create products that address local problems. A number of so-called Tinkering Labs could be based in engineering colleges, with the state and the academic institute sharing responsibility for maintenance. They should be equipped with basic engineering design equipment and with a 3D printer, as well as staffed with appropriate technical personnel. They will need young leaders who have strong hands-on experience in technology problem-solving. While designing training programmes for the convenors of these Tinkering Labs, inspiration could be sought from organisations like JED-I (The Joy of Engineering, Design and Innovation), focused on quality in engineering.

Some experimentation is needed to decide the format and associated economics of the Tinkering Labs. For example, it's quite clear that such a lab will not exist in a vacuum. It will have to be part of the local societal fabric. How to fashion that link in different local circumstances is an exercise in creativity. Further, we envisage that the labs will develop differing sectoral expertise depending on their local contextual circumstances.

4. Fostering a National Entrepreneurship & Innovation Movement: Celebrating and recognizing entrepreneurship at the national level could go a long way in raising the profile of entrepreneurs, shedding light on their role and importance in society, and encouraging more young people to consider entrepreneurship as a career.

A. Institute a National Entrepreneurs' Day: The committee recommends instituting a National Entrepreneurs' Day during which entrepreneurial success from different entrepreneurship programs is celebrated. On this day, winners of competitions such as those between entrepreneurs from different state initiatives, or business plan competitions run by incubators, could be honored.

National Entrepreneurship Day – USA

- The National Entrepreneurs' Day is held in November since 2010 in the USA. It celebrates the contribution of American new businesses and entrepreneurs in job and wealth creation.
- Celebration of the Entrepreneurs' Day started as recently as 2010. The proposal for the idea came from two young entrepreneurs and the idea was turned into a Presidential Proclamation, with now efforts being made to turn it into an official Holiday.
- In 2012, the President declared November of that year the National Entrepreneurship Month, which included the Entrepreneurs' Day.

B. National Action Brigade: The committee recommends setting up a platform to get youth and others interested and involved in multiple ways. The Action Brigade could be a network of volunteers helping with the “back-end” of setting up online entrepreneurial platforms, volunteering for events such as the National Entrepreneurs’ Day, and helping build other assets for the Atal Innovation Mission. One could think along the lines of the “Teach for India” or even the National Cadet Corps (NCC).

C. National Knowledge Infrastructure: Developing powerful knowledge infrastructure is just as crucial as building world-class institutions and organizations. Without highly-skilled intellectuals, academics, managers and leaders, even the most progressive physical infrastructure and facilities will remain under-utilized. The country needs to invest and nurture its talent from academia and industry, as well as tap into the network of accomplished Indians globally. Two simple yet effective recommendations to kick-start the building of Knowledge Infrastructure follow:

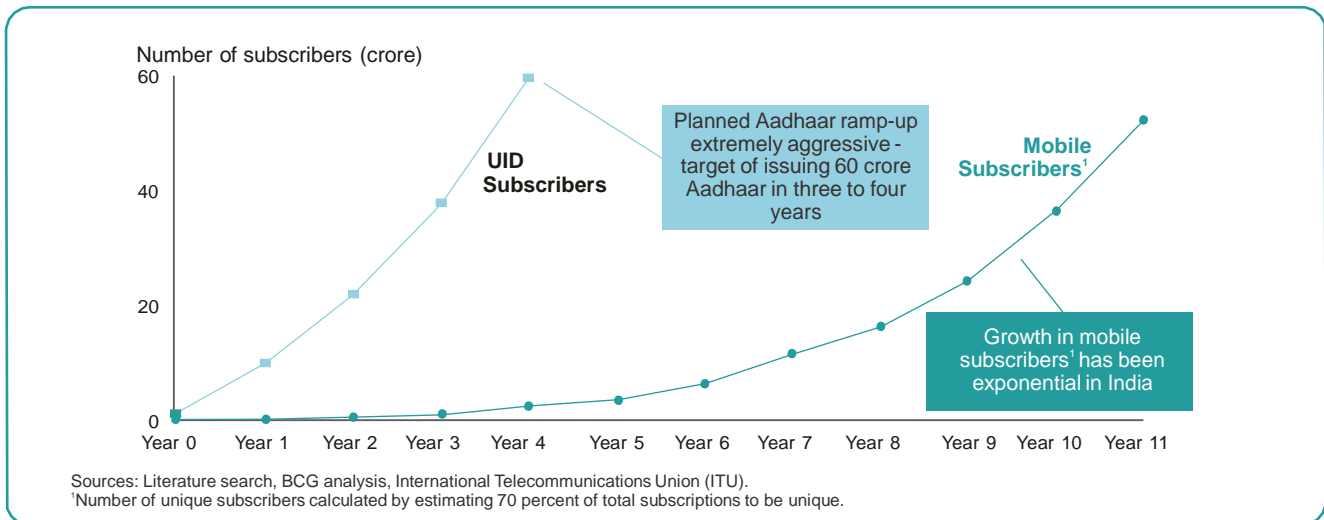
Harnessing the NRI talent pool: We are fortunate that members of the Indian diaspora have attained much professional and personal acclaim in several countries around the world. For example, the Indian-American community is among the most educated and affluent in the US. Roughly a third of new ventures in Silicon Valley are promoted by entrepreneurs of Indian origin. This massive knowledge pool of NRIs, from all over the world covers all the major advanced technology sectors and could be harnessed quickly. China, with a laser-like focus on tapping into its own diaspora, has shown the way here over the past three decades. Members of the diaspora could be offered time-bound assignments, opportunities to attend/conduct seminars, lead short or long-term courses at universities and more.

Faculty Fellowships for Indian Academics: The committee recommends encouraging professors to be stakeholders/partners of the entrepreneurial and incubation eco-systems in universities by offering “faculty entrepreneurial fellowships”. In addition to monthly stipends, the perks could include time-off from teaching responsibilities, talent resource from the student pool and more.

Intermediate Layer: Creating an Enabling Environment for Innovation

1. Embracing the Platform Mindset: The committee recommends creating digital platforms, similar to the Unique Identifications Scheme (Aadhaar), to inspire innovation & entrepreneurship. The Aadhaar initiative was introduced to provide identification for each resident across the country, thereby providing legitimacy to vast numbers of people living in rural areas, who currently have no proof of identity. One of the key objectives of the program was to encourage innovation and provide a platform for public and private agencies to develop Aadhaar-linked applications. The Aadhaar platform has already been used by the government to initiate Aadhaar-based direct benefit transfers for cooking gas, and Aadhaar-based biometric attendance systems. More recently, in June 2015, the Unique Identification (UIDAI), in collaboration with Khosla Labs, Nasscom, and AngelPrime, launched an “Aadhaar hackathon”, an initiative to create useful applications based on the platform. More than 5000 participants (from India and abroad) were part of the 48-hour coding marathon with the purpose of building applications in areas like financial services, payments, healthcare, FMCG, and social inclusion. Winners received prize money of up to Rs. 2 lakh. The winner developed an app to use Aadhaar for verification of student identity. It provides a central database for all exam results, enables online registrations for exams, and prevents impersonation during exams. A previous such hackathon winner developed an app to link Aadhaar with medical history. The full socio-economic impact of the UIDAI project is yet to be seen, as the platform continues to enroll Indians at a pace faster than mobile phone subscription in India.^{lxiii} Though launching and implementing new digital platforms cannot be done overnight, it will not require generations either. Projects should be conceived to develop new platforms that can be implemented in the medium-term.

Figure 7: Aadhaar Scheme has seen a rapid take-up



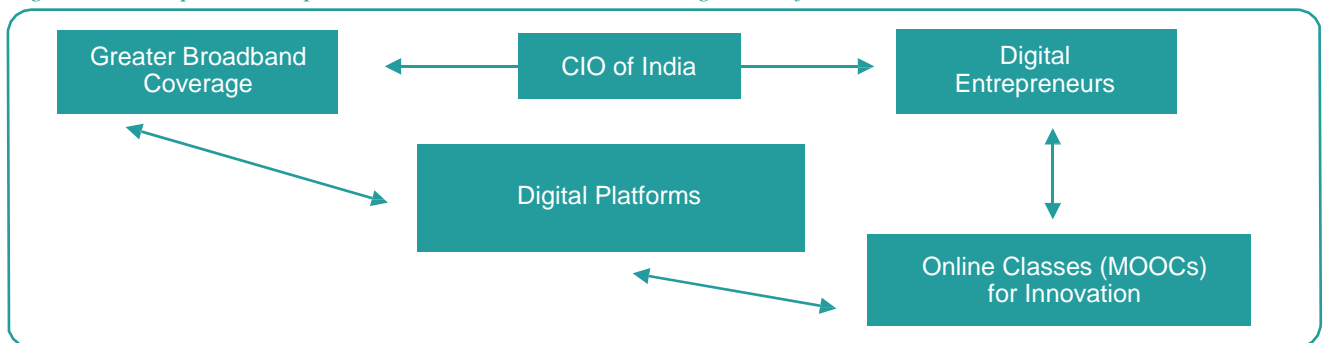
Source: Boston Consulting Group

The committee makes the following recommendations:

A. The AIM should focus on building sector-specific searchable digital platforms that could lead to the creation of new enterprises, digital entrepreneurs and extensive digital innovation. For instance, one of the first initiatives should be building a platform to store Health Care records for all individuals, starting with new born babies, and then building it out for major chunks of the population like government employees etc. This would create opportunities for entrepreneurship across the health care, insurance, pharmaceutical, and training space. Similar platforms could be built to cover pensions, insurance, and education.

B. The AIM must be empowered to appoint India’s Chief Information Officer in order to manage the Digital Platforms programme.

Figure 8: Entrepreneurship & Innovation centred around Digital Platforms



C. Related initiatives centered on the digital platform, such as online learning (Massive Open Online Courses, MOOCs), and more generally digitization of services, together with greater broadband coverage, could have a multiplier effect on enterprise creation and innovation. For instance, basic digital training and online information on specific topics relevant to agriculture (e.g. appropriate fertilizer usage) or and health care (e.g. vaccination use, or policies to address maternal mortality), could help improve the quality of life and health of the disenfranchised. Access to e-information could also allow villagers across India to access new markets, find customers, and therefore improve economic freedom.

D. Digitization of government processes could help drive faster procurement, processing, approvals, project management, and payments. These could dramatically improve efficiency for the public distribution system, pensions, taxes, agricultural subsidies and more. For instance, a public registry linked to Aadhaar that offers a searchable database of beneficiaries of various public distribution/welfare schemes could help curtail exploitation of the system. The digitization space also offers tremendous opportunities for entrepreneurs who can get involved to help deliver these services.

2. Reforming the Education System and Upskilling Workers: The creation of the Ministry of Skill Development and Entrepreneurship is a welcome initiative and the National Policy for Skill Development and Entrepreneurship 2015 report has many excellent recommendations, which this committee acknowledges. The committee supports the Ministry's focus on the steady re-engineering of the education system in the country to prepare our youth for the new innovation economy and provide our young enterprises with a large pool of highly-employable workforce. A multi-layered approach will be required, including overhaul of existing school and college curricula, change in existing teaching techniques, better monitoring of school and faculty standards, better access to e-education facilities, and better targeted skilling and training to ensure employability of youth. In the section below, the committee makes a further number of recommendations that it views as pivotal.

A. Reforming school curricula and examination methodology: The curricula and examination format of the Indian central and state boards need to be overhauled and reoriented from rote-based to application-based learning and testing. The focus should be on testing higher-order skills like reasoning, analysis, lateral thinking, creativity, and judgement, rather than memorization alone. Until testing standards change, teaching and learning methods are unlikely to change. The International Baccalaureate (IB) curriculum, for instance, could be used as a benchmark. The IB is known to cover a broader spectrum of subjects that leads to all-round development. IB examinations test students' understanding rather than their memory/ speed. It is also known to equip students with tools needed to succeed in higher education and in the workplace, like self-confidence, preparedness, research skills, and presentation skills. Teaching methods that use real world problems to explain concepts and theories should be encouraged. Students should be exposed to broad needs of society—health, education, hygiene and cultural development—to promote business and entrepreneurial solutions to public policy issues.

B. Annual assessment of schools and faculty: Schools across the country should “pass” an annual assessment based on a standardised exam that their students must take in basic science, maths and literacy. Care must be taken to ensure that the exam cannot be cracked by rote learning or formulaic study methods. The Pratham Annual Status of Education Report (ASER) is a good example of a non-governmental annual survey of children's basic learning skills in arithmetic and reading in rural India. In 2014, the ASER survey covered 577 rural districts, surveying children from 341,070 households, and covering over 500 institutions. Even in many of the best urban and international schools, the quality of teaching is poor and learning is based on rote. To ensure a high quality of teaching, teaching standards need to be monitored. One way to do this is to set up an expert committee consisting of qualified NRIs to carry out random quality checks. The emphasis in these checks should be on how well teachers are able to communicate to explain complex and abstract issues, rather than on textbook teaching. This could serve as an effective deterrent to lax teaching quality standards. Simultaneously, a revised and updated minimum nation-wide standard/ exam for faculty should be introduced, to ensure that teachers are suitably qualified to effectively impart learning.

C. Providing access to entrepreneurship courses: Students in secondary and tertiary levels must have easy access to entrepreneurship education courses and programs.

D. Build a virtual platform that documents experiments and innovations in education around the world, and provides an ecosystem for education innovation in the country: The platform would help draw together a community interested in education and innovation, which looks at the challenges bottom-up rather than top-down and encourages, rewards and supports these initiatives. The platform must be accessible to all, allow screening, categorization, review, data analysis and evidence-based evaluation of these innovations by the broad community and global experts. The Government of Singapore has encouraged many such experiments, for example, from which there is much we can learn.

E. Encourage a focus on technology-based solutions to education and open up the market to global education providers: International or home-grown education innovators (both private and public) should be allowed access to schools and universities in India. These places of learning could become “virtual laboratories” where education experimentation is encouraged and monitored.¹² All universities in India should be allowed to offer online education, available across states. The use of MOOCs and online education is a fast-moving space and can ensure access to those in remote and rural locations, and aid the process of social inclusion.

¹² Students and teachers should collectively and individually have the option to opt in or out of the innovation programs.

F. Create a National Education Service Program, after drawing best practices from the world over:

Inspiration could be derived from the National Service systems of Israel (IDF), Korea and Singapore, but the program must be designed specifically to meet Indian needs. The Indian program could have several tracks such as practical education, education and health, education and security, education technology, education and skilling and entrepreneurship education.

G. Train workers for specific job-related skills: The committee recommends creating special education curriculums, vocational, and skilling programs to fill large-scale vacancies in certain careers that have a big and direct impact on entrepreneurship and innovation. At the moment, the limited incubation-based skilling programs present in India are focussed on e-commerce-related skills. More broad-based skilling programs need to be developed to cater to the needs of unskilled, semi-skilled, and highly-skilled workers. Such programs could be implemented on a PPP-basis, with some sort of funding/ fiscal incentives from the government, and expertise/ management from the private sector.

The unskilled category, consisting of those with only a high-school degree, could be trained to fill vacancies in low-skill jobs. This includes jobs within gardening, dry cleaning, women's tailoring, women salons, taxi driving, carpentry, and construction, amongst others. In smaller towns in India, where many low-skilled women need work, there is no training available in fields that may be suitable for them—such as beauty, tailoring, embroidery, design and more (this is not an exhaustive list and certainly women have wide-ranging interests). The rapid growth of the private cab industry in cities has led to many unskilled workers finding jobs in the sector, thanks to a semi-organised driving school industry. Similarly, India is experiencing a construction boom unlike ever before in its modern history. Construction Schools across the country could elevate lakhs of manual labourers to specialists in plastering, tiling, or foundation laying. After training, these labourers would be eligible to earn close to double of their current daily wages. SMEs could benefit from trained workers in this category and there should be dedicated SME training camps that could potentially have a bigger impact on business than the current trend of incubators dedicated to ecommerce and mobile phone applications. The expert committee recommends setting a target to introduce 5000 SME training camps/ schools within 3 years. If each takes 3 months to train a batch of students and

500 students are admitted per batch, 10 million students could graduate in one year.

Similarly, there are lakhs of young Indians who fall into the semi-skilled category, those who have completed basic undergraduate college degrees, but are not trained to take up highly-skilled jobs. Efforts can be made to train and match these graduates with suitable jobs. To this purpose, skilling programs should be devised after a careful assessment of the job market and the supply gaps that these workers could fill.

Finally, even highly-skilled workers i.e. those with a technical undergraduate college degree, an advanced degree, or vocational training, need help finding suitable work. For this category, there could be special, nation-wide entrance exams and training programs that enlarge the pool of trained professionals in a short timeframe. For instance, two areas where highly-skilled workers are immediately required are teaching and patent examination. Both these areas have a direct impact on innovation. For instance, in 2010, India was short of 12 lakh teachers. While the Right to Education requires 1 teacher for every 30 students, some government schools function at the ratio of 1 teacher for over 100 students.^{ixiv} It is not just the number of teachers which is important; quality is equally important. The B.Ed curriculum should be overhauled and reoriented towards practical rather than textbook teaching. Examinations should place emphasis on how well teachers can explain complex and abstract concepts, rather than textbook teaching. Similarly, the speed of patent approvals has a direct impact on innovation and the morale of the innovators. As of 2013, there were 194,000 pending patent applications and only 201 patent examiners in the country.^{ixv} Quality skilling programs need to be introduced to train workers to fill vacancies in patent examination. The number of patent examiners needs to be increased at least tenfold by 2018.

Over and above this, the efficiency of existing government initiatives need to be improved. The number of apprentices need to be increased to 1 crore from the current 4 lakh, and employment exchanges need to be converted to career centers (last year, 1200 exchanges led to only 3 lakh jobs for the 4 crore people registered). Loan programs for skilling need to be scaled up. One option is to fund students directly rather than institutions. In this context, the government's recent launch of the Skill Loan scheme is a step in the right direction. Under this scheme, loans ranging from Rs 5000-1.5 lakh will be made available to 34 lakh youth seeking to attend skill development programmes over the next 5 years. More generally, the Skill India initiative, under which the government aims to train 40 crore workers by 2022, is an excellent initiative, and efforts should be made to monitor impact annually, to ensure effective execution of the program.

H. Promoting internship and coop programs to improve “work-readiness”: The corporate sector should be required to develop clearly-defined internship and coop programs. The requirement on the number of internships/ coop programs could be made proportional to firm revenues. This would be useful for students, who would get a sense of different career options and the skills/ inclinations required for each. Graduates would thereby be able to make informed career choices. It would also help firms in getting a head start in identifying and training talent that they can later employ. Through “testing” graduates within a trial period, firms would also be able to limit the number of hiring mistakes. The internship and coop systems are well-developed in the West, and have proved to be effective in helping match students with firms.

I. Establishing two separate sets of regulations for universities: There is a case to have two separate regulatory regimes—one for small research universities (focused on knowledge creation, innovation, and global rankings), and large vocational universities (focussed on employer connectivity and delivery via distance education and apprenticeships).

3. Strengthening the Intellectual Property (IP) Rights Regime: As a fast growing economy, India will have to establish that it is serious about rewarding innovation. A strong and robust IP ecosystem will not just boost India’s image globally but also help spur domestic innovation and investment in R&D.

A. Enhanced Enforcement: IP Laws in India are compliant with Trade-Related Aspects of Intellectual Property Rights (TRIPS) administered by the World Trade Organization (WTO). However, the laws are poorly enforced, as innovation and protection of intellectual property are not prioritised adequately by enforcement officials. An important first step is spreading awareness and sensitising all the relevant authorities involved in enforcing laws, including the police and the judiciary. Further, specialised training must be provided to members of the judiciary on Intellectual Property and innovation, given the complexity of the cases involved.

B. Dedicated IP Courts: Due to the limited jurisdictional reach of the Intellectual Property Appellate Board and the rise in the number of patent litigations, India needs dedicated IP courts to manage specialised IP cases, as well as to improve the efficiency and speed in IP judgement. The IP courts must be stipulated to give their judgements within 2 years, with no more than 3 adjournments between hearings, and no more than 10 adjournments in total throughout the trial.

C. National Virtual IP Platform: AIM could oversee the establishment of a National Virtual IP Platform that offers a forum for the stakeholders and all those interested in Intellectual Property Law to discuss, innovate and collaborate. Further, the Virtual IP Platform could contain a database of all the resolved IP cases in India, as well as details of those under litigation. Over time, an electronic case management system can be integrated into the Virtual IP Platform for quick resolution of IP-related disputes and issues.

D. Increase Number of Patent Examiners: New innovations are often time-sensitive and a large number of pending patent applications severely dampens the spirit of innovation in the country. The shortage and attrition of patent examiners at the Patent Office must be addressed to resolve the issue of pending applications. There should be a concerted effort to introduce a large number of high-quality patent examiners, with a ten-fold increase from the current number of examiners by 2018 being a reasonable goal.

4. Improving the Ease of Doing Business:

A. Digitization of government permits: The central government must require all government departments to have all registrations, permissions, and licenses to be online within two years. States must be given incentives and ranked based on electronic, single window compliance within a deadline. The process for name, approval, and company incorporation needs to move completely online. There could be a deadline of three days free, and one day with payment of expedited services. All new laws should be mandatorily born digitally native. Automation of as many government processes should take place, and discretion of government officials should be reduced as much as possible, to reduce red-tape. Innovation in governance is critical. Without this, even well-intentioned policies are doomed to fail.

B. Create a Central ID for enterprises: Every enterprise in India, whether company or not, is assigned multiple numbers. A single number for enterprises is a key ease of doing business initiative and the basis for the “online” portal for enterprises proposed above. The AIM should set up a committee to chart a 1-year roadmap for all enterprise numbers to converge on the Central ID.

Among the Multiple Identities Issued to Indian companies are:

- Corporate Identity Number (21 digit alphanumeric) from ROC
- Tax Payer Identification Number for Commercial Taxes (11 digit numeric)
- Service Tax Number (15 digit alphanumeric)
- PAN Number (10 digit alphanumeric)
- Central Excise (PAN Number +2 characters)
- Provident Fund Number (11 digit alphanumeric)
- Profession Tax Registration Certificate (9 digit numeric)
- Profession Tax Enrollment Certificate (9 digit numeric)
- Tax Deduction and Calculation Number (10 digit alphanumeric)
- ESIC number (17 digit numeric)
- Labour Department Registration Number (13 digit alphanumeric but varies from state to state)
- Importer Exporter Code (10 digit numeric)
- Shops and Establishments Act Registration (20+ digits alphanumeric)
- CLRA Registration (15+ digits alphanumeric)
- Labour Welfare Board (5 digit numeric)

C. Revisit the Companies Act: The Act needs to distinguish between closely held private companies, public companies, and publicly listed companies. Recommendations specific to the Act follow:

- Regulation of listed companies should be left to stock exchanges and SEBI norms.
- Streamline the more than 15 filings required
- Revisit liabilities of key management or raise the threshold to Rs. 50 crores.
- The Act bans ESOPS to Independent Directors of unlisted companies. Further, it confers on these Independent Directors more powers that come with additional responsibilities. Such rules which deter talented and experienced individuals from taking up these positions that come with all of the challenges but none of the rewards. As a result of this ban, Indian companies are finding it increasingly difficult to recruit Independent Directors, who often play a crucial role in offering strategic guidance to new and small enterprises.

D. Tax compliance: All tax law, government notices related to taxation, and responses to taxpayer queries should be available online. Any tax law that cannot be codified should be reviewed to avoid misuse. Digitization will require a radical review of the organization structure, culture and incentives of the Central Board Of Direct Taxation (CBDT). The government should prescribe a clear timeline for complete digitization of taxation within the next 24 months. There is also an urgent need to revisit Section 56 of the Income Tax Act that has greatly impacted fair market valuation norms on angel investments.

E. Move service tax back to actuals rather than accruals: The move to service tax becoming due when payments are received rather than when they are invoiced has created a huge cash flow problem for all enterprises but particularly the small ones.

F. Improving access to capital: To structurally lower interest rates, the following measures are needed: more bank licences, development of the corporate bond market, a level playing field for offshore and onshore private equity and venture capital, and a stable and transparent regulatory and taxation regime. The RBI has recently approved 11 applications for payments bank licenses, and intends to approve applications for small finance bank licenses shortly. The latter would further the government's financial inclusion agenda by making large swathes of the population "bankable," and provide a meaningful source of funds for the micro-enterprise sector both in urban and rural areas. Approval of more bank licenses will increase competition within banking and lower interest rates over a period of time. Quick implementation of the proposed bankruptcy law will also be key to improve access to capital. The law aims to allow faster closure of troubled businesses and give creditors easier and faster exit options. Therefore, it should expedite the cleansing of bank balance sheets, and allow banks to undertake fresh lending. Delays in dealing with bad loans can be hugely detrimental to economic growth, as we have seen in Japan in the

1990s, and in the European periphery more recently. Development of a healthy corporate bond market too will require a quick resolution process in favor of secured bond holders (within 90 days) in the event of corporate default. India could also take note from foreign countries that provide fiscal incentives for entrepreneurship. Some examples are: In Israel, non-Israeli investors are exempt from capital gains tax on investments in VC funds and tax rates on capital investments has been lowered for certain priority areas. The government absorbs a percentage of losses that institutional investors might suffer from VC investments, and also gives grants to R&D centres that employ high-salary staff. Singapore provides tax deductions of up to 50% of angel investment into new ventures. In New Zealand, the government co-invests with angel groups. Similar measures should be considered to boost entrepreneurship in India. We note that the Securities and Exchange Board of India (SEBI) has recently set up the Alternative Investment Policy Advisory Committee to advise the Board on growing the alternative investment industry in the country. Some of their recommendations, due later in 2015, are expected to bear on financing methods relevant to entrepreneurs, for example, the provision of risk capital (angel capital).

G. Labour market reform: The committee recommends the following:

- The central government should implement the 3 employee choices for pensions and health insurance announced in the Union Budget 2015-16.
- Complete consolidation of 44 central labour laws into 4 labour codes.
- Create an employer choice of complying under Factories Act or Shops and Establishments Act for all non-hazardous enterprises.
- Amend the Trade Unions Act to make them more representative, and amend the act to reduce if not remove the role of outsiders because the politicisation of trade unions is toxic for the Make in India campaign.
- Set a deadline for all central government labour approvals to be live on a single online portal with a 90 day deadline.
- Encourage states to use Article 254 (2) of the constitution to amend labour laws.

H. Creation of an online nationwide real estate registry: An online portal should be set up for the registration of all land purchase/ sale deals by all entities and their beneficiaries. Registration for all real-estate transactions should be made mandatory within 48 hours, with strict penalties laid out for non-compliance. This would serve as a deterrent to corruption in land deals. Simultaneously, the land registration fee should be lowered to facilitate a more dynamic and transparent real estate market. The Registry should have the "search" feature, and search should be enabled by name, address, company, across companies, chain of relatives etc. This database should allow cross referencing with Income tax and other tax departments. Any piece of urban or rural land that is sold or provided at nominal value (including land given to nonprofits) by a government entity without an open bidding process must be publically listed on this portal. Any land acquired by non-profits should also be listed on this portal, as this is a common route for corruption.

I. Creation of an online nationwide lien registry: An online nationwide Lien Registry should be set up to record details on all borrowings and pledgings of all persons and entities (without exception) across India, and their beneficiaries. This portal should include a search function, to enable searching lending data across banks, thereby providing a comprehensive view into a borrower's existing borrowing, collateral pledges, and credit history.

J. Creating an online portal to aggregate information on funding to entrepreneurs: Information on all state and central incentive programs for entrepreneurship, including loans, grants, subsidies, venture funds, assistance to minorities, and other such measures should be available on one online portal. This would ensure that entrepreneurs have access to information on funding options and assistance available to them. Lack of visibility on government venture funds, for instance, is a key problem.

K. Creation of an AIM Entrepreneurship Index: AIM should work towards creating an Entrepreneurship Index that measures entrepreneurial activity in India, and thereby help stakeholders track improvement. Each year, the Index could update the number of start-ups in India, the states and cities attracting the most number of entrepreneurs, the share of female, minority, and dalit entrepreneurs, and other important factors. In the US, the Kauffman Index has become the authoritative indicator and predictor of entrepreneurial activity.

L. Creation of a separate regulatory category for new business: According to the World Bank 2015 Ease of Doing Business Survey, India ranks in the bottom quartile in the “Starting a New Business” category, at 158th place out of 189 countries. According to this survey, it takes close to a month and more than 10 procedures to start a new business in India.^{lxvi} India’s New Business ranking is even lower than the country’s overall “Ease of Doing Business” Ranking, which is at a dismal 142nd place. The committee recommends introducing a “New Entity” category that exempts new businesses from heavy regulatory compliance. New businesses should only have to follow a set of bare minimum regulations and procedures. This new category could exclude businesses operating in sensitive areas, large-scale businesses and where foreign capital is involved.

M. Legal reforms: The legal system is notoriously inefficient and slow. There is an urgent need to improve timeliness in adjudication. For instance, the government could set a rule stipulating that there can be no more than 3 adjournments between hearings and no more than 10 adjournments in total through the course of each case.

N. Creating an enabling environment for social enterprise: Creating the relevant infrastructure to promote social enterprise is important. Though we have several successes in this space, efforts need to be scaled up to have an impact at the macro level. In the following box, we discuss what can be done to promote social entrepreneurship.

Encouraging Social Enterprise: Social entrepreneurship is the recognition of a social problem and the uses of entrepreneurial principles to organize create and manage a social venture to achieve a desired social change. Social entrepreneurs are commonly associated with the voluntary and not-for-profit sectors, but this need not preclude making a profit. Social entrepreneurship has progressed significantly in India over the last decade. Companies like Narayan Hospitals, Arvind Eye Hospitals, and Vaatsalya Healthcare are well-known and recognized for improving access to affordable healthcare. Pratham and Aakanksha are well-recognized for improving access to education amongst the underprivileged. Several enterprises have been set up to deliver high-quality affordable solar solutions for families living off-grid. Of late, many SMEs have been set up to encourage rural craftsmanship. Impact investing is becoming increasingly better established in India, with over \$1.6 billion invested in over 220 enterprises since 2000. However, there is still a long way to go. Though several ventures are creating impact on a local/ regional basis, the impact at the macro level appears small.^{lxvii} Furthermore, 60% of all impact investment was channelled to just 15 out of the 220 enterprises, and 70% of investment was directed towards microfinance and financial inclusion. Areas like water and sanitation, affordable housing, energy, education, and healthcare need funding and attention. Much can be done to encourage these ventures. Some measures that would encourage social enterprise are:

A. Involving the corporate sector to fund social enterprise: The corporate sector could have much to gain from partnering with social entrepreneurs. This includes reaching untapped markets through entrepreneurs who have spent decades refining innovation means of bringing excluded groups into the marketplace. It also includes attracting more “millennials”, for whom social impact is a key component of job satisfaction. The 2% CSR “tax” (estimated to amount to \$2.5 billion per year) on corporates presents a significant pool of domestic funds that could be used to fund social enterprise. To be effective, funds need to be utilized efficiently. Improved transparency on CSR spend is much required. This could be achieved through collation of company-level CSR information on an e-platform. This could help firms augment each others’ CSR efforts, rather than duplicate them. Coordination of CSR can be done by industry bodies. A common fund to pool CSR resources to make sure the corpus is spent intelligently could also be useful. One option is for firms to aggregate CSR funds and channel them to Impact Investors (like Aavishkaar, Acumen, and Elevar Equity), as these organizations have the skill and expertise to generate and monitor impact.

B. Encouraging the setting up of business incubators for social impact: UnLtd, Dasra, and Khosla Labs, are amongst the most prominent incubators for social enterprise. Many more such incubators are needed to provide expertise, technical help, and financial support for social enterprise. A quick way to achieve impact is to set up virtual incubators i.e. curated sites to provide social entrepreneurs with access to advisors, mentors, and experts, remotely.

C. Promoting a culture of “giving back”: The government should encourage philanthropy amongst high net-worth individuals to increase funding. One way is to provide tax credits to HNIs that invest in early stage VCs or to incubators and angel investors. Involve students in finding solutions to practical problems could promote a culture of innovation and may increase the number of professionals working in the social impact space.^{lxviii}

Base Layer: Addressing the Cultural Context

Changing cultural attitudes towards entrepreneurship is likely to be a long-term exercise, and may require generational change. Recognizing that change needs to occur is an important first step for cultural attitudes to be modified. As the first generation in many families will soon be educated and will have moved up the income ladder, they may be more open to the idea of their children being self-employed. A revamp of the school system and curriculum could also play a role in encouraging entrepreneurship in the generations to come. There are some sections of Indian society (the Gujarati's, Parsis, and Marwaris, for instance) which are culturally more disposed to entrepreneurship than others. One way to expedite the entrepreneurship agenda could be to conduct exchange programs wherein the youth from some parts of the country spend time learning in another, and vice-versa. Europe has a well-formed such exchange program to facilitate cross-country learning, termed the "Erasmus" program. Changing the culture of apathy, corruption, and scepticism towards intellectual property rights within the bureaucracy, is also likely to take time. Consistent trust-building over time can help address the general sense of mistrust between the corporate sector and the government. The government's commitment to avoid retrospective changes in law going forward is a positive first step. To expedite cultural changes, the expert committee proposes the following recommendations:

1. Attach Entrepreneurship to Large Scale Economic and Social Programs: To spread the spirit of entrepreneurship and innovation widely, AIM should use various important government economic and social programs as vehicles of change. For instance, "Swachh Bharat" could be used to encourage and promote social entrepreneurs focused on the areas of cleanliness, hygiene and civic responsibility.

2. Promote New, High-Potential Sectors via the "Make in India" Campaign: New-age sectors within manufacturing with the potential to create future jobs, enterprises and economic growth should be encouraged. AIM should set-up incentive structures to develop a few chosen high-potential industries as part of the "Make in India" initiative. Knowledge flows into these sectors must be supported to foster India's competitiveness in the world. A focused and systematic approach towards some of the niche sectors could improve export income, create industry growth and enable talent development.

3. Foster a Culture of Coordination and Collaboration: Working in silos has an insidious effect on the innovation ecosystem; while there are many noteworthy entrepreneurship and innovation-boosting initiatives emerging from different sections of the government, private and non-profit sectors, the lack of coordination does not help these programs scale and create long-lasting, long-term impact. A culture of coordination between ministries, departments, incubator cells across the country, enterprises, and more should be strongly encouraged and institutionalised. To monitor progress and measure impact, an annual survey of start-ups and early-stage ventures should be commissioned. The purpose of this survey should be to receive regular feedback from entrepreneurs on problem areas and areas of strength in coordination and collaboration with various stakeholders. This relates to an earlier point on monitoring impact of incubator cells and using feedback as a tool to reform policy and improve efficiency.

4. Redefine Success: While encouraging a healthy tolerance for failure at the societal level, AIM must push for a new culture that redefines success in crucial governmental bodies. R&D, entrepreneurship and innovation-centred organisations within the government system must be allowed to pursue projects and experiments that are high risk and may fail. Different measures of accountability and success must be outlined.

5. Make Entrepreneurship Part of the Social-inclusion Agenda: With economic growth and national progress, India will remain focused on greater social inclusion and mobility for decades to come. AIM must capitalise on this predictable trend and make entrepreneurship part of the larger social agenda, bringing in more women, dalits, rural population and the urban underprivileged into the fold of new Indian entrepreneurs and innovators.

Proposed Structure for the AIM

The time is ripe for India to embrace a new path of enterprise building and disruptive innovation; a path that may involve risks but also high rewards, because status quo will only yield incremental results—and for a country where more than 350 million people are below 24 years in age, that simply isn't good enough anymore. The committee welcomes the vision to create the Atal Innovation Mission (AIM)—a catalyst for change and the vehicle that will steer the construction of a new and strong innovation ecosystem in India.

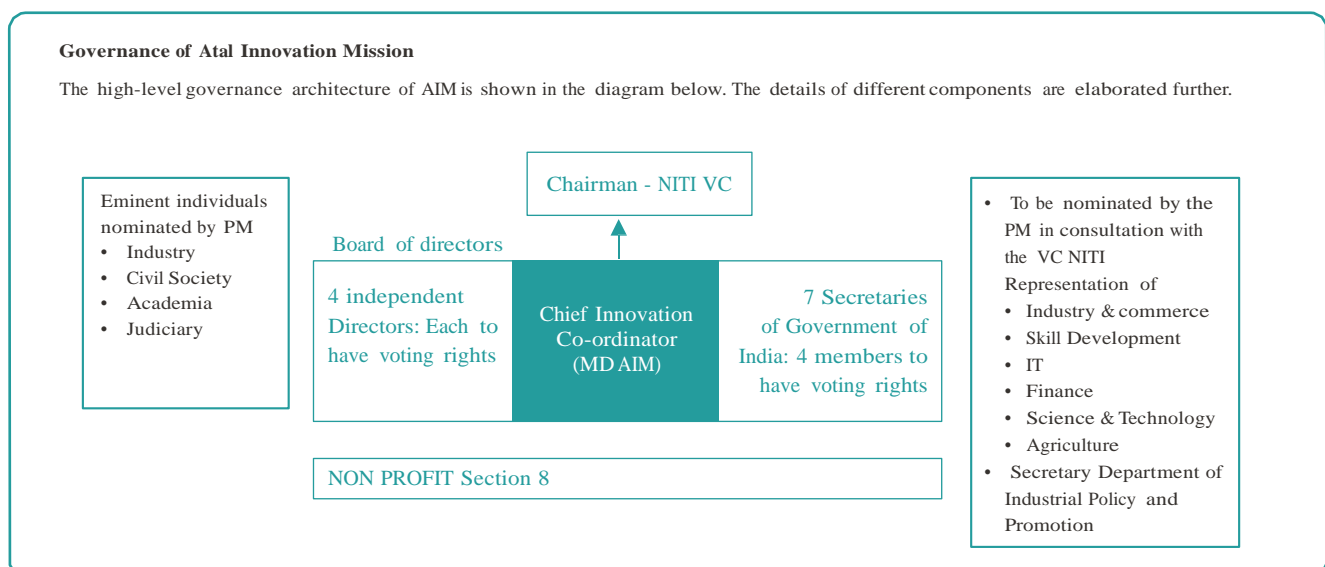
Below, the committee has outlined the recommended objectives of the Atal Innovation Mission and provides a brief overview of the recommended structure.

Objectives of the Atal Innovation Mission

AIM is conceived as a self-sustaining organisation that will play the following key roles:

- Facilitate growth and development of an innovation eco-system through policy advocacy and, in select cases, offer active implementation support
- Identify, recognize and reward innovations with demonstrated or clearly visible potential and impact
- Innovations can be of technology, business model, commercialization, working innovation, scaling-up or any other type
- Provide support for scaling up of solutions based on proven and promising innovations
- Institutional collaboration/support, tie-ups with global institutions, funding, (direct funding, or fund of funds model), other resources/support, support of policy for innovation success
- Identify problems of national importance, and facilitate innovation focus by orchestrating institutional priorities, funding and other levers
- Establish itself as an apex governance body regarding co-ordination of innovation agenda being executed through different elements of the eco-system
- Authority to measuring outputs and value of innovation (without changing reporting)
- Facilitator of internal collaboration and tie-ups with external agencies (including public-private partnerships)
- Must have the authority to request and receive information in a timely manner

Figure 9: Recommended Structure of the Atal Innovation Mission



1. **Chairman** – VC NITI Aayog shall serve as the chairman of AIM board.

2. **7 Government Functionaries** would serve as Directors on the board of AIM. These functionaries shall be no less than Secretary level from the following Ministries:

- a. Secretary Skill development
- b. Secretary Industry and commerce
- c. Secretary IT
- d. Secretary finance
- e. Secretary science and technology
- f. Secretary Department of Industrial Policy and Promotion
- g. Secretary Agriculture

Only 4 of these Directors would have voting rights

3. **4 Independent Directors** chosen from outside of Government would serve on the board of AIM. Each of these Directors would have voting rights. With this structure in place, private and public sector Directors would have an equal number of votes.

For more details on the structure, competencies required for AIM personnel, organizational metrics, please refer to Appendix E.

Case Study: Potential of the Bioeconomy Sector

This section draws special focus to the biotechnology industry that currently generates close to \$5 billion a year in India, and is projected to continue to grow at just under 20% CAGR for the next decade.^{lxix} The economic potential of biotechnology is comparable to the software industry in the early 90s; indeed experts say biotechnology can have a more wholesome impact because of its relevance to domestic and global markets.¹³

Biotechnology presents technology driven levers for addressing health, food, fuel and environment—the four largest challenges faced by the planet. As a nation we need to embrace biotechnology and thereby create a thriving bio-economy just as we have an information economy. As former Prime Minister Atal Bihari Vajpayee used to say “IT stands for India Today and BT stands for Bharat Tomorrow”.

After a brief review and exploration of the sector, including its history and current state, industry-specific recommendations are offered below. The recommendations are structured along the lines of the AIM pyramid model, and classified into short, medium, and long-term measures.

Industry Overview

1. Dropping costs and rising speed of innovation: PCs and Smart Phones have transformed our lives at a rapid pace and continue to do so, reflecting Moore’s Law which posits that as computing technology increases in power, its relative costs decrease. But biotechnology is poised to take us even further, as technology unlocks the potential of biology at inconceivable speed and cost. For instance, the costs and speed of genome sequencing is outpacing Moore’s law. In 2003, less than a decade ago, genome sequencing cost US \$2.5 billion. Just a year back, a high-end genome sequencer machine that cost US \$10 million brought the cost of genome sequencing down to \$1000. More recently, during the Ebola outbreak, a hand-held genome sequencer was deployed to check for mutations; the cost of the device was just \$1000.^{lxx} These dropping costs of measurement of molecular signatures opens a strategic opportunity for India to play in the “software” needs of genomics globally – bioinformatics analytics and genome variant interpretation.

2. A Brief History of Biotechnology in India: India’s contribution to global biotech began in the 1950s. Shortly after the double-helix structure of the DNA was discovered, Indian scientists Dr. G.N. Ramachandran proposed a triple-helix structure of collagen using X-Ray diffraction, which led him to develop the Ramachandran Plot—an essential tool in protein confirmation even today.^{lxxi}

In 1982, the Department of Biotechnology (DBT) was set up, which established and funded research labs. Meanwhile, India’s pioneering private biotech company, Biocon, had become the first Indian company to receive funding from the US for proprietary technologies.^{lxxii}

In recent years, Biotechnology Industry Research Assistance Council (BIRAC), a section 8 non-profit under the DBT, has been charged with fostering innovation and entrepreneurship in the sector. So far, BIRAC has supported over 150 young Entrepreneurs, 300 startups and SMEs. BIRAC also provides incubation space to over 100 young ventures. The challenge for this sector is whether this early stage support is followed up with right levels of capitalization. Biotechnology is a risk capital intensive sector with longer gestation times for entrepreneurial success. It therefore requires a complex financial ecosystem that provides either risk capital that is patient or speculative public markets like Nasdaq that value the innovation potential of intellectual property far ahead of full commercialization of the innovation.

Figure 10 : Ranking of Biotechnology Firms in India

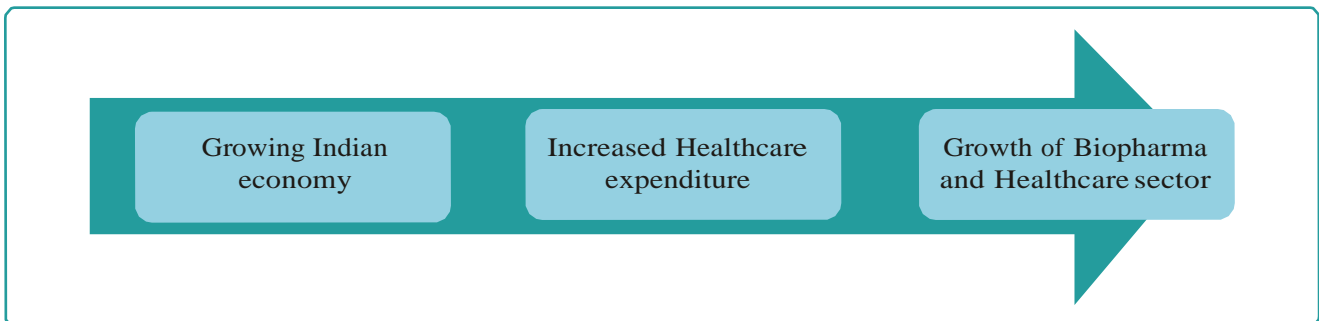
Rank	Company	2013-14
1.	Serum Institute of India	3,340.00
2.	Biocon	2,218.00
3.	NovoNordisk	793.00
4.	Nuziveedu Seeds	775.00
5.	Syngene Internatioal	715.00
6.	Reliance Life Sciences	700.00
7.	Kaveri Seeds	647.00
8.	GVK Bio	599.00
9.	Indian Immunologicals	442.00
10.	Eli Lilly	430.82

Source: ABLE Spectrum Survey 2013-14

¹³Communication with members of Biotechnology Industry Research Assistance Council and Association of Biotechnology Led Enterprises, July 2015

3. State of Play-Biotechnology: In 2014, the Indian biotech industry was worth \$4.66 billion and was growing at a modest rate of 6.98% perhaps due to regulatory challenges that the industry faced in the areas of clinical trials and GMO based agriculture.^{lxxiii} In 2013, the industry had registered growth of 15.08% and for the preceding five years, Indian Biotech had grown at an average rate of 18%.^{lxxiv} With a vast technology-trained talent pool and adequate infrastructure, biotechnology in India is on a high-growth trajectory. It holds immense potential to contribute in a big way to “Make in India,” raise the country’s profile as a manufacturing hub with a difference, and contribute to enterprise creation, innovation and economic growth. Its growth potential is comparable to that of the IT sector in India in the early 1990s.¹⁴ Like the software industry, biotech can play a crucial role in driving India’s economic growth in the future. The Indian economy^{lxxv} is set to grow to US \$4 trillion by 2025, and Biotech could become a significant contributor to the Indian economy. Importantly, as the economy grows, India will contend not just with diseases borne out of poverty, but also with chronic and acute diseases of affluence. The sector must rise to the challenge, provide innovative yet affordable solutions, and seize this opportunity for growth.

Figure 11: Potential for Growth



Source: Indian Biotechnology Roadmap to the Next Decade and Beyond, May 2012, ABL & DBT Report.

Over the years, several Indian biotech firms have devised innovative solutions and scaled up the production of cutting-edge products that are low in cost and high in quality. These include Serum Institute, Bharat Biotech and Shantha Biotech that have developed and supply more than 50% of vaccines to international organizations such as WHO and UNICEF.^{lxxvi}

There are also several bio-clusters spread across the country, in Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh, NCR and Gujarat. However, Bangalore could be considered the country’s biggest hub with 137 biotechnology companies, which makes it 40% of the total 340 such units in India.^{lxxvii} The biotech industry includes biopharma manufacturing, bioservices, bioagriculture, bioindustrial and several sub-sectors, with biopharma being the largest revenue generator.

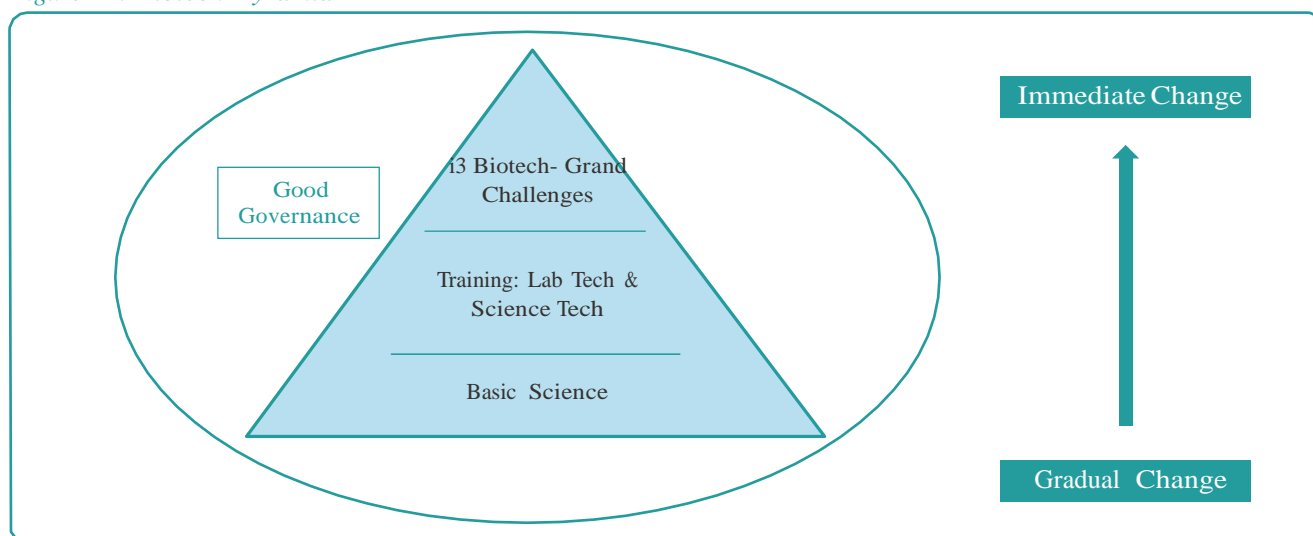
Recommendations to Unleash a Biotech Boom

Biotechnology stands at the threshold of enormous growth and could have a direct impact on the economy and offer wide-ranging societal benefits beyond just public health. The industry has attracted talent from different parts of the country, as well as qualified non-resident Indian scientists and other biotech professionals. While biotech innovation exists in India, there is scope for greater improvement.

The expert committee has highlighted recommendations to boost the Biotech sector that range from the short-term to the long-term. As in the main recommendations section of the report, long-lasting but profound changes are outlined in the base layer of the pyramid, measures that will have an impact in the medium-term are outlined in the intermediate layer, and measures in the top layer offer payoffs that will be quick, but perhaps not as substantial. The Biotech Pyramid is also encased in the very crucial good governance circle.

¹⁴ Communication with members of the Biotechnology Industry Research Assistance Council and Association of Biotechnology Led Enterprises, July 2015.

Figure 12: Biotech Pyramid



Top Layer Recommendations

In general, biotechnology innovations have long gestation periods. In the biopharma sub-sector, for instance, some drug discoveries may take close-to-a decade to be launched as products, and the entire process cycle may involve millions of dollars of investment.^{lxxviii} However, it is still possible to create an inspiring and vibrant environment, and draw attention to the sector in the short to medium timeframe.

1. Incentivize Innovation in India (i3) - Biotech-focused Grand Challenges

The committee recommends that the Mission set aside part of its resources to structure and run biotech focused i3 challenges.¹⁵ Medical device innovation and Med Tech lend themselves well to the i3 format, where the potential of the innovation can be tested relatively easily in a shorter timeframe. Similarly, interplay of informatics in the life sciences and healthcare sectors is also a domain, where Grand Challenge innovations can come from.

i3 Ideas to Overcome Skill Shortage

A medical device plugs the skill gap in Indian Healthcare today, where often, poorly trained or semi-skilled professionals deliver healthcare solutions.

Grand Challenge 1: Non-invasive tool for automated diagnosis and screening of TB, particularly the drug resistant strains. This challenge could also be applicable to other key public health concerns such as diabetes, oral and cervical cancers (saliva and urine tests) and high-risk pregnancies.

Grand Challenge 2: A robotic surgery platform that can perform basic laparoscopic surgical procedures. The surgery platform should be affordable (cost less than Rs. 2 Crore) with low procedural costs, easily operable by a trained MBBS physician and perform a set of relatively easy, high-volume, minimally invasive procedures.

i3 Ideas to Drive Innovation in Bioinformatics and Medical Informatics

We believe there are many interesting grand challenges that can be posed in this interface domain. It is interesting to note that genomics alone is likely to be the source of the world's largest data type in the next 5 to 10 years.^{lxxix}

Grand Challenge 3: Akin to the KDD Cup challenges¹⁶, benchmark sets of raw sequence big data sets of say cancer genomes, rare disease genomes, plant genomes and microbial genomes of South Asian origin are created and contestants are given a restricted time to analyze and deliver interpretation reports. A substantive KPO service sector for processing global genomics data can result from the innovators who rise to the challenge.

¹⁵i3 is discussed in greater detail in the main recommendations section

Grand Challenge 4: A mobile friendly *Electronic Health Records* platform in the cloud that can work with data standards of hospital based instrumentation (medical scans, for instance) and with readings from wearable/portable devices used by ASHA workers in remote primary healthcare settings. Interfacing medical records with payment systems (insurance, public health schemes) is usually a difficult challenge that might be facilitated in the Indian context with the Aadhaar platform.

2. Support Early Stage Investments

The gestation period for biotech start-ups is between 5 to 10 years, while investors prefer shorter timeframes. This, among other factors, has led to an imbalance in early stage investments, where most investors look for opportunities in e-commerce and IT-enabled services rather than high technology startups. Funding vehicles like the BIRAC AcE Fund will need to be adequately supported to help boost the sector in the short- to medium-term.

Intermediate Layer Recommendations

Biotechnology is a multifaceted field and encompasses different areas like biopharma, biofuel, biosimilars, medical equipment and more. It requires a vibrant pool of talent employable by the different sectors of biotechnology. However, the pool of skilled workers available to the sector isn't nearly diverse enough.¹⁶ In the main section of this report, the committee recommended embracing the platform mindset. Members are of the view that this is applicable to biotechnology as well.

1. Responsive Course Curricula: Public academic institutes offering biotechnology training must adapt course curricula to reflect the diverse nature of the industry and look beyond large sub-sectors such as biopharma. The institutes should also offer skilling programs that bridge the common gaps in biotech entrepreneurs or employees of biotech startups. For instance, scientist-entrepreneurs should have access to tailor-made management training programs. Karnataka's Biotech Finishing Schools have now completed close to 5 years of operations and should be evaluated in arriving at a model curriculum.

2. All India Biotech Digital Platform: The relevant stakeholders in the Biotech ecosystem must come together to set up a Digital Platform that boosts linkages, promotes collaborative innovation, mentoring and more. The Digital Platform could include the following:

A. Database of Current Biotech Ideas: As the biotech community grows in India it is important that a database be created that is dynamic and reflects the growth of the sector India. The database should contain the technologies emerging from various start-ups, academia and research institutes. This should help investors, potential collaborators and other stakeholders easily identify strategically important technologies and extend support or partnership.

B. Virtual Clusters: The platform could integrate forums, virtual meets and e-events into the system to enable greater interaction among the diverse group of scientists, academicians, entrepreneurs, institutes, private companies and investors from the biotech sector. These virtual clusters, integrated within the Digital Platform, would reduce the investment in building physical infrastructure, and the funds could be put into funding ventures, skilling programs and more.

C. Accessible Bioinformatics Databases: India has the potential to create a large pool of excellent bioinformaticians. Hands-on experience with a number of open source bioinformatics tools and big data representative of real experimental data will make a lot of difference. There are many global datasets in the public domain made available by institutions such as NCBI/EBI, which can be used to begin with. Eventually more context specific (Indian) datasets should be brought into these environments to seed locally relevant innovation.

¹⁶ <http://www.sigkdd.org/kddcup/index.php>

3. Reform Regulatory Impediments to Biotechnology Innovation:

Innovation in biotechnology is an R&D intensive enterprise and several incentives for R&D institutions in India have been created for tax advantage, special funding and special privileges for import of equipment etc. In order to avail these incentives, the enterprise is required to qualify as a “DSIR Certified R&D Enterprise”. Some of the requirements for such qualification is that the enterprise has to be at least 3 years old, it needs to have equipment of a certain quantum in value, library facilities and so on, many of which are challenges for early stage biotechnology ventures. This regulatory issue needs to be looked at and suitable mechanisms evolved for a more flexible approach in this sector, so young and dynamic biotech firms are able to capitalise on these incentives and privileges.

Another serious regulatory impediment is the regulatory burden imposed by the “Biological Diversity Act of 2002” which has introduced certain immutable restrictions on biotechnology ventures that have any international funding or foreign national director/s that need to access biological material in India. The process for obtaining approvals is cumbersome and causes serious delays in research and is a deterrent to innovation. The general wisdom on this impediment is that the Act itself may need to be amended to arrive at a solution.

Base Layer Recommendations

As with the AIM Pyramid in the main section of the report, the base layer of the Biotech Pyramid seeks to highlight long-term changes that will have a profound impact on innovation and enterprise-creation in the Biotech sector.

1. Basic Science in Schools and Colleges: Innovative and hands-on science teaching in schools and colleges will help contribute to biotechnology in the future. Given the projected growth of the industry and its potential for job creation, a well-rounded education with science, maths and creative thinking will help prepare the students of today for the jobs, enterprise-building and innovation opportunities of tomorrow.

2. Indians Among the World’s Top 50 to 100 Computational Genomics Experts: Over the next five to ten years, computational biology and genomics must receive a big push in engineering colleges to meet the demand of future professionals, help raise the profile of the sector on the global map, and inspire innovation within the country.

3. Addressing Negative Connotations of Biotechnology: Over the last five years, biotechnology has suffered from negative publicity associated with ethical issues in clinical trials, genetically modified organisms and so on. The positive impact of biotechnology research and investment on public health and the economy should be brought into the narrative of public discourse and help address the issue.

Appendix A

Literature Review of Past Reports on Entrepreneurship

1. Twelfth Five Year Plan - Chapter 9 – Innovations¹⁷

India has unique challenges and large unmet needs across diverse areas such as health, education, skills, agriculture, urban and rural development, energy and so on. We also have significant challenges of exclusion and inequitable access due to multiple deprivations of class, caste and gender—all of which require innovative approaches and solutions, and looking beyond the conventional way of doing things. Innovation is going to be central to providing answers to the most pressing challenges and for creating opportunity structures for sharing the benefits of the emerging knowledge economy. Affordable solutions, innovative business models or processes which ease delivery of services to citizens can enable more people to join the development process.

India is also uniquely poised to reap the advantages provided by a nation of a billion connected people, with over 800 million mobile phones, and global leadership in Information and Communication Technology (ICT) and software. This connectivity as well as ICT talent is changing the nature of processes, business, industry, governance, education and delivery systems; and our innovation thinking also has to leverage the unprecedented advantages provided by this changing landscape of connectivity and collaboration.

Government has a critical role to play in strengthening the innovation ecosystem. It must provide the enabling policy interventions, strengthen knowledge infrastructure, improve inter-institutional collaborations, provide a mechanism for funding business innovations at all levels especially small and medium scale enterprises (SMEs) and provide vision through a national-level road map for innovations.

Innovation can play a very important role in the development discourse, because it can offer a new approach to a system that is currently over-burdened by the multiple demands and has limited resources at its disposal. Enhanced focus on innovation can have an impact much beyond the realm of S&T in diverse areas such as health and education delivery, governance, enterprise development and much more. Collectively, this can herald a generational change in the country and can lay out a chart for a more sustainable and inclusive growth paradigm.

2. Initiatives of S&T Departments:

2.1 Department of Science and Technology (DST)

2.1.1 Science, Technology and Innovation Policy-2013¹⁸

Shaping the Future of an Aspiring India

Science, Technology and Innovation (STI) have emerged as the major drivers of national development globally. As India aspires for faster, sustainable and inclusive growth, the Indian STI system, with the advantages of a large demographic dividend and the huge talent pool, will need to play a defining role in achieving these national goals. The national STI enterprise must become central to national development.

Changing Phases of National Policies in S&T

India's Scientific Policy Resolution (SPR) of 1958 resolved to “foster, promote and sustain” the “cultivation of science and scientific research in all its aspects”. Technology was then expected to flow from the country's established science infrastructure. The Technology Policy Statement (TPS) of 1983 emphasized the need to attain technological competence and self-reliance. The Science and Technology Policy (STP) of 2003 brought science and technology (S&T) together and emphasized the need for investment in R&D. It called for integrating programmes of socio-economic sectors with the national R&D system to address national problems as well as creating a national innovation system.

The Need for a Science, Technology and Innovation Policy

Scientific research utilizes money to generate knowledge and, by providing solutions, innovation converts knowledge into wealth and/or value. Innovation thus implies S&T-based solutions that are successfully deployed in the economy or the society. It has assumed centre stage in the developmental goals of nations. Paradigms of innovation have become country and context specific. India has, hitherto not accorded due importance to innovation as an instrument of policy. The national S&T enterprise must now embrace S&T led innovation as a driver for development.

¹⁷12th Plan Document Chapter 9 – “Innovations”

¹⁸Science, Technology and Innovation Policy, Department of Science and Technology, Government of India 2013

India has declared 2010-20 as the “Decade of Innovation”. The Government has stressed the need to enunciate a policy to synergize science, technology and innovation and has also established the National Innovation Council (NInC). The STI Policy 2013 is in furtherance of these pronouncements. It aims to bring fresh perspectives to bear on innovation in the Indian context.

STI Policy: A New Paradigm

Science, technology and innovation can exist separately on their own in disconnected spaces. But, it is their integration that leads to new value creation. India’s global competitiveness will be determined by the extent to which the STI enterprise contributes social good and/or economic wealth. There is, therefore, the need to create the necessary framework for enabling this integration in identified priority areas by exploiting endogenous resources, strengths and capacities. New structural mechanisms and models are needed to address the pressing challenges of energy and environment, food and nutrition, water and sanitation, habitat, affordable health care and skill building and unemployment. “Science technology and innovation for the people” is the new paradigm of the Indian STI enterprise. The national STI system must, therefore, recognize the Indian society as its major stake holder. Global innovation systems tend to bypass large sections of the community. Innovation for inclusive growth implies ensuring access, availability and affordability of solutions to as large a population as possible. Innovation, therefore, must be inclusive. The instruments of the STI policy will enable this to be realized. The policy will drive both investment in science and investment of science-led technology and innovation in select areas of socio-economic importance. Emphasis will be to bridge the gaps between the STI system and the socio-economic sectors by developing a symbiotic relationship with economic and other policies.

Capturing Aspirations

The key elements of the STI policy are:

- Promoting the spread of scientific temper amongst all sections of society.
- Enhancing skill for applications of science among the young from all social strata.
- Making careers in science, research and innovation attractive enough for talented and bright minds.
- Establishing world class infrastructure for R&D for gaining global leadership in some select frontier areas of science.
- Positioning India among the top five global scientific powers by 2020.
- Linking contributions of science, research and innovation system with the inclusive economic growth agenda and combining priorities of excellence and relevance.
- Creating an environment for enhanced Private Sector Participation in R&D.
- Enabling conversion of R&D outputs into societal and commercial applications by replicating hitherto successful models as well as establishing of new PPP structures.
- Seeding S&T-based high-risk innovations through new mechanisms.
- Fostering resource-optimized, cost-effective innovations across size and technology domains.
- Triggering changes in the mindset and value systems to recognize, respect and reward performances which create wealth from S&T derived knowledge.
- Creating a robust national innovation system.

Investment in Research and Development

Global investments in science, technology and innovation are estimated at \$1.2 trillion as of 2009. India’s R&D investment is less than 2.5% of this and is currently under 1% of the GDP. Increasing Gross Expenditure in Research and Development (GERD) to 2% of the GDP has been a national goal for some time. Achieving this in the next five years is realizable if the private sector raises its R&D investment to at least match the public sector R&D investment from the current ratio of around 1:3. This seems attainable as the industrial R&D investment grew by 250% and the sales by 200% between 2005 and 2010. Increased private investment is necessary for translating R&D outputs into commercial outcomes. While maintaining current rates of growth in public R&D investments, a conducive environment will be created for enhancing private sector investment in R&D.

The gross budgetary support for the science and technology sector has significantly increased during the last decade. The impact of such increase is becoming evident. India ranks ninth globally in the number of scientific publications and 12th in the number of patents filed. The Composite Annual Growth Rate (CAGR) of Indian publications is around 12±1% and India's global share has increased from 1.8% in 2001 to 3.5% in 2011. But the percentage of Indian publications in the top 1% impact making journals is only 2.5%. By 2020, the global share of publications must double and the number of papers in the top 1% journals must quadruple from the current levels. The citation impact of Indian publications must improve and match at least the world average. Initiatives under the new policy should enable these macro indicators of research to be achieved by 2020.

According to the Global Science Report of the UNESCO, India's current global ranking is commensurate with its number of Full-Time Equivalent (FTE) of R&D personnel. It is imperative that the total number of FTE of R&D personnel increases by at least 66% of the present strength within the next five years.

Promoting Excellence and Relevance in R&D

Nourishing the Roots

Ensuring sustainable pipeline of talented youth for science is a challenge. India has mounted some significant initiatives for attracting talent to science and careers with research. Empowering stakeholders for local actions is a key element of these initiatives. The policy framework will further enable school science education reforms by improving teaching methods, science curricula, motivating science teachers and schemes for early attraction of talent to science. Also special incentive mechanisms will be devised to stimulate research in the universities and develop young leaders in science and engineering.

Excellence and Relevance

Investment in basic research will be enhanced for fostering excellence against global benchmarks and focusing on relevance for addressing national challenges.

Gender Parity

Participation of women in STI activities is important. New and flexible schemes to address the mobility challenges of employed women scientists and technologists will be put in place. A broad scope for re-entry of women into R&D and facilitation mechanisms for special career paths in diverse areas will be sought.

Inter-University Centres

The few inter-university centres that have been set up have proved the concept to be a successful and viable one. Such centres need to be multiplied in different fields to enable a wider cross section of university researchers access advanced research facilities and equipment which are otherwise not available in university environments. These will be discipline-specific as well as multi-disciplinary, including humanities, to address the grand challenges in S&T and its applications.

Participation in Global R&D Infrastructure and Big Science

Modern science is increasingly becoming resource intensive. It has become necessary to create high-cost global infrastructures in some fields through international consortia models. Indian participation in such international projects will be encouraged and facilitated to gain access to facilities for advanced research in cutting edge areas of science. This will also enable the Indian industry to gain global experience and competitiveness in some high-technology areas with spin-off benefits.

Performance-Linked Rewards and Investments

Transparent centrally implementable Performance Related Incentive Scheme (PRIS), based on past and proven track record in research, will be put in place to enable grant-based investments in such performers. For R&D leading to technology development and knowledge services, the criteria would, however, be institution specific. Centrally instituted incentives to public-funded R&D centres for outcomes leading to public

National Agenda and the STI System

Macro indicators of R&D do not really reflect the innovation capability of a nation. Appropriate indicators, which integrate measures of excellence and inventiveness with relevance and affordable innovation, are necessary for evidence based policy actions. Supply side interventions have hitherto been the main strategy for public investment in R&D. This needs to change. There should be equal emphasis on both supply side interventions and demand based investments.

Around 10 sectors of high impact potential will be identified for directed STI intervention and deployment of requisite resources. Enabling policy instruments that facilitate both institutional research and R&D enterprises to focus their efforts in these areas will be put in place.

The complex value chain of innovation – from idea to market – often calls for STI intervention at all levels: research, technology inputs, manufacturing and services. In the priority areas of socio-economic importance, the policy will enable a holistic approach to intervention, support and investment. Measures taken in this direction will be in consonance with the programmes initiated by the NInC.

R&D policy for agriculture is articulated by the Indian Council of Agriculture Research (ICAR). Integration of the agriculture R&D policy with the national R&D system and the STI policy will be brought about.

STI inputs to the manufacturing sector can lead to enhanced employment generation. The innovation ecosystem for the sector, however, depends on the nature and size of the enterprise and the context. India's share of global trade in high technology products is at present only around 8% and the present technology intensity of the sector is a low of 6-7%. The aim is to double these through greater technology inputs from R&D. A strategic selection of some industry sectors, where India can aspire for leadership, would be made for stepping up R&D intensity and increase India's share in high-technology trade. Small and Medium Enterprises (SME) generally have low R&D intensity. Special schemes, to support R&D as well as related services at the firm or collective level, will be devised and put in place.

The R&D intensity of the service sector is generally low. This needs to be enhanced considerably and the skill base also expanded significantly. For rapidly accomplishing the tasks of modernization of technology-based services, missions in some select service sector areas, will be identified. Deployment of technology-led services for transparent Government machinery will also be supported.

Climate variability and change is of global concern and India has articulated a National Action Plan for Climate Change (NAPCC) and identified several national missions. The STI system will have an active role in these missions. It will also serve as a source of strategic knowledge to cope with the challenges of climate variability and change as well as to meet equity-based differentiated and shared responsibilities of India.

Attracting Private Sector Investments in R&D

Public funds for partnerships with the private sector for social and public good objectives will be earmarked as a new policy initiative. A National Science, Technology and Innovation Foundation will be established as a Public-Private Partnership (PPP) initiative for investing critical levels of resources in innovative and ambitious projects.

The focus of the policy will be:

- Facilitating private sector investment in R&D centres in India and overseas.
- Promoting establishment of large R&D facilities in PPP mode with provisions for benefits sharing.
- Permitting multi stakeholders participation in the Indian R&D system.
- Treating R&D in the private sector at par with public institutions for availing public funds.
- Bench marking of R&D funding mechanisms and patterns globally.
- Modifying IPR policy to provide for marching rights for social good when supported by public funds and for co-sharing IPRs generated under PPP.
- Launching newer mechanisms for nurturing Technology Business Incubators (TBIs) and science-led entrepreneurship.
- Providing incentives for commercialization of innovations with focus on green manufacturing.

Delivery Systems for STI Outputs to Stake Holders and Society

Diffusion of scientific outputs and technology interventions into social systems is a multi-layered process. Except for the mission-oriented strategic sectors, the delivery mechanism involves a large number of intermediaries both from the public and private sectors. This requires strengthening of linkages between the scientific and socio-economic sectors. The STI policy will leverage the R&D allocations of socio-economic ministries through a shared vision, mission-oriented approach and adoption of new delivery models with provisions for accountability. The state governments constitute important stakeholders. Measures will be taken to ensure that state-specific S&T vision and plans are informed and guided by the new STI Policy towards which State S&T Councils/Boards will be strengthened. NGOs will be accorded a pivotal role in the delivery of STI outputs, especially rural technologies, to the grassroots level.

Ecosystem Changes for Science, Technology and Innovation

Special and innovative mechanisms for fostering academia-research-industry partnerships will be devised. Mobility of experts from academia to industry and vice-versa will be facilitated. Success stories in S&T-based innovations from Indian experience would be replicated and scaled up. Regulatory and legal framework for sharing of IPRs between inventors and investors will be put in place. Measures to close gaps in the translation of new R&D findings and grass root innovations into the commercial space will be taken.

Rigidity of centrally developed plans for investments often does not suit frontline science, technology development and innovation. A flexible approach that allows for fine tuning the Five Year Plan schemes in response to rapid changes in S&T would be put in place with speed, scale and sustainability as key governance parameters. “Risks” are an integral part of a vibrant innovation system. Risk sharing by the government will significantly increase private sector investment in R&D and technology development. New financing mechanisms for investing in enterprises without fear of failure and options for foreclosing unsuccessful ventures are essential part of an enabling innovation ecosystem. A public procurement policy that favours first of its kind products developed through indigenous innovation and measures to promote such products globally are necessary.

General rules of expenditure control of publicly funded institutions do not suit non-linear growth sectors like science and technology, and more so the innovation sector. Auditing principles should be more aligned to “performance” than “compliance to procedure”. The system should be able to differentiate between genuine failures and process deficits.

Specifically the policy will focus on:

- Prioritizing critical R&D areas like agriculture, telecommunications, energy, water management, health and drug discovery, materials, environment and climate variability and change.
- Promoting inter-disciplinary research, including traditional knowledge.
- Fostering the delivery and use in the society of innovations in the strategic sectors with civilian application potential.
- Promoting mechanisms such as “small idea-small money” and “Risky Idea Fund” to support innovation incubators.
- Establishing of a Fund for Innovations for Social Inclusion.
- Leveraging traditional knowledge through modern science for finding solutions to national challenges.
- Supporting STI driven entrepreneurship with viable and highly scalable business models.
- Investing in young innovators and entrepreneurs through education, training and mentoring.

Gaining Global Competitiveness through Collaboration

Open source approaches for public and social goods form interesting innovation systems. Knowledge commons is an emerging theme for managing IPRs created through multi-stakeholder participation. The STI Policy will seek to establish a new regulatory framework for data access and sharing as also for creation and sharing of IPRs. The new policy framework will enable strategic partnerships and alliances with other nations through both bilateral and multilateral cooperation in science, technology and innovation. Science diplomacy, technology synergy and technology acquisition models will be judiciously deployed based on strategic relationships.

Public Awareness and Public Accountability of Indian STI Sector

Public understanding of science is an important dimension for introducing and reaching the benefits of modern science and technology to the people. The civilizational aspect of science, or scientific temper, needs to be promoted across all sections of the society systematically. Effective science communication methods, by using tools such as the National Knowledge Network, will be initiated.

Public and political understanding of science should be based on evidence and debates with open mind. People and decision makers must be made aware of the implications of emerging technologies, including their ethical, social and economic dimensions. White papers on mission-oriented programmes, with specific deliverables and timelines, will be published. Mechanisms for assessing the performance of the national STI enterprise through an autonomous and robust evaluation system, which includes social scientists, will be established. The national science academies will be accorded a major role in this endeavour of public accountability.

Policy Vision

The guiding vision of aspiring Indian STI enterprise is to accelerate the pace of discovery and delivery of science-led solutions for faster, sustainable and inclusive growth. A strong and viable Science, Research and Innovation System for High Technology-led path for India (SRISHTI) is the goal of the new STI policy.

2.1.2 In addition to the above policy initiative, the following activities have also been taken up by DST:

- i. DST has established new institution, namely: National Innovation Foundation (NIF), Ahmedabad which provides support to grassroots innovators and outstanding traditional knowledge holders from the unorganized sector of the society. NIF helps India becoming an innovative and creative society and a global leader in sustainable technologies by scouting, spawning and sustaining grassroots innovations. Its mandate include: evolution and diffusion of green grassroots innovation to meet the socio-economic and environmental needs of our society, provide institutional support for transition of grassroots green innovations to self-supporting activities and create a knowledge network to link various stakeholders through application of information technology and other means.
- ii. DST is implementing Institutional Program on Innovation and Entrepreneurship with an aim of orienting job seekers to be the job generators and translating knowledge to wealth creation of globally competitive and innovative ventures.
- iii. Technology Business Incubator (TBIs) have been established for nurturing technology based new ventures/start-ups by incubating TBIs hosted generally by academic and R&D institutions. Around 2,000 new ventures have been incubated so far. These enterprises have cumulatively generated approximately 32,000 jobs. The incubated start-ups have generated around 450 patents/ copyrights.
- iv. Innovation and Entrepreneurship Development Cell (IEDC) have been promoted in education institutions to create entrepreneurial culture amongst the faculty and students.
- v. Scheme on Innovation-Science and Technology Entrepreneurship Development for promoting micro-enterprises based on technologies relevant at local area level is being implemented.
- vi. DST has also taken initiatives for Awareness, Training and Capacity Building on entrepreneurship to help self-employment as well as creation of enterprises.

- vii. Under the PPP Initiative for supporting Innovation and Entrepreneurship, various programmes such as India Innovation Growth Program (IIGP) with world-class commercialization strategies and the business development assistance which helps accelerate innovative Indian technologies into the global markets, “The Power of Ideas” Program for scouting, selecting and recognizing innovation across various sectors and across the country and India Innovation Fund- A SEBI registered, PPP venture capital fund that invests in innovation led, early stage Indian firms. These programmes will help in making enterprises globally competitive and innovative. In addition, value added support to Entrepreneurs and the seed supports to TBIs are also being provided.
- viii. DST has also established the Technology Development Board (TDB) as per the provisions of the Technology Development Board Act, 1995. The Act enables creation of a Fund for Technology Development and Application to be administered by TDB. The Fund receives grants from the Government of India out of the Cess collected by the Government from the industrial concerns under the provisions of the Research and Development Cess Act, 1986, as amended in 1995. Any income from investment of the amount of the Fund and the recoveries made of the amounts granted from the Fund is also credited to the Fund. The donations are also received by the fund. The Finance Act, 1999, enabled full deductions to donations made to the Fund for income tax purposes.

2.2 Department of Biotechnology (DBT)

- i. BIRAC (Biotechnology Industry Research Assistance Council), a non-profit, section 8, Public Sector Undertaking set up under the aegis of Department of Biotechnology, has been a pioneer in promoting the innovation research and ecosystem in the country. BIRAC has scaled up its operations to promote the innovation research for product development in biotechnology. DBT, through BIRAC has laid emphasis on strengthening the funding, mentoring and infrastructural support to the bio-entrepreneurs for creating a sustainable bio-economy in the country.
- ii. DBT initiated the establishment of bio-incubation hubs across the country and since its inception, BIRAC has been in the forefront in providing the infrastructural access to the innovators and entrepreneurs through its BISS (Bio-incubator Support Scheme) programme. The BISS programme aims at strengthening and up-gradation of the existing Bio-incubators and also to establish New World Class Bio-incubators. These Bio-incubators will provide the incubation space and other required services to start-up companies for their initial growth.
- iii. In consideration of the Government’s vision to promote the innovation hubs in the country, BIRAC has undertaken following initiatives:
 - Supported and strengthened the Innovative R&D infrastructure in 15 bio-incubators across the country
 - 1,24,000 sq feet of incubation space created, support extended to 199 start-ups/entrepreneurs
 - Rs. 100.00 crore sanctioned under the programme
 - 5 University Innovation Clusters have been initiated to promote the innovation entrepreneurship at university level
 - 3 Bio-industrial facilities supported
- iv. BIRAC, also provides funding support through programmes such as Biotechnology Ignition Grant (BIG), Small Business Innovation Research Initiative (SBIRI), Biotechnology Industry Partnership programme (BIPP), Contract Research Services (CRS) and Social Innovation Programme (SPARSH). The impact of BIRAC’s initiatives is as follows:
 - BIRAC has been managing challenge oriented calls from the idea to pre-commercialization stages, under which the support has been extended to 270 companies through 360 projects
 - Fund commitment of USD 225 Mn
 - Outcome of the BIRAC funding programmes – 17 affordable products, 11 New Technologies and

2.3 Department of Scientific & Industrial Research (DSIR)

The thrust of the Department of Scientific & Industrial Research (DSIR) is to promote industrial research, technology development and transfer to enable India to emerge as a global industrial research and innovation hub. Emphasis is on attracting industrial research in the country through industry and institution-centric motivational measures and incentives, creating an enabling environment for development of new innovations to channelize benefits to the people. DSIR has launched four new schemes during 12th Plan such as

- i. Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)—wherein innovative proposals of MSMEs are being supported; existing network of TePP Outreach Centres are being expanded; proposals from individual innovators/incubates are being supported;
- ii. Scheme on “ Patent Acquisition and Collaborative Research and Technology Development” (PACE) - wherein support is being provided to Indian industries to acquire Intellectual Property at early stage from overseas or within the country and add value to the acquired IP; and focus on Public-Private- Partnerships (PPP) to create enabling environment for collaborative research between Industry and Universities/Public Funded Research Institutions;
- iii. “ Building Industrial R&D and Common Research Facilities” (BIRD)—wherein R&D in Industry are being encouraged and supported; and support is provided for creation of Common Research Facilities for Small and Micro Industries;
- iv. Access to Knowledge for Technology Development and Dissemination (A2K+)—wherein science, technology and innovation related international journals from major publishers are made accessible to 1500 in-house R&D units of industry and 600 Scientific & Industrial Research Organisations (SIROs) and techno-entrepreneurs, besides conducting studies/conferences on Industrial Status in the country

2.4 Council of Scientific & Industrial Research (CSIR)

During Twelfth Five Year Plan, focus of CSIR is on: achieving science and engineering leadership; developing innovative technological solutions; practicing open innovation initiatives; developing and nurturing human resource in trans-disciplinary areas; facilitating science based entrepreneurship.

- i. CSIR has launched Open Source Drug Discovery (OSDD) programme which has emerged as a new platform for innovation in the domain of healthcare. This CSIR-led “ Team India” consortium with global partnership has more than 4500 researchers from over 100 countries as registered participants. Distributed Organic Chemical Synthesis (DOCS) programme envisages building a national repository of 400,000 small molecules by the end of the Plan through open source.
- ii. Science 3.0, an initiative for open innovation and knowledge-ware development through crowd sourcing would endeavour to engage a large number of engineering institutions to identify the most vexing problems and attempt to provide solutions on issues like attaining energy efficiency, reduction in materials use, minimizing waste generation and developing business and financial models to increase productivity and profitability of the units.
- iii. CSIR Outreach Centres are envisaged to be operated and managed through CSIR-people partnership mode (CPP), and implemented either through mobile kiosks or pre-fabricated self-inclusive containers placed at identified locations. The Centres would also have close coordination and networking with the Cluster Innovation Centres of the NInC-CSIR initiative. The Innovation Complexes are envisaged to consolidate and sustain the value chain of R&D within the CSIR; consolidate the CSIR brand and make CSIR R&D accessible to society at large; catalyse regionally balanced economic development; and promote entrepreneurial culture among the scientific community. The CSIR Initiative for Inverted Innovation is a unique paradigm where children/young engineers invent, CSIR laboratories mentor and industries commercialize.

- iv. CSIR has also undertaken a scheme entitled New Millennium Indian Technology Leadership Initiative (NMITLI). NMITLI seeks to catalyze innovation centered scientific and technological developments as a vehicle to attain for Indian industry a global leadership position, in selected niche areas in a true “ Team India” spirit, by synergising the best competencies of publicly funded R&D institutions, academia and private industry. NMITLI is the largest public-private-partnership effort within the R&D domain in the country. It looks beyond today’ s technology and thus seeks to build, capture and retain for India a leadership position by synergising the best competencies of publicly funded R&D institutions, academia and private industry. The Government finances and plays a catalytic role. It is based on the premise of consciously and deliberately identifying, selecting and supporting potential winners. NMITLI has carved out a unique niche in the innovation space and enjoys an excellent reputation. NMITLI has so far evolved 60 largely networked projects in diverse areas viz. Agriculture & Plant Biotechnology, General Biotechnology, Bioinformatics, Drugs & Pharmaceuticals, Chemicals, Materials, Information and Communication Technology and Energy. These projects involve 85 industry partners & 280 R&D groups from different institutions. Approximately 1750 researchers are engaged in these projects. These 60 projects cumulatively have had an outlay of approximately Rs. 550 crore. It is also plan to establish NMITLI innovation centres in the country.

2.5 Department of Electronics & IT (Deity)

- i. Technology Incubation and Development of Entrepreneurs (TIDE) scheme was initiated by Department of Electronics and Information Technology (DeitY), in the year 2008 with an outlay of Rs 23.40 crores for supporting 15 TIDE centres over a duration of 4 years with the following objectives:
- Setting up and strengthening Technology Incubation Centre in institutions of higher learning,
 - Nurture Technology Entrepreneurship Development for commercial exploitation of technologies developed by them,
 - Promoting product oriented research and development,
 - Encourage development of indigenous products and packages and bridging the gap between R&D and commercialization.

The scheme was expanded to include additional 12 TIDE centres in the year 2009 with an additional outlay of Rs 25.934 crores. The outlay included cost for scheme publicity, project monitoring unit and creation of virtual incubation centres. The current tenure of the scheme is till March, 2017.

- ii. DeitY has initiated a scheme to support International Patent Filing in January 2015 and duration of the scheme is 5 Years with a budgetary outlay of Rs 1846.62 lakhs. So far DeitY has received 25 applications for reimbursement for international patent filing. The expert committee scrutinised the applications and recommended 5 applications for support. For conducting IPR Awareness workshops, 6 applications have been received and 1 workshop has been organized successfully.
- iii. DeitY has also taken up Multiplier Grants Scheme. The aim of the scheme is to encourage industry to collaborate with premier Academic and Government R&D institutions for development of products/packages. The idea for collaborative research should originate from industry/industry consortium, and academic institution(s)/R&D bodies undertaking industry specific research will submit the project proposal jointly with the industry/industry consortium to DeitY under the scheme. The proposal should be for innovation in modules/ products/ packages/ services in the area of Electronics and IT. The proposals envisaging prototyping to package for commercialization may also be considered under the scheme. The objectives of the scheme are:
- a. Establish, nurture and strengthen the linkages between the Industry and Institutes;
 - b. To promote industry oriented R&D at institutes;
 - c. Encourage and accelerate development of indigenous products and packages; and
 - d. Bridge the gap between R&D / Proof-of-concept and commercialization / globalization.

3. Initiatives undertaken by the erstwhile Office of Adviser to PM on Public Information Infrastructure and Innovation (PIII).

Hon' ble President of India declared 2010-20 as the “ Decade of Innovation” . To take this agenda forward, the former Prime Minister set up the National Innovation Council (NInC) under the Chairmanship of Mr. Sam Pitroda, former Adviser to Prime Minister on PIII with the following Terms of Reference:

- (i) Formulating a Roadmap for Innovation for 2010-2020
- (ii) Creating 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 and 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 multi-disciplinary and globally competitive approaches for innovations

3.1 Sectoral Innovation Councils

In order to drive innovative strategies in key sectors and create multiple roadmaps, the NInC encouraged the creation of multiple Sectoral Innovation Councils aligned to Union Government Ministries for enhancing innovation capabilities in respective sectors. The Sectoral Innovation Councils are expected to drive the innovation agenda in the country across various sectors and harness the core competencies, local talent, resources and capabilities to create new opportunities taking into consideration cross-cutting themes that impact the sector and work collaboratively with other Councils. The focus is on undertaking activities that improve the innovation quotient of the sector going forward, with a special emphasis on inclusive and sustainable innovation.

In all, 26 Ministries have constituted the Sectoral Innovation Councils. Out of these, Innovation Roadmaps have been submitted by 8 Ministries/Departments.

3.2 State Innovation Councils (SInC)

Further, NInC has also encouraged the creation of State Innovation Councils (SInCs) to replicate the efforts of the National Innovation Council to nurture an innovation ecosystem at the State level. The innovation ecosystem consists of five critical ingredients namely – (a) providing a conducive policy framework; (b) offering institutional platforms for inter-agency collaborations; (c) strengthening and expanding ICT connectivity; (d) fostering innovations in the education system; (e) and setting up a regime of incentives and rewards to encourage innovations. The SInCs are expected to carry forward the innovation movement on all these five fronts and present a Roadmap or Innovation Action Plan (IAP) for the State.

So far, 28 States and UTs have constituted the SInCs. Most of the State Governments which have formulated the Councils have focused on the multi sectoral nature of these platforms and anchored them in the Planning Departments of the State Governments, with the Departments of Science & Technology and Education as the nodal pivots to support the campaign. The focus of most of the Councils has been on areas such as Planning, S&T, Education (both School, and Higher education including Technical education), Industry, Agriculture, Rural Development, Urban Development and Information Technology.

The National Innovation Council's initiative to set up multiple innovation Councils, both at the State and Sectoral level, was a first of its kind. Government effort is to galvanize a large constituency around the idea of innovation. The Councils have been tasked to recommend strategies and policies for driving innovation and create an innovation movement by expanding the discourse on innovation and empowering domain experts across areas. The State Innovation Councils are also expected to sensitize State Governments to the idea of innovation and to ensure that innovation becomes a focus area in the long term development agenda of the States. Some State and Union Territory Innovation Councils have taken impressive initiatives.

3.3 India Inclusive Innovation Fund (IIIF)

To promote inclusive innovation and entrepreneurship, focusing on the needs of the citizens who lie at the bottom of the economic pyramid, the India Inclusive Innovation Fund was launched jointly by NInC and Ministry of Small and Medium Enterprise. The Fund aims to fill a presently un-serviced area of venture capital funding for enterprises that create social impact and also generate a modest financial return. The IIIF is now being operated by the Ministry of Small and Medium Enterprises (MSME).

3.4 Innovation in Education

Recognizing the fundamental role of education in nurturing and fostering an ecosystem of Innovation, NInC also took a series of initiatives to encourage innovations in existing educational Institutions, as well as promoting new educational models and innovative platforms for knowledge creation, dissemination and application. Some of the key proposals of the NInC in this domain include:

- i. Creation of a separate scholarship stream of **National Innovation Scholarships** analogous to the National Talent Search Scheme.
- ii. Setting up an **Innovation Centre in each DIET** (District Institute of Education and Training) to enhance teacher training and enable them to become facilitators of creativity and innovative thinking.
- iii. **Mapping of Local History, Ecology and Cultural Heritage** by High School students to create critical thinking on their local environment.
- iv. Creation of a **National Innovation Promotion Service** to replace/add to National Service Scheme in Colleges to use college students to identify local innovations.
- v. Setting up a **Meta University**, as a new model for a 21st Century University to offer students a collaborative and multidisciplinary learning experience.
- vi. Setting up twenty **Design Innovation Centres** co-located in institutes of National importance.
- vii. Setting up of 20 **University Innovation Clusters** across the country where innovation would be seeded through Cluster Innovation Centres.
- viii. Igniting Youth Innovation with **Tod Fod Jod** Centers at Schools and Colleges to foster Innovation at an early stage and to create an innovative mindset in the youth.

4. Report of the Committee on Angel Investment & Early Stage Venture Capital¹⁹

A Committee on "Angel Investment and early Stage Venture Capital" was constituted by the erstwhile Planning Commission on 17th October, 2011 under the Chairmanship of Shri Sunil Mitra, former Revenue Secretary, Government of India. The committee gave its report in June, 2012. The executive summary of the report is given below:

¹⁹ Report of The Committee on Angel Investment & Early Stage Venture Capital, June 2012, Planning Commission, Government of India

4.1 Executive Summary

India needs to create 1- 1.5 crore (10-15 million) jobs per year for the next decade to provide gainful employment to its young population. Accelerating entrepreneurship and business creation is crucial for such large-scale employment generation. Moreover, entrepreneurship tends to be innovation-driven and will also help generate solutions to India's myriad social problems including high-quality education, affordable health care, clean energy and waste management, and financial inclusion. Entrepreneurship-led economic growth is also more inclusive and typically does not involve exploitation of natural resources.

Large Indian businesses—both in the public and private sector - have not generated significant employment in the past few decades and are unlikely to do so in the coming decade or two. Public sector and government employment has declined in the last few years, and is expected to grow very slowly in the coming years. Large private sector firms have also n slow in generating employment, which is unlikely to change due to increasing automation, digitization, and productivity gains. For example, the banking sector in India has recorded almost no employment growth in the last two decades despite multifold growth in its revenue and assets. Agriculture employs nearly a half of India's work force but employment is likely to decline in this sector, due to improvements in productivity.

India is an entrepreneurial country, but its entrepreneurs have had to struggle to create and grow their business ventures. There is, however, a growing group of first-generation Indian entrepreneurs - the founders of companies such as HCL, Cognizant, Infosys, Bharti and others—that have generated large scale employment and significant wealth. They and others such as IndiaBulls, Makemytrip and Naukri have also demonstrated value creation through a public listing. These successes have encouraged a new breed of entrepreneurs especially in the internet and e-commerce space.

The Committee believes India's entrepreneurial growth can be accelerated by creating more conducive conditions - a catalytic government and regulatory environment, adequate capital flows (both debt and equity), support from businesses and society, and availability of appropriate talent and mentoring. Such an environment could replicate the success demonstrated by the Indian Information Technology (IT) and IT enabled services (ITES) industry over the last two decades. Starting in the early 1990s, the industry now directly employs 28 lakh (2.8 million) and indirectly an additional 89 lakh (8.9 million) people. Its revenues have grown from Rs. 350 crore in 1990 to Rs 4.5 lakh crore (\$88 billion) in FY 2012²⁰. Several leading companies in this industry started as first-generation entrepreneurial ventures. By 2020, the IT and ITES industry is projected to contribute 9% of GOP with a revenue of over Rs 12 lakh crore (\$225 billion) and direct and indirect employment to 30 million people²¹.

India has the potential to build about 2,500 highly scalable businesses in the next 10 years - and given the probability of entrepreneurial success that means 10,000 start-ups will need to be spawned to get to 2,500 large-scale businesses. These businesses could generate revenues of Rs10 lakh crore (\$200 billion) - a contribution to GOP and creation of employment at the same scale as projected for IT and TTES industry. Experience across countries suggests that vibrant entrepreneurial activity significantly improves social harmony, living standards, and quality of life.

However, there are significant roadblocks that hold back and dampen entrepreneurial activity in India. The country ranks low on comparative ratings across entrepreneurship, innovation and ease of doing business. The ecosystem for starting and running new ventures has many gaps. Regulations and procedures are restrictive and time-consuming and add significant cost for an emerging venture. Banks and financial institutions are wary of lending to first-generation entrepreneurs and to MSMEs in general, due to various norms like tangible asset coverage, DER etc., even though such enterprises make a major contribution to the economy, employment, and exports. This imposes constraints on their credit absorption capacity and consequently, growth. Established businesses have generally been passive in engaging with emerging ventures. Educational institutions are yet to actively promote entrepreneurship over careerism. Lack of collaboration between all stakeholders leads to further roadblocks.

²⁰NASSCOM Strategic Review 2012

²¹NASSCOM Perspective 2020: Transform Business, Transform India

The entrepreneur's journey proceeds from idea generation to venture formation to scaling up a business. Typically, the steps are:

- An entrepreneur begins with an idea and works towards a prototype with either his own funds or those taken from friends and family. He/she then seeks to create a more formalized venture, often with the aid of an incubator that provides him real estate and other services, which may also include introduction to potential investors. Angel investors play an important role at this stage by both funding and mentoring the entrepreneurs.
- Further scale-up then requires higher amount of capital, which is typically provided by venture capital funds.
- Apart from equity capital, the venture also needs debt for working capital. In the absence of formal sources of debt, the entrepreneur is often compelled to use equity capital for working capital, which limits the ability of the entrepreneur to scale the business.
- In addition to funds, the entrepreneur needs support from a range of other players in the ecosystem - educational institutions, large businesses and government - as also access to skilled labour, research, and a market. In other words, an environment that eases this journey.

Creating a vibrant entrepreneurial ecosystem will require strong capital flows to entrepreneurial ventures- the Committee expects that Rs.3 lakh crore (or around \$55 billion) of capital would be needed over the next decade with around half of this in form of debt.

Currently, early stage investing in India is inadequate:

- Angel investors drive significant early-stage investments in countries with high entrepreneurial activity. Apart from capital, Angel investors also provide mentoring and network access to entrepreneurs. They play a critical role in scaling up businesses to make them attractive for institutional investors such as venture capital funds. Angel investing is just beginning in India. In 2011, Indian angels, constrained by regulations that make both investing and exits cumbersome, invested only about Rs 100 crore (approximately \$20 million) in around 50 deals as compared to Canada²²- where angels invested Rs 2,000 crore (\$390 million). Even as a proportion of early-stage investing (investing in the initial or growth phase of the venture), angel investments in India comprise around 7 per cent as against around 75 per cent in the US. We estimate that a well-developed ecosystem would expand these investments to around Rs. 3,500 crore (\$700 million) annually in next 10 years.
- India also lags in early-stage venture capital investing²³. Annual investments are around Rs.1,200 crore (\$240 million) as against Rs. 29,000 crore (\$6.3 billion) in the US and Rs. 3,000 crore (\$700 million) in China. Around 90% of the early stage venture funds in India come from offshore sources rather than from domestic investors. We estimate that these investments could increase to around Rs. 14,000 crore (\$3 billion) annually in the next 10 years as both the number of funds and propensity to invest increases with a larger entrepreneurial base.
- Financing of MSMEs, particularly service sector enterprises is also below par because these industries often do not create tangible assets. Capital is required for product development, R&D, marketing, hiring professional teams, etc. Thus, access to adequate and timely finance continues to be an issue for MSMEs. Early stage companies in innovation-driven industries such as IT services, business process outsourcing, healthcare, etc., especially, if promoted by first generation entrepreneurs, also find it difficult to access funds from banks.
- Impact investing, or investing for both social and financial return, is an imperative in India. This kind of investing seeks out businesses and social ventures that can deliver measurable social and/ or environmental impact as well as appropriate financial returns in sectors such as education, healthcare, sanitation, environment, and infrastructure. In 2011, around Rs 400 crore (\$80 million) of such investments were made by impact investors. Impact investing needs to grow dramatically to support businesses that target India's 900 million strong base of-pyramid population.

²²Investment Activity by Canadian Angel Groups. 2010 Report, NACO

²³Early stage investments defined as investments of up to \$10 Million in early stage ventures

Sectors with higher potential for rapid entrepreneurship-driven growth include manufacturing (IT hardware and electronics, automotive components, food processing), software, technology and telecom, affordable healthcare, clean technology (alternative energy, clean water, and sanitation) and personal care amongst many others. These sectors are seeing growing consumer demand and have already received some investment from both angel investors and venture capital funds albeit to a somewhat limited extent.

4.2 The Committee has identified five major drivers for creating a vibrant entrepreneurial ecosystem. Given below are the key recommendations of the Committee:

- 4.2.1 **Catalytic government policy and regulatory framework:** The government and its agencies could play a proactive role in facilitating entrepreneurship. Following are key steps that should be taken:
- a. **Facilitate investments:** Recognition and promotion of early-stage investments and early stage investors such as angel investors, venture and seed funds, and impact investors through development of appropriate policy measures and fiscal incentives. The Committee recommends the following definitions:
 - i. **Angel investing:** An angel investor is an individual who invests his own money directly in a seed stage venture in which there is no family connection. The angel investor could be acting alone or in a formal or informal angel group. Such investment in the venture for the individual is less than Rs 5 crore and in aggregate for a group is less than Rs. 10 crore. Seed stage venture is defined as a business which (a) has a turnover below Rs 25 crore; (b) is unlisted and (c) is not promoted, sponsored or related to an Industrial Group whose group turnover is in excess of Rs. 300 crore. The limits on investments and turnover threshold for the seed stage should be indexed to inflation.
 - ii. **Early-stage venture capital investing:** Investments in an early stage venture by an entity which is registered with the appropriate financial regulatory authority (such as appropriate AIF or FVCI). Early-stage venture is defined as a business which (a) has a turnover of less than Rs 50 crore; (b) is unlisted; and (c) is not promoted, sponsored or related to an Industrial Group whose group turnover is in excess of Rs. 300 crore. The limits on investment and turnover threshold for the early stage should be indexed to inflation.
 - iii. **Impact investing:** Investments in businesses and social ventures with the intention to generate measurable social and environmental impact alongside a financial return and which target a range of returns from below market to market rate. Impact investing is based on the conviction that such investments play a crucial role in addressing social and environmental challenges.
 - b. **Enhance and scale-up venture incubation programs:** Incubators are a very critical part of the entrepreneurial ecosystem:
 - i. Currently there are 120 incubators in India -almost all are government sponsored and largely affiliated to educational institutions. The number of incubators needs to be exponentially increased. In the next decade we should aim to have 1000 incubators covering most of Tier I and II cities in India.
 - ii. In addition to physical infrastructure, Incubators must enhance their services to include mentoring, providing access to business networks, and investors.
 - iii. For rapid scale up of the Incubators and enhancement of services, participation of the private sector will be critical—whether through PPP or other appropriate models including for-profit models.
 - iv. We also need to establish incubators that focus on socially relevant businesses such as the renewable-energy dedicated arm of CIIE (IIM Ahmedabad's incubator).

- c. **Ease entrepreneurial activity:** Regulations and processes for setting up, operating, and exiting a business in India are time consuming and complex. Governments and their agencies can at all levels - central, state, and local - reduce transaction time and costs through measures such as single-window clearance and access to well-developed industrial clusters. Also, a mechanism where businesses of a certain scale can self-certify regulatory compliance would be useful. A model along the lines of Software Technology Parks of India (STPI) could be created for early stage ventures which could get affiliated to "entrepreneurial hubs" that enjoy similar facilities as STPI units.
- d. **Ease exits for investors:** Policy framework for easier exits will encourage early stage investments by Angels and others:
 - i. Provide appropriate fiscal incentive on capital gains to Angels and other early stage investor).
 - ii. Simplify IPO requirements including permitting overseas listing without requirement of domestic listing and exclusion of such investors from "lock in" provisions.
 - iii. Enable preferential treatment of such investment in liquidation.
- e. **Establish expeditious procedures for closing of businesses:** Closing down or winding up a business in India is a complex and time consuming process. Entrepreneurial ecosystem recognizes that business ventures fail and such failure is neither a stigma nor a constraint on future entrepreneurial activity. The complexity of closing down a business is a disincentive to setting up a business in the first place. Cost and complications of retrenchment of workers is a prime disincentive for establishment of labour intensive businesses.

4.2.2 Easy access to equity capital and debt

- a. **Remove regulatory hurdles that inhibit domestic fund raising:** Permitting pension funds, insurance funds and provident funds to invest a small part of their corpus in early-stage venture funds could significantly improve capital flows. Special incentives such as tax credits could be provided to HNIs, corporates and institutions that invest in early stage venture funds or to incubators and to angel investors. Banks must also be encouraged to invest in early-stage venture capital funds by treating such investments as "priority sector" funding without capital market exposure and provisioning norms being applied.
- b. **Government could establish a "fund-of-funds (FOF)" to seed other early stage venture funds:** With a corpus of Rs. 5000 crore this FOF will invest as an anchor investor, in a number of Alternative Investment Funds. These AIFs will raise capital from other sources - domestic and foreign - thereby creating a multiplier effect. This could result in capital flow of up to Rs. 25,000 crore over the next 10 years. The India Opportunities Venture Fund, set up under SLDBI by the Government of India should also play this role.
- c. **Develop and scale-up debt offerings:** Debt is critical to meeting working capital requirements. Traditional debt providers, however, do not lend without collateral. As such, early stage ventures cannot meet lender requirements. Measures to mitigate this can include:
 - i. Expand the lender base by incentivizing banks to offer SIDBI like schemes to early stage ventures. Banks to create capacity and capability for lending to such ventures.
 - ii. SIDBI can expand its role in the area of venture debt by providing funds to specialized NBFCs focused on venture debt (similar to Silicon Valley Bank).
 - iii. Establish and promote UNIDO like mutual credit guarantee schemes which have played an important role, particularly, in Europe and Brazil. These measures would require the support of Ministry of Micro, Small & Medium Enterprises and the banking system to work successfully.
 - iv. Improve- credit rating models and their coverage; SMERA, CRISIL and other rating agencies empanelled under "Performance and Credit Rating Scheme" of the Ministry of MSME need to actively work towards improving quality and reach of their credit models for small businesses. This would be a key enabler in allowing banks and other financial institutions to provide debt capital to such ventures.

- 4.2.3 **Businesses as entrepreneurial hubs:** Greater engagement of established businesses with emerging ventures is needed.
- a. **Private sector could participate in setting up and operating incubators in PPP** or other appropriate models including for profit. Such incubators would have access to high quality managerial and technical resources of the sponsoring private enterprise.
 - b. **Industry bodies and chambers of commerce could drive greater collaboration** between established and emerging businesses, leading to:
 - i. Greater collaboration both as a buyer and a supplier: Established businesses can work with small businesses strategically to source innovation and technology. They will also better understand buying needs of emerging firms and hence develop solutions and products specifically tailored for them.
 - ii. Greater M&A activity: Established businesses need to also proactively look at entrepreneurial ventures as sources of inorganic growth - both intellectual property (IP) and non-IP related. Greater engagement with new ventures will improve established businesses' understanding of such ventures and encourage acquisitions as a preferred mode over organic development, with the benefits of the access to passion-driven talent and reduced time-to-market.
- 4.2.4 **Culture and institutions which encourage entrepreneurship over careerism:** There is a mutually reinforcing relationship between thriving entrepreneurial activity and a culture that supports entrepreneurship - risk-taking and greater tolerance of failure. Measures taken by educational institutions greatly assist in creation of such a culture over time.
- a. **Upgrade courses and programs:** India needs more entrepreneurship courses (including social entrepreneurship) and programs across institutions of higher learning. Such programs will be a valuable complement to programs that have traditionally focused on technical and theoretical learning.
 - b. **Enhance linkages between educational institutions and entrepreneurial ecosystem:** This can be done through a sustained engagement of entrepreneurs, angel investors, and venture capitalists as faculty and mentors.
 - c. **Promote innovation and commercialization:** India has several institutions dedicated to advanced research. However, the commercialization of research is lacking. Engagement with entrepreneurial ecosystem can provide such institutions with a mutually beneficial and reinforcing relationship leading to opportunities of commercializing the IP through appropriate licensing arrangements.
 - d. **Celebrate success stories:** The media - TV, print and online - should disseminate entrepreneurial success stories to inspire and encourage entrepreneurship.
- 4.2.5 **Adequate and effective collaboration forums:** A vibrant entrepreneurial ecosystem needs forums, virtual or physical, where all stakeholders can come together to share experience, expertise and develop symbiotic relationships. There are several models of developing such forums including:
- a. **Develop online portals:** Creating an online portal that provides comprehensive information to a new entrepreneur is highly valuable. In addition to providing information on government policies and regulations, such portals can also provide means for virtual mentorship support. The government can play a role by aligning all arms - various ministries, regulators, etc - to help develop such a comprehensive information portal which will host all relevant information on statutory compliances for setting up and operating businesses. Collaborative forums could also participate in creation of such a portal by providing inputs and encouraging its use.
 - b. **Encourage creation of collaborative forums** along the lines of TiE and MentorSquare to make mentorship networks available to a wider audience of entrepreneurs.

- c. **Set up Innovation Labs (iLabs):** India should develop a network of 15-20 iLabs that can serve as the focal points for collaboration across the region. Such iLabs could also serve as a hub for incubators, accelerators and other enablers in the region.

4.3 Key recommendation: National Entrepreneurship Mission

The Committee has made extensive recommendations that are relevant to a number of stakeholders both within the Governmental and Regulatory fold and those outside their immediate purview. The Committee believes however, that to build a vibrant entrepreneurial ecosystem leading to significant employment and wealth creation in the country, there has to be a sustained and continuous focus on the simultaneous and coordinated implementation of these measures.

Towards this objective, we recommend that the Central Government set up a National Entrepreneurship Mission (the "Mission"), whose sole focus will be to establish a vibrant entrepreneurial ecosystem in India. The Mission's mandate, as one single entity within the Governments both at the National and State levels, will require it to pursue exclusively, the task of facilitating entrepreneurs and entrepreneurship. The Mission's key roles will be:

- i. The Mission will collaborate and work with all other entities, within Government and outside it, with the following objectives:
 - a. Ensure that the promotion of entrepreneurship is continuously high on the agenda of all stakeholders
 - b. Educate & inform all best practices globally & put forward well researched recommendations and action plans that would facilitate entrepreneurship
 - c. Create appropriate measurements, methodologies and systems to track performance across various industries, in this area. A few of these for example, could be India's global ranking in entrepreneurship, ease of doing business
- ii. The Mission would work closely with Government ministries/ departments of Finance, MSME, HRD, Industry, IT, etc. at both National and State levels, many of whom have developed strategic plans of their own and seek to help them strengthen the element of entrepreneurship in those plans.
- iii. It would similarly work with Regulators, Banks, financial Institutions, Angel investors, Venture Capitalists, industry bodies & Chambers of Commerce and educational institutions, both public and private, with the objective of regulatory outcomes which promote and facilitate entrepreneurship.
- iv. While the general approach would be to work in an enabling and coordinating capacity, it would have the lead role in the area of driving the financing part of the eco system which is the most critical component. In this area it would need to have appropriate empowerment whilst engaging with other stakeholders. In the area of financing, the Mission would be the sole recommending authority to the Government of India and counterpart bodies set up at the State levels.
- v. This Mission would derive its unique strength and importance from the fact that it would be the most knowledgeable entity in India on the subject of creation and development of an entrepreneurial eco system that will foster levels of innovation, enterprise and employment that the country needs, on a sustainable basis. It would therefore, be able to achieve a vast majority of its objectives without having an overarching mandate over other entities of Governments.
- vi. It would also become the nodal point for an entrepreneurship movement and in that capacity, articulate and disseminate the view point of the entrepreneurs amongst all the stakeholders within Government and outside- a capacity that is lacking today.
- vii. The mission will develop a clearly defined plan of action, ownership of initiatives, key dependencies, resource-requirements for research as well as designing, devising, driving, tracking, and monitoring progress of the initiatives and plans.

- viii. The mission should ideally be set up under the Prime Minister's office which will give it the ability to exercise adequate influence without necessarily a statutory authority.
- ix. The mission would set up appropriate mechanisms and metrics that will allow it to track its impact on the entrepreneurial eco system in the country.
- x. It would similarly help all other stake holders in drawing up mechanisms to measure their impact on increasing entrepreneurial activity.

5. Assessment of India's Innovation Policies (RIS Discussion Paper)²⁴

This paper, authored by Shri Biswajit Dhar and Sabyasachi Saha, presents a detailed overview of the innovation policy framework in India in order to assess its role in innovations and enterprise development in the Indian industry. Over the decades, India's innovation strategies have been guided by the S&T policy statements, while industrial policy resolutions/statements have given direction to the development of manufacturing enterprises. These twin processes have tried to ensure that India is able to develop a sufficiently robust manufacturing base and at the same time build a sound S&T infrastructure and create a high-skilled manpower base. The authors have distinguished between eras of closed and liberalised economy in India and accounted for recent policy overtures. The authors have also closely examined the Indian scenario with respect to technological capability of its industry and have drawn suggestive international comparisons. Substantial attention has been devoted to the emerging issue of innovations in the SME sector in India and technological interventions in two traditional industry clusters in India have been discussed in detail. Finally, the existing bottlenecks in India's national innovation system have been highlighted. In this paper the authors have noted that the existing policy paradigm does not draw upon immediate innovation challenges that may be specific to India, particularly when developmental priorities are overwhelming. The paper suggest that while, economic policies should ensure sustained demand for innovations, innovation policies in India at this juncture should cater to two definite goals. First, streamline availability of broad-based skills to seize opportunities of specialization, industrial development and knowledge economy. And, second, achieve frontier R&D focused on pro-poor innovations, niche knowledge and green technologies.

This paper has relevant references which could be of interest to the expert committee.

²⁴Research and Information System for Developing Countries Discussion Paper # 189, by Shri Biswajit Dhar and Sabyasachi Saha

Appendix B

Results from Survey of Manufacturing Clusters

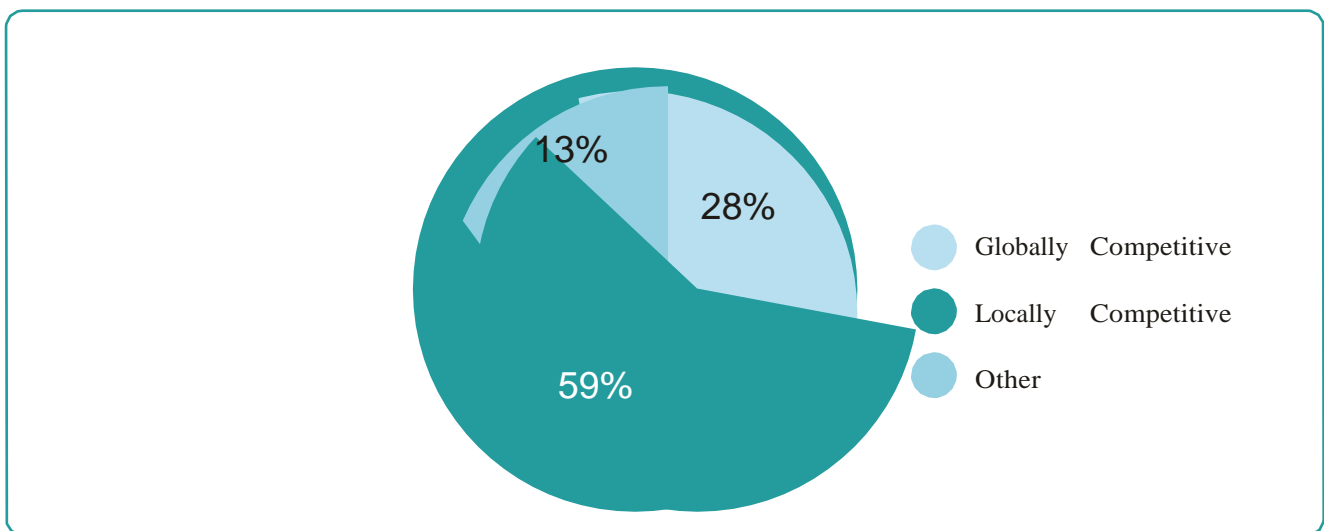
The expert committee commissioned several surveys to understand entrepreneurship as it currently exists, the challenges facing existing entrepreneurs and the barriers to entry for new business owners. Taken together, these surveys offer key insights into various factors hampering or slowing down the growth of entrepreneurship for different sections of the population, and provide a way to look at solutions for the future.

In this section, we outline the main results from a survey on manufacturing clusters. The survey was conducted on 462 participants from 28 independent industry clusters across different geographic areas.

1. Sector competitiveness:

While 59% of the respondents from over 25 different manufacturing and export sectors felt they were locally competitive, only 28% felt they were globally competitive.

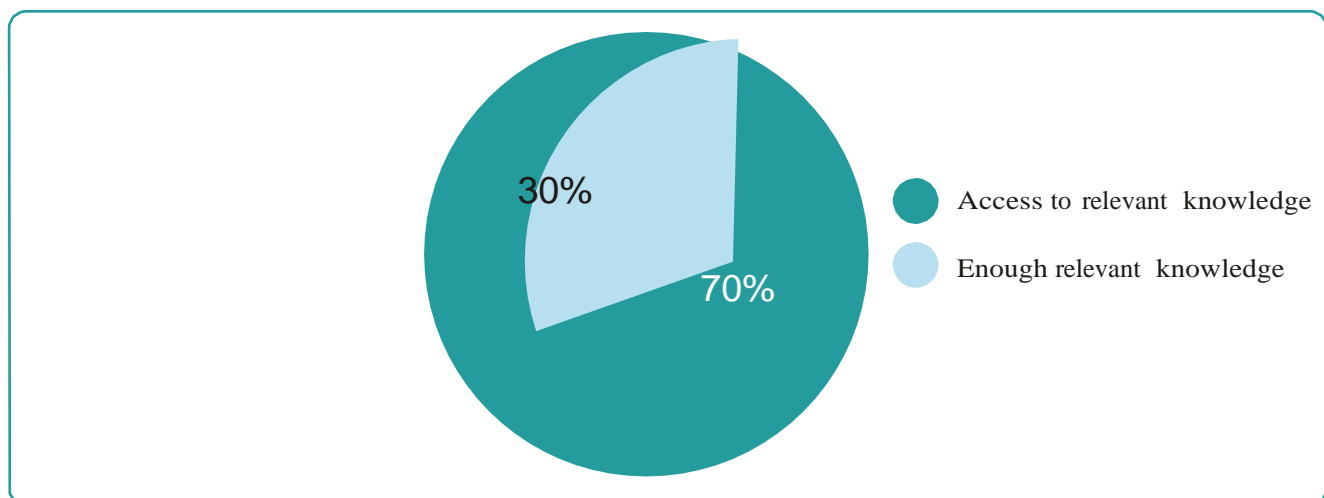
Figure 13: How Healthy is Your Business?



2. Access to relevant knowledge

An astounding 70%, across various manufacturing sectors, agreed that access to relevant knowledge needs to be strengthened. In some sectors, such as among machine knitters, garment manufacturers, rice millers and pulses manufacturers, 100% of the respondents felt that access to knowledge needed to be firmed up.

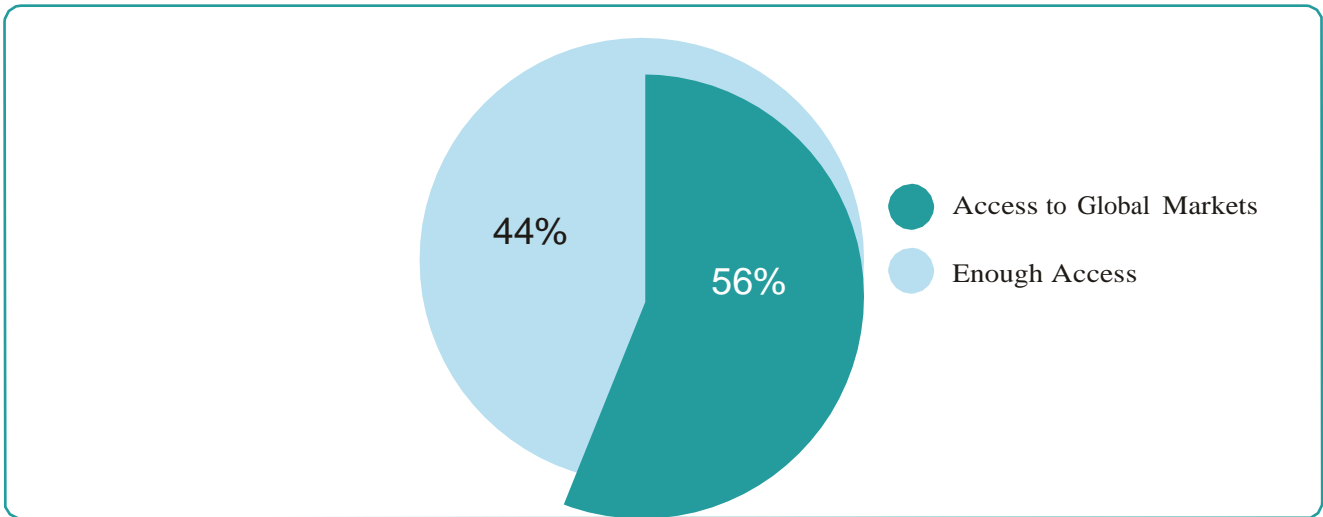
Figure 14: Benefit to Strengthen - Knowledge Access



3. Access to global markets

An average of 56% of the respondents across all the sectors surveyed felt that access to global markets needed to be strengthened. In some sectors such as among brass manufacturers and yarn merchants, over 80% of the respondents felt this was a benefit that needed to be strengthened.

Figure 15: Benefit to Strengthen - Global Market Access

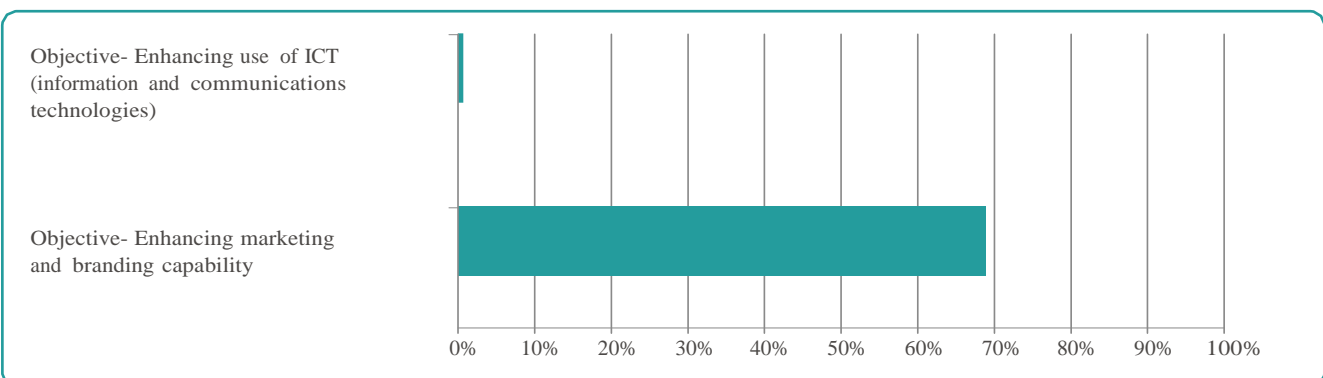


4. Marketing and branding capability

69% of respondent felt that enhancing marketing and branding capability was needed. In fact, in many clusters such as rice millers, machine knitters, garment manufacturers, yarn manufacturers, 80 percent or more correspondents felt that this was an area to focus on. In contrast, most clusters felt that knowledge of technology or ICT was not holding them back.

Product design, packaging and brand creation help manufacturers capture and retain more value from their products. Marketing allows manufacturers to see their product and its usage in a new light, thereby opening up new markets locally, nationally or even globally. Understand consumer behaviour and needs leads to future innovation. As the economy opens up and manufacturers understand competition or aspire to plug into the global economy, it is natural that marketing and branding capabilities would be viewed as a necessary skill to expand and move up the value chain. While design thinking and product innovation needs to be absorbed over time, in the short term interventions are possible to enable these clusters to learn about marketing and quality control.

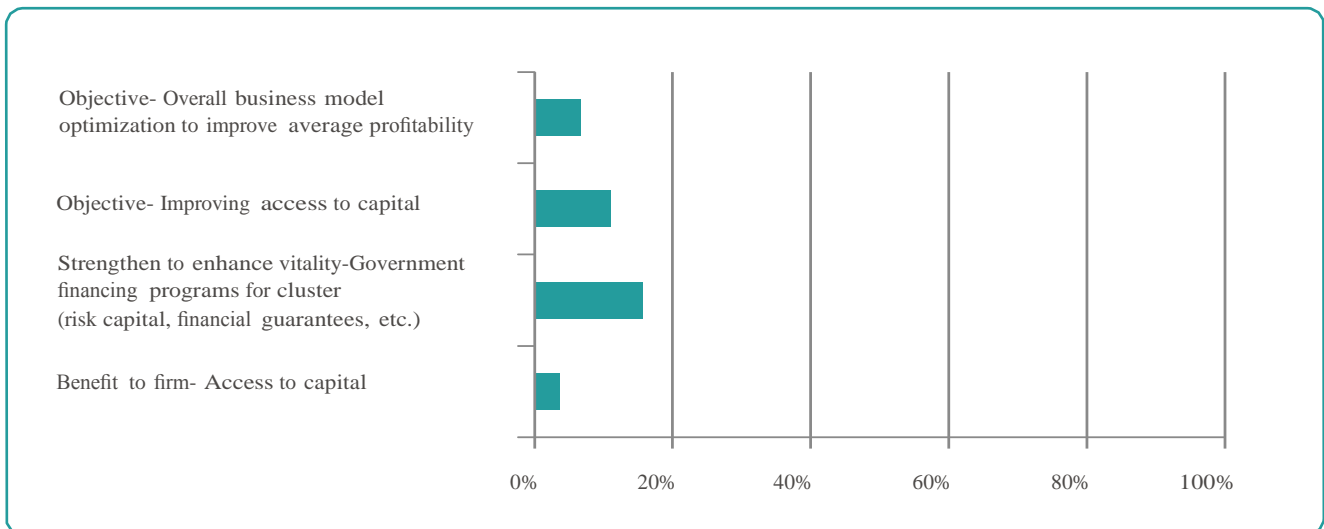
Figure 16: Technical and marketing capability in manufacturing clusters



5. Access to capital or business knowledge is not perceived as a barrier

It is interesting to note that most clusters did not find elements related to the business model or access to capital as a deterrent. This may be because the government has various schemes to support MSME clusters and established manufacturing outfits could be adequately aware of sources of funding needed to support their businesses.

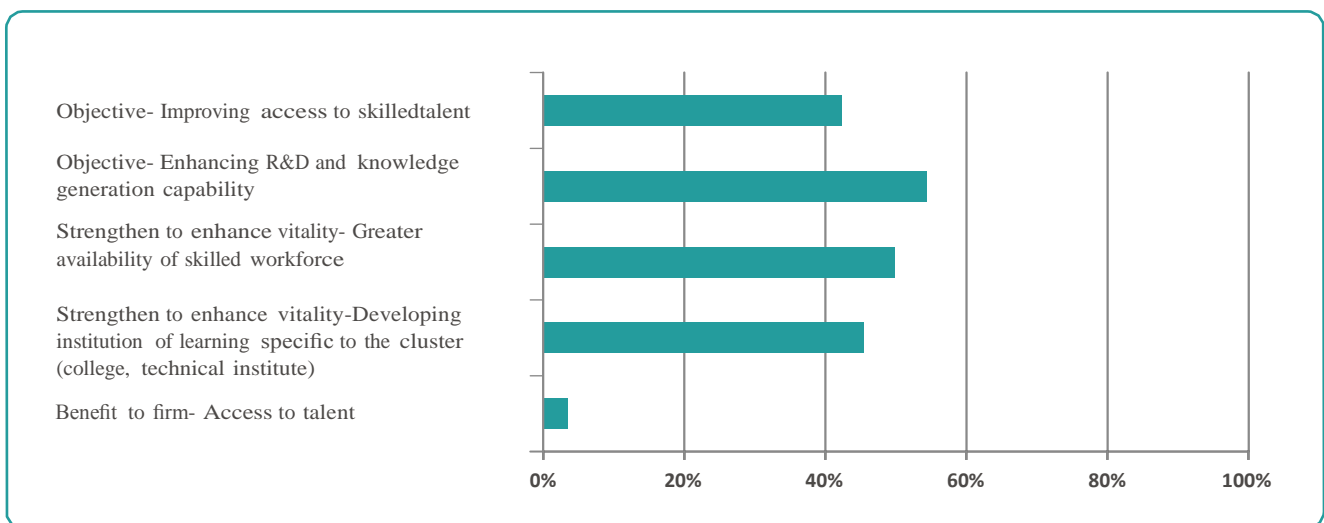
Figure 17: Access to Capital in manufacturing clusters



6. Knowledge and Technical Knowhow

Nearly 50% of clusters are looking for availability of skilled workforce. The critical elements to revitalise and skill the workforce could be through cluster-specific technical institutes, as suggested by 45% of respondents, and an ability to research and innovate in areas related to the cluster, as suggested by 54% of respondents. This indicates a need, not for broad-based education, rather for targeted skilling of large number of people in distributed clusters to support the specific requirements of each sector.

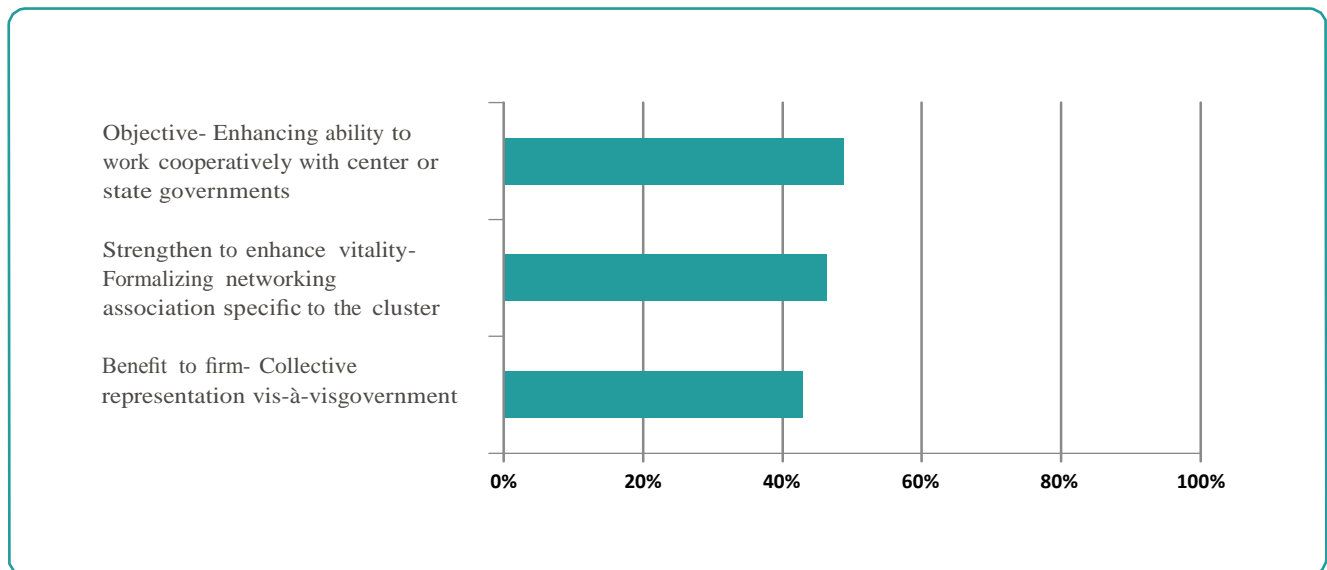
Figure 18: Need for skills & knowledge in manufacturing cluster workforce



7. Platforms for Cluster Networking and Government Interconnect

49% of respondents surveyed felt the need to improve formal networking within the sector through associations. 46% of respondent felt the need to enhance their ability to work cooperatively with government at the centre or state levels. While industry bodies and associations already exist and are active at the national and zonal levels, there may be a need to cascade the activities of such networks down to the district and cluster levels. Clusters also perceive they could benefit from collective representation with the government.

Figure 19: Need for organization in clusters



Appendix C

Results from Survey of Start-up Clusters

In this survey, the online profiles of 900 start-up innovator/entrepreneurs were analyzed in clusters located in Bangalore. Our study reveals that these entrepreneurs come from a variety of backgrounds and also different parts of the country. Quest for innovation and the demand for talent are increasingly drawing a pool of skilled individuals from diverse backgrounds to cities like Bangalore and Mumbai. While Internet and e-commerce-based ideas dominate the start-up “scene,” there is a lot that these hot-spots reveal to us that we can apply to larger programs related to entrepreneurship and innovation. But before that, a quick look at some of the key figures related to start-up clusters in Mumbai and Bangalore:

Both clusters demonstrate a year-on-year compounded annual growth rate of around 30%

40 start-ups raised a median amount of \$2.5 million

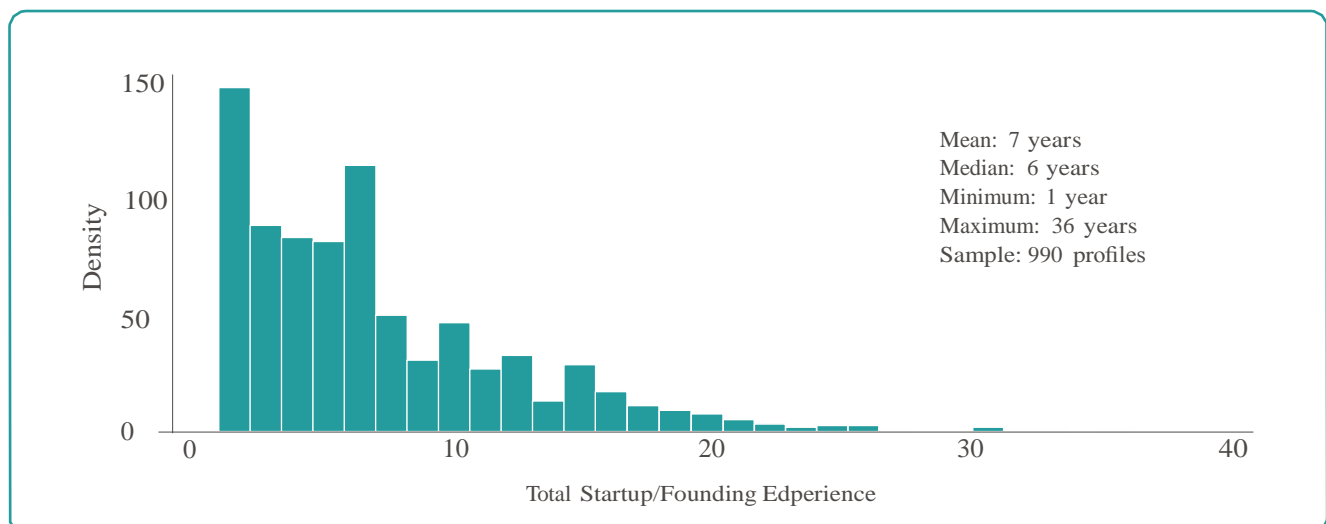
There are approximately 180 investors, with 15 to 20 serial investors

In terms of immediate relevance, the Koramangala Cluster study offers some interesting insights about the experience level of start-up entrepreneurs:

1. Work Experience

A look at the experience level of start-up entrepreneurs reveals that on average, most have worked for a few years thereby acquiring skills necessary to found and grow their own businesses. These highly educated individuals find easy employment in India’s fast growing new economy firms, before branching out to start their own ventures, after having seen process orientation, implementation procedures, and entrepreneurship in action.

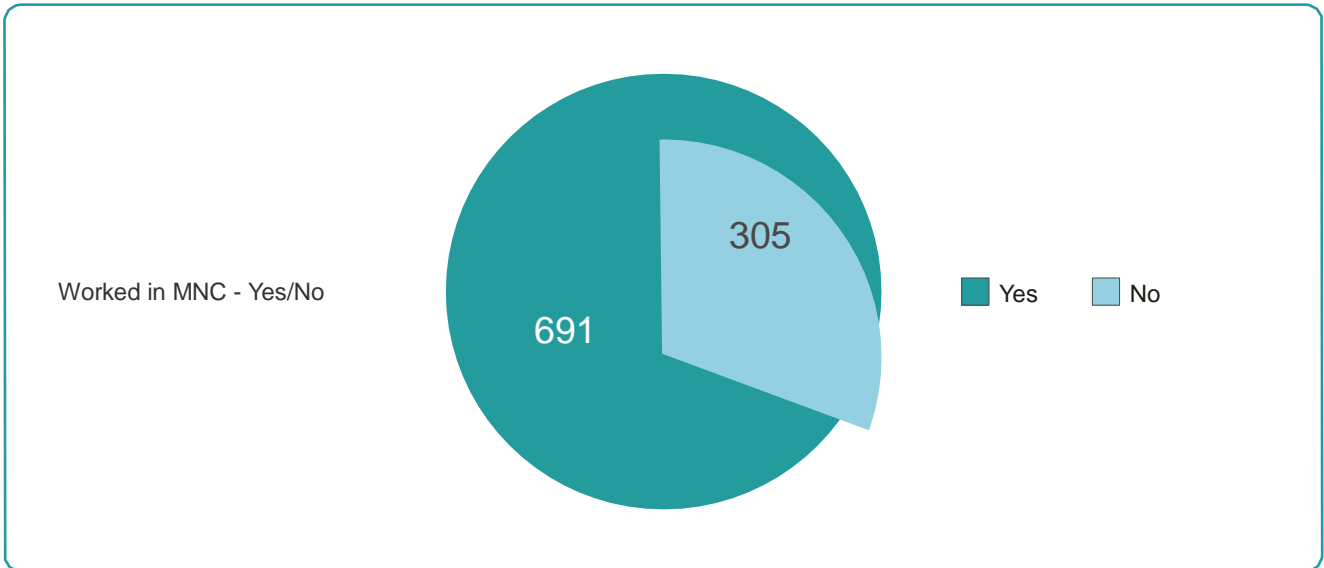
Figure 20: Start-up founder experience



2. Work Segments

It is interesting to note that digital economy entrepreneurs gain their work experience in MNCs or Indian firms, indicating that working in more structured environments with early on-the-job training and development interventions offered by these organizations could play a role in the development of entrepreneurial skills, knowhow and networks.

Figure 21: Start-up founder experience



3. Education

One of the most interesting findings from the Koramangala Cluster study was that start-up clusters foster a culture of Inclusive Innovation. What seems to count here is talent, skill and experience, rather than a degree from a national institute of importance. While all entrepreneurs were highly educated with graduate or post-graduate degrees, they came from a mix of engineering and non-engineering backgrounds and only 16% came from institutions of national repute.

Figure 22: Start-up founder education

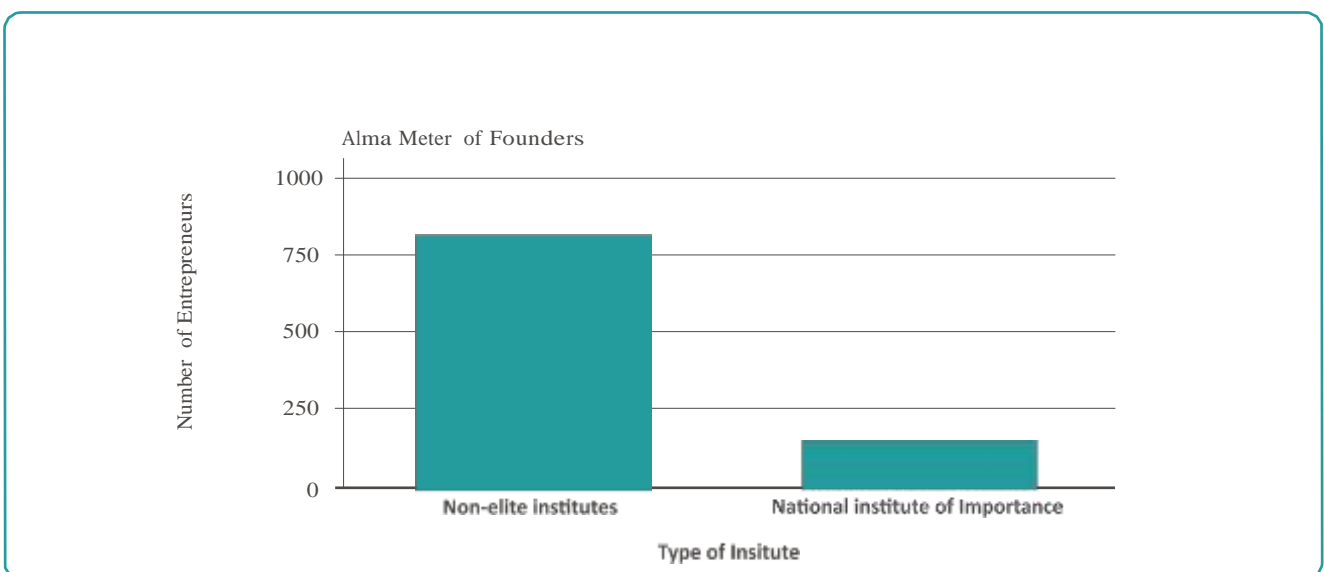
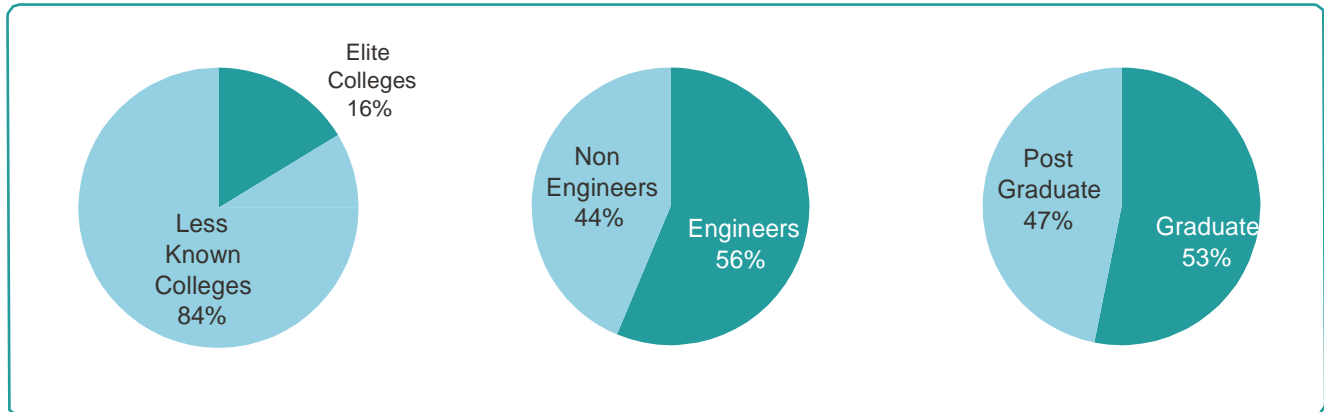


Figure 23: Education of start-up founders



The above finding is relevant given the fact that the degrees offered by most institutes in India are not valued as highly as say the top twenty or so national institutes of importance. This leaves out a large talent pool from the mainstream, partly because the logistics and expenses involved in recruiting talent from these vastly spread out institutes outweigh the benefits for employers. Now, clusters seem to make opportunities accessible to talent, and draw them out of wherever they are – be it Bareilly or Asansol! This suggests a need for focus on quality education and awareness in a larger number of institutions spread across the nation, rather than focusing inordinate resources on fewer elite colleges, to lead towards wider spread of the entrepreneurial culture.

Survey results also highlight a trend of entrepreneurs moving back to their home provinces—in the North East or Goa or Orissa—to start ventures, after having worked in urban clusters of Bangalore or Mumbai. Reasons cited were: desire to cater to their local areas, desire to create a national footprint while being closer to the source of their raw materials, and desire to employ a local workforce. This type of distributed growth is essential to enable every part of the country to move ahead and prosper. It might even be required for long term stability that the aspirations of youth in every segment of society and in every part of the country are met.

Appendix D

Results from Survey on Economically Backward Youth

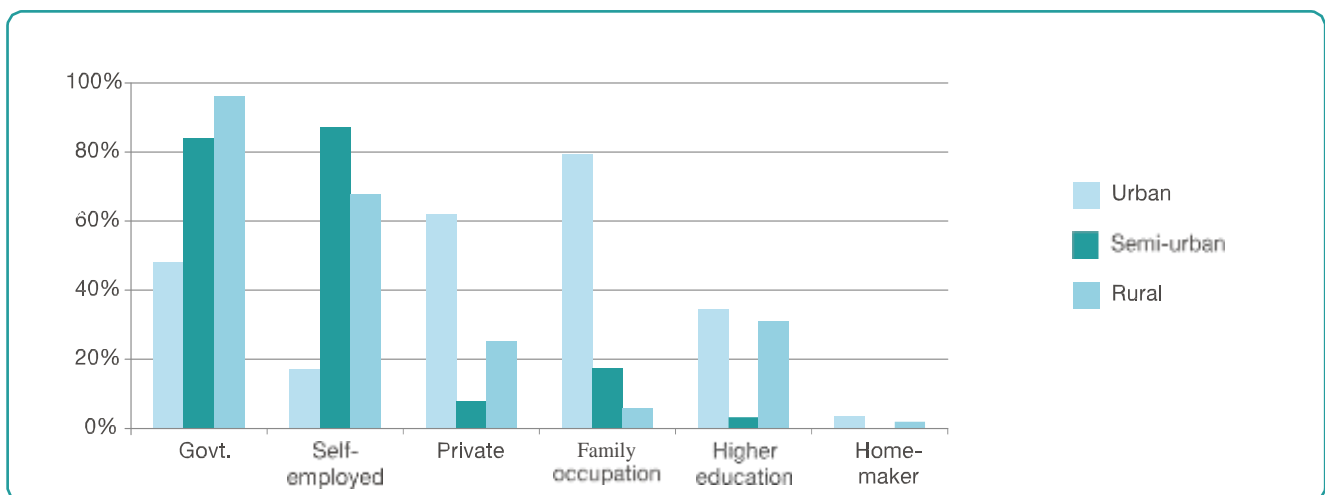
In this survey, 195 participants were surveyed across 10 Pratham Institutes in the states of Maharashtra, Delhi, Andhra Pradesh, Chhattisgarh. They included economically challenged youth in urban, semi-urban and rural areas. The purpose of the survey was to investigate the propensity and challenges for self-employment and entrepreneurship amongst the economically-backward youth. Respondents hail from the bottom 30% income strata, and are undergoing vocational training in sectors of hospitality, healthcare, construction, and beauty and wellness. Most respondents have completed education only till Class 10 or 12. Various multiple choice questions were asked, to which respondents in many cases chose more than one option. In this appendix, we outline the most interesting results from this survey.

1. Desire for entrepreneurship is high

The desire for entrepreneurship varies by location and gender. Only 17% of lower income youth in urban areas expressed interest in entrepreneurship or self-employment, as compared with 87% of respondents in semi-urban areas and 68% in rural areas. Opportunities for formal or informal sector employment in private or family occupations are lower in semi-urban and rural areas, potentially leading to this desire.

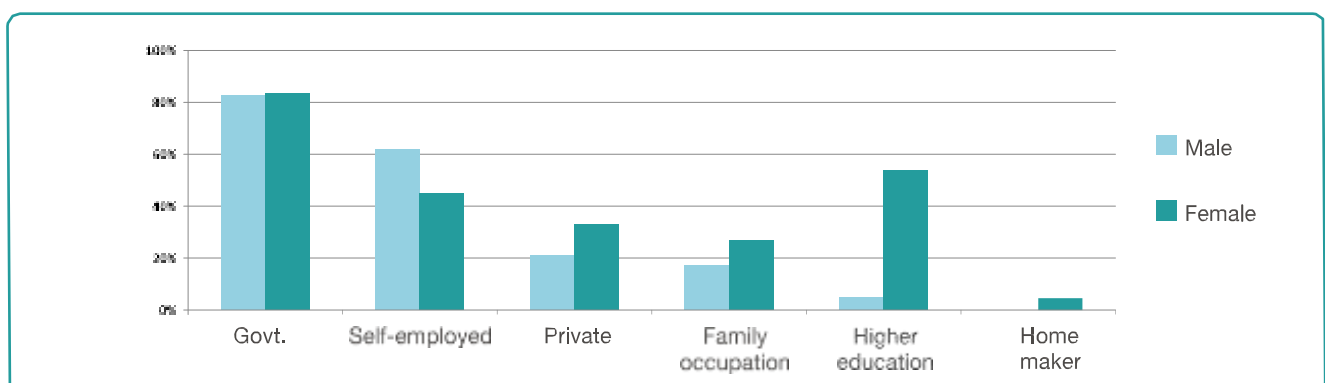
Over 80% of respondents in semi-urban and rural areas also aspire for government jobs, whereas urban youth envision themselves working in private or family businesses.

Figure 24: 3 year employment aspiration of youth, by location



Female respondents were more inclined towards self-employment (62%) as opposed to the male respondents (45%) and also responded saying they were more likely to opt for higher education (54%) as opposed to their male counterparts (5%). This indicates that much could be done in the short term to encourage education, vocational education and self-employment in women.

Figure 25: 3 year employment aspiration of youth, by location



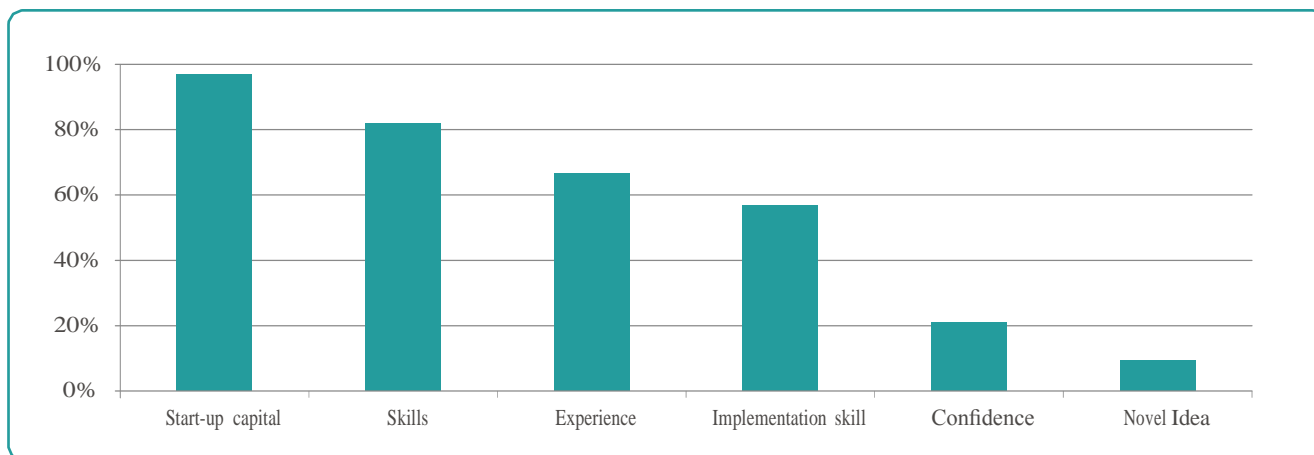
Nearly 55% of respondents in rural areas and 60% of respondents in urban areas would prefer to start an enterprise in areas closer to their homes. The openness to migration is highest in semi-urban areas.

2. Access to start-up capital is perceived as biggest barrier

Across all geographic areas, 97% of the youth perceived that access to start-up was a barrier to entrepreneurship. Looking at detailed responses, nearly 75% of respondents in semi-urban areas and over 90% of respondents in rural areas indicated that they would opt for entrepreneurship if a government scheme provided support. It is interesting to contrast this with the response from the manufacturing clusters, where less than 10% of respondents felt that lack of capital, government financial support schemes or business knowhow was a deterrent to their business. Similarly, 60% to 90% of respondents in urban or semi-urban areas would opt for entrepreneurship if independent sources of capital were accessible.

All this points towards an interesting information gap that can be bridged in the short term to make lower income youth become aware of existing government programs, policies and schemes to support entrepreneurship, as well as non-governmental funding and patient capital sources available to support business or self-employment, particularly in rural or semi-rural areas.

Figure 26: Factors limiting entrepreneurship



3. Skills, Experience and Implementation Skills

Lower income group youth uniformly express the need for skills by location, whether in urban, semi-urban and rural areas, and by gender. The need for experience was higher in urban (84%) and semi-urban (85%) youth compared with rural youth (44%), and was balanced across male and female respondents. In contrast the need for implementation skills was felt the most by rural youth (75%) and female respondents (88%).

Over 80% of youth in all locations and both genders feel that technical and entrepreneurship training would allow them to become self-starters. 46% think that they need to get specialized sector based knowledge and 46% would like to see entrepreneurship being taught in school and college curriculum.

Figure 27: Factors that would enable youth to become entrepreneurs, by location

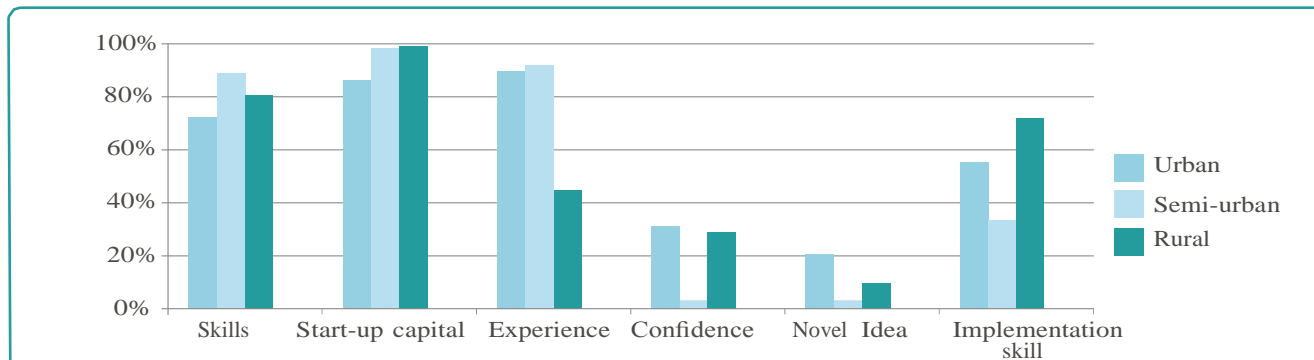


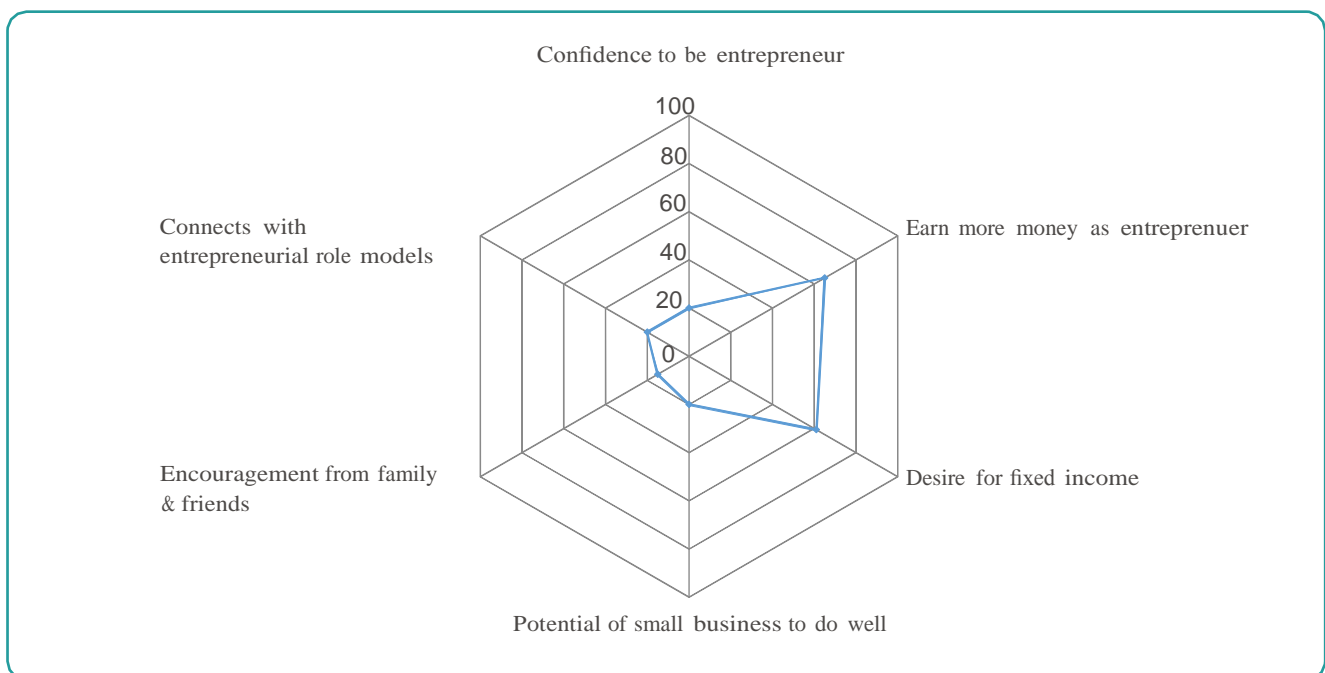
Figure 28: Factors that would enable youth to become entrepreneurs, by gender



4. Cultural impediments to entrepreneurship:

The Pratham survey highlights societal preferences for job security. While respondents felt that they could earn more money if they succeeded as an entrepreneur, they have a high desire to get a fixed income. They can neither envision a small business doing well in their hometown, nor do they have sufficient confidence, encouragement from friends and family or access to role models to venture into self-employment or entrepreneurship.

Figure 29: Attitudes that deter entrepreneurship amid low income youth



i. Desire for security: Over 60% of the respondents across location, whether in urban, semi-urban or rural areas, would prefer the security of steady income from a job. The ratio of male respondents preferring steady income (40%) is higher than female respondents (20%). Youth in semi-urban and rural areas see greater potential for a small business doing well in their hometown, compared with 45% of urban youth who are sceptical of entrepreneurial success. This is perhaps reflective of the opportunity space in semi-urban and rural areas; given fewer jobs in the formal sector, they see more potential in entrepreneurship.

ii. Confidence: Entrepreneurship requires the ability to take an initial risk and stay the course, both of which require a large measure of confidence. Urban (31%) and rural (29%) youth had higher response to “lack of confidence” in being successful as an entrepreneur, whereas only 3% youth in semi-urban areas indicated a lack of confidence. Further, more women expressed “lack of confidence” (48%) as a barrier to starting their own business compared with male respondents (7%). This justifies the effort being given to promote girls education and their participation levels in social and government institutions.

iii. Family background: Of respondents whose parents are entrepreneurs, only 65% aspired for government jobs, compared with 87% for the overall group. While nearly all youth selected “fear of the monetary-risks” as a reason for not wanting to become an entrepreneur, a high 67% also chose “Family pressure to seek stable employment.” Barring 8% of the respondents, who wanted to follow the family tradition of becoming an entrepreneur, the others prefer the stability of a government job to private sector job. The highest proportion of “aspiring entrepreneurs” come from agrarian families – the “self-employed” nature of their family profession seems to incline these youth towards entrepreneurship as well. These results suggest that families play a huge role in supporting career choices, and that the change would happen not just by skilling the youth, but by challenging the belief systems and changing the mindsets of families and communities at large.

iv. Access to role models: 48% of respondents in urban areas and 30% of males indicated that meeting some entrepreneur role models with similar backgrounds would help them in starting their own businesses. Very few respondents knew an entrepreneur in their immediate friends or family circle. However, 98% of male and 69% of female respondents knew an entrepreneur in their village or home town. Looking by location, 72% of urban, 94% of semi-urban and 89% of rural respondents knew an entrepreneur from their home town or village. Clearly many respondents knew of successful entrepreneurs, but outside their immediate circle. To help them understand how others from a similar background succeeded as business owners, these youth need platforms and organized opportunities for interaction. Such interactions demystify the entrepreneurial process and give confidence to youth to take risks. Local incubators or association chapters could play a role in making these interconnections and help aspiring entrepreneurs meet with and learn from role models.

Appendix E

Detailed Explanation on Grand Challenges/ Incentivized Innovations in India (i3)

1. Why Incentivised Innovations in India?

While the country has made significant progress in the last two decades, the population remains the tale of two economies - 74% of the population remains mired in deep poverty according to Social, Economic, and Caste Census of 2011. On the other hand about 15% to 20% of the population seems to be doing well. About 69% of the population lives in rural India and their contribution to the national GDP is lagging far behind. The average income of the 75% of the rural households is Rs.33 per person, per day. A high percentage of the rural population suffers from unemployment, low wages, lack of industrialization, and unsuitable housing. Basic services such as functioning roads, 24/7 electricity, and clean water are typically missing. Same applies to rudimentary healthcare and quality education. Many of these issues also plague day-to-day lives of the poor urban population. Additional challenges such as waste treatment, food adulteration, severely weakened old infrastructure, and high pollution remain unsolved.

While state-of-the-art technology can address a number of these challenges, the existing answers have been out of reach due to the excessively high price tag. This document highlights eleven key burning problems and recommends grand prizes to anyone who delivers in a timely manner disruptive technology solutions that are ultra-low cost, low maintenance, and durable. Wide spread adaption and deployment of these disruptive solutions will result in economic transformation of the bottom 70% and beyond of the population and elimination of poverty. An additional objective is to further energize the local scientific and engineering community/academic institutions and engage them in innovative research and development towards finding novel solutions. Yet another objective is to make India a source of innovation and novel products to address similar problems faced by about 5 billion people worldwide and in the process also accelerate our own economy.

2. Brief Summary of i3

An organization structure that is part of the suggested AIM organization and a process are proposed for managing the grand prizes. The head of this organization will work with corresponding subject matter experts for each challenge. Anyone who is an Indian citizen is eligible to participate. Same applies to those of Indian origin such as NRIs, as long as there is a credible technical counterpart in India working in close collaboration. Those receiving the prize money are mandated to make the product in India. Each challenge will end in three years from the date of the grand prize challenges' announcement. It is anticipated that several of them should have solutions within 12 to

24 months. 25% of the prize money is provided in phase one to promising technical approaches. Remaining 75% of the prize money is paid only at successful delivery, validated by rigorous testing against detailed specifications. The prize amount for a challenge will range between Rs. 10 crore to Rs. 30 crore. Assuming a budget of Rs. 150 Crore, the first year outlay will be Rs. 37.5 Crore. It will be followed by Rs. 56 Crore per year for the subsequent two years assuming every single challenge has been successfully addressed. There is a possibility that no novel solution is found within the stipulated time frame for some of the challenges. However, if solutions are delivered even for half of the challenges, that will be a substantial success. The exact amount for each challenge is To Be Determined and is a function of importance of the project and the level of technical difficulties involved. The award amount will be decided after consultation with the Ministry of Science & Technology and others suggested by Niti Aayog. In the future, other government and non-government entities can also announce their own grand challenges or add to the prizes announced, under this umbrella. It is recommended that AIM collects 3% to 4% royalties on the gross sales from the recipients of the grand prizes.

Finding desirable answers to these challenges dubbed as "i3 grand prize challenges" will assist in quickly meeting the goals of several major government campaigns such as Make in India, Housing for all, Health assurance, Swachh Bharat, and Rural industrialization.

(More details on implementation, eligibility and process can be found below.)

3. Overview:

The factors holding back rural and semi-urban India are lack of 24/7 electricity, roads that are usable round the year, clean water, suitable housing, access to basic healthcare, quality education, and employable skills. From the outset providing these services is quite expensive and is further hampered by sub-par execution, resulting in sluggish deployment across the board. All of these lead to rampant poverty, unemployment, and quality of life that leave a lot to be desired. These issues are also forcing a significant migration from rural to urban areas that to begin with are falling apart at the seams in terms of their ability to deliver services. Meaningful rural industrialization and inclusion in supply chain cannot be developed without addressing these key challenges. Without a thriving rural industry, it is not possible to uplift the large majority of the country's population. This is more important than ever considering that the average farm land holding is progressively getting smaller to the point where most small farmers cannot produce enough to support themselves and their families. Additionally there are significant issues that impact everyone regardless of rural or urban settings such as waste management, the rampant pollution, and food adulteration that by some estimates are the worst in the world.

4. The Key Problems:

- About 400 million people in India are without electricity, mostly in rural areas. Additionally, in the areas that do have power, electricity is unreliable and intermittent at best. Off-grid solar power remains economically unviable. Diesel and other environmentally unfriendly options are used to generate expensive back-up electricity and the impact of such practices on the environment is massive. It is also a noteworthy drain on foreign exchange. Lead acid batteries are also widely used either as a primary or back-up source. At the end of such battery's life, lead is routinely disposed of in the ground by scrap merchants causing a serious ground/water lead contamination making its way into food we eat, and thus a source of crippling diseases. Lack of electricity hurts every aspect of economic activity and human life; from the lack of rural industrialization resulting in high unemployment, to rural students who cannot study after dark and are permanently relegated to being second tier citizens, to health clinics without any ability to test, to large amount of produce that rots, farmers who cannot operate pumps etc. Even those who are employed, their wages are meager: 670 million people on average earning Rs.33 per person, per day.
- Most people do not have consistent access to clean, usable drinking water. It is filled with pollutants, pathogens, and toxic substances. In rural areas the problem is even worse caused by run-off from extensive and unconstrained usage of chemical fertilizers and pesticides. The wealthy either buy bottled water, or set up personal water filtration systems, while the average individuals that are over 80% of the population are forced to ingest all manner of harmful substances dissolved in the water. The net result is a large number of water-borne diseases, serious kidney, liver, and gastrointestinal issues, and a rapidly growing cancer rate, human suffering at a mega scale with no escape so far.
- One of the biggest bottlenecks in rural industrialization is the lack of round the year quality road access in many parts of the country. This directly impacts the livelihood of the rural poor. While low cost manpower and cheaper land makes rural areas ideal for small industries and ancillary units, the lack of roads remains a serious impediment. How can we, as a nation, march forward when 69% of our population and the goods produced are unable to move in a timely manner? A data point to note, 51% of the rural households make a living by manual labor.
- Indian farmers in spite of their hard work lose the highest percentage of milk and produce in the world due to the lack of affordable cold storage. This is pathetic considering that 90% of the rural household make less than Rs.10,000 per month, so this is money straight out of their pockets. Furthermore, small fruit and vegetable street vendors are forced to sell their goods at pennies on the dollar at the end of the day due to lack of cold storage, thus denying them a fair return on their hard work – less money in their hands.
- There is a serious lack of affordable housing. About half of rural population (that is about 435 million people) still lives in Kuccha house. They are poorly protected against weather be it rain, cold or heat. Many of them routinely suffer serious damage during monsoon season. Furthermore, most generally lack running water or sanitation facilities forcing men, women, and children to defecate outdoors.

- The poor population routinely suffers from easily treatable illnesses due to a lack of access to rudimentary healthcare including cost effective diagnostics such as basic blood tests. Most rural areas lack the equipment and effectively force a common person to suffer with diseases much longer or go to the cities. Places where the equipment does exist, the tests themselves are cost prohibitive, and are often hindered by erratic power supply.
- Food adulteration is a serious problem across the board. A recent India Today article called it a “ticking food bomb.” Milk adulteration is a serious health hazard. Urea, detergent, ammonium sulphate, paint etc., when ingested are toxic and carcinogenic, are routinely mixed in milk. The existing lactometers are not meant to test for the presence of such chemicals. Everyday usage of such toxic milk is leading to major diseases in the population-at-large from children to senior citizens.
- The cities have a huge problem with waste removal and decomposition, which is another source of debilitating diseases. Most urban facilities are woefully inadequate while in rural areas these are almost non-existent. Even if a village or a town could collect all the waste, what to do with it remains unanswered in most cases. Most incinerators typically burn the waste, in some cases the heat is used to generate electricity, and the gases are released in the air further compromising the already poor quality of the air. Approximately one ton of carbon dioxide is emitted for every ton of municipal waste incinerated. The solid residue is hazardous and is not properly stored creating additional health risks.
- A significant percentage of the population still uses solid or liquid fuel for cooking, resulting in deforestation and a considerably increased carbon footprint. Liquid fuel such as kerosene is also drain on foreign reserve. There are serious health consequences as well especially for women who primarily do most of the cooking.
- The strength of the existing buildings, bridges, and dams is in a state of disrepair and the structures built today typically last only half of their anticipated design life. Global climate change is further accelerating the deterioration. There are about 125,000 major bridges used by the Indian railways, most are over 50 years old. The current allowable loads far exceed that existed during construction. Furthermore, weakened infrastructure is also at a much greater risk of collapsing during earthquakes and other natural disasters including fires, cyclones, tsunamis, flooding, etc. Such situation can cause large scale disasters, threaten national security, and can derail progress for years to come. Unfortunately current strengthening solutions cost over 50% of the replacement cost.
- Air-conditioning usage is rapidly rising in the country. It has been estimated that if air conditioning was as prevalent in Mumbai as in New York, it will consume the same amount of electricity as 25% of the total electricity used for air conditioning in the United States. This has tremendously increased the demand on new power generation, most of that is coal-fired - a recipe for environmental disaster.

It should be noted that the problems for which research and development is already underway elsewhere and substantial sums are being spent are not included in the above list. An example is the extensive work being done by Gates Foundation on developing low-cost toilets. Besides, the award amounts would pale in comparison to the budget of such on-going efforts. Similarly, problems for which cost-effective solutions already exist but are constrained by the implementation efforts have also not been included.

In many cases, the technology addressing the above mentioned pressing problems does exist; however, in every instance they are too expensive and thus economically unviable in the Indian context. There is an urgent need to develop novel disruptive technologies that are ultra-low cost, economically affordable and customized to the local conditions. It should be noted that while on the surface these may appear to be easy challenges, one only needs to dig deeper to find out that ultra-low cost answers have been out of reach so far either due to lack of awareness or effort, or, lack of capital, or the inherent challenge in finding the right answer, or all of the above. We need to place these on top of the national agenda and draw attention of the community of scientists/engineers/entrepreneurs to quickly find out-of-the-box answers to these difficult challenges.

Disruptive innovation in addressing these problems and incentivizing technology breakthroughs is the way to move forward. By providing substantial cash rewards to individuals or teams that can come up with ultra-low cost sustainable novel solutions to the problems that face the common person in India, there will be greater motivation to find the answers to what the nation faces today. This enables the government to focus on change that will benefit everyone's progress. Additionally, this will act as a catalyst in encouraging local research and development activity at all levels from entrepreneurs to academic institutions. Rewards will only be given out at success to solutions that have been proven to work, and part of the innovation process must include extensive and thorough testing against well-defined detailed specifications.

The incentivized innovation challenges should be clearly defined along with detailed specifications and method of verification, and allow people to be as creative as they wish in devising the solution. The solution should be feasible by a single individual or a small team. It should not require a large group. The problem solving should drive investment in the corresponding field and related industries. And lastly, the innovation should provide vision and hope.

Incentivized innovation has worked around the world in stimulating innovation. In the US, XPrize is giving tens of millions of dollars to those who can provide solutions to major technological challenges. The Automotive XPrize ran from 2007 to 2010 and required teams to build vehicles that were minimally 100MPGe efficient, produce less than 200g/mile of CO₂, and able to be made for the mass market. There were two subdivisions within the competition: one for mainstream cars, and the other for alternative cars. The mainstream prize of \$5M was awarded to a team for its four-passenger Very Light Car, obtaining 102.5 MPGe. Another team won the \$2.5 million Alternative Side-by-Side competition with their aerodynamic Wave-II electric vehicle achieving 187 MPGe. Yet, another team won the \$2.5 million Alternative Tandem competition with their 205.3 MPGe faired electric motorcycle.

Another XPrize competition that had a great impact was the Ansari XPrize which was awarded to the team that could create a manned spaceship that could go 100KM above the Earth's surface. Additionally it would have to be able to make the trip twice in 2 weeks, and hold at least 3 people. Mojave Airspace Ventures won this prize in 2004. This contest led to a great deal of innovation and started the concept of sustainable space travel. However, it should be noted that while XPrizes have focused on finding solutions where none exist, the i3 grand prize challenges are focused on finding ultra-low cost, durable and low maintenance variants.

5. Recommended projects for i3 grand prize challenge:

Below are essential ultra-low cost, low maintenance, and durable innovations customized to local conditions that will considerably increase rural employment and industrialization putting substantially more money in the pockets of rural/semi-urban households, improved health care, cleaner environment, strengthen infrastructure, and vastly improve the quality of life across the board.

Battery: A novel and environmentally-safe energy storage that delivers about 150 Wh for a minimum of six hours, at half the cost of a typical corresponding lead-acid battery, and has at least 5 times the life cycle of the prevalent lead-acid batteries. Other than routine maintenance, the battery should essentially be maintenance-free. This will enable economically viable off-grid electricity usage without having to wait for the government's distribution grid to be built. A poor rural household will be able to operate two bulbs, a fan, a TV, a small refrigerator and charge a mobile phone. This will directly impact the quality of education and study hours of rural students. The battery should also be linearly scalable for larger loads. With incremental power one will be able to build cold storage units requiring 24/7 electricity, thus reducing the large scale produce wastage. Small scale industries such as dairy, food processing, machinery repair, handicraft, ancillary units will be enabled. All of these will substantially enhance the average income of a rural household. Usage of lead acid battery in inverters commonly used in urban households could also be replaced thereby reducing the highly toxic lead contamination.

o This challenge is expected to be solved within 18 to 24 months.

Solar Panels: A panel that costs 33% of the existing widely used solution while maintaining the same specifications in terms of power delivered, durability, and more. Solar panels combined with the battery described above would go a long way to make solar power economically attractive and primed for large-scale adoption.

o This challenge could take 2 to 3 years.

Water Purifier: A fast, cheap way to purify drinking water is a must. A solution would have to be able to deliver 10 liters of potable water for under Rs. 2. A solution would not only remove 99%+ pathogens; it must also remove pollutants, which often end up in the water supply due to fertilizers and pesticide run-offs, and various other reasons. Centralized solutions so far have high procurement, maintenance, and delivery costs, thus individualized solutions such as a tablet that can be dissolved in 10 liters of water is a preferred choice.

o This challenge is expected to be solved within 18 to 24 months.

Cheap and Durable Rural Roads: Roads that will cost 33% of today's and last for a minimum of 20 years. This will enable much rapid road build-out and in turn expedite rural industrialization and generate employment at higher wages. Quality roads accessible round the year will bring in ancillary units into the villages. This development along with 24/7 electricity will be a key factor in economic transformation of the rural economy and thereby of the country. A supply chain stretching from farms to factories will accelerate rural industrialization.

o This challenge is expected to be solved within 12 to 18 months.

Refrigeration: An affordable small cold storage option capable of preserving perishable fruits, vegetables, and dairy products, and costs no more than 33% of the prevailing cost, and consuming only half as much electricity when compared to the existing solutions, would enable scalable and viable rural industries in dairy and produce. It will allow farmers to put more money in their pockets by greatly reducing the amount of spoiled goods. It would also allow them to amass more production before selling it. Furthermore, similar units in urban settings will allow small fruit and vegetable street vendors to share such facility at a very low cost and considerably increase the money they make.

o This challenge could take up to three years or potentially even longer.

Affordable Housing: Small 200 to 300 square feet self-standing homes that could be built at the cost of Rs. 300/square feet using locally available materials and are optimized for local weather conditions, while meeting the building codes. Thus 200 square feet home will cost about Rs. 60,000. The homes will be wired for daily electric usage, running water and equipped with sanitation facilities. This should be feasible using emerging low-cost construction and roofing materials, and doors and windows built using man-made materials. Standardization of dimensions for windows, doors, sinks, cooktops etc. will enable high volume production at low cost further enhancing the affordability. Multi-story designs could reduce the cost further. Development of 3 or 4 standardized layouts to choose from will also assist in reducing the cost.

o This challenge could be solved within 12 months.

Blood Tests: Diagnostics are a fast, easy way to determine a plethora of health problems. Diagnostic equipment that is not only affordable in price but also low in operating cost can help save millions of lives. Diagnostic tests and screening protocols for both chronic and infectious disease exist. However, the dependence of these tests on central labs and trained laboratory technicians make it untenable for any cost-effective screening program to be implemented at scale. There is a need to create a new class of diagnostic devices without compromising the quality, which cover a basic blood test panel for Diabetes, Cardiovascular Disease, Malaria, TB and Anemia screening/management. For example (Hemoglobin, CBC, Glucose, Creatinine, HbA1c, Salts (Sodium, Potassium), Lipids, Liver Function). It should be able to provide instantaneous results at the point of care and cost less than Rs. 15 each or 25% of the existing cost. Untrained or semi-trained nurses or community health workers should be able to use it. The device will only require a single capillary blood draw using simple lancets. The device should be able to work with smart phones for data collection and telemedicine, and cost less than Rs. 3,000. Smart phone connectivity will make telemedicine a reality and will allow 100s of millions of people access to quality health care.

o This challenge is expected to be solved within 18 months to 3 years.

Milk Chemical Analyzer: Equipment that could analyze milk's chemical components and detect presence of commonly used adulterations such as urea, detergent, ammonium sulphate, paint, oil etc. Within three minutes at Rs. 4 or less. This will allow the testing of the milk right at the last mile – the collection point at which milk is procured for dairies. Same equipment can also be used at the dairy itself. The equipment itself should cost under Rs. 10,000 and preferably plugs into a smartphone. This will help eliminate the curse that has been plaguing a billion plus population.

o This challenge is expected to be solved within 18 to 24 months.

Waste Treatment: Develop solutions at half the prevailing cost where the three incineration by-products, namely heat, ash residues, and carbon dioxide are entirely utilized to produce not only inexpensive thermal power but also environmentally friendly and durable products useful for infrastructure and other sectors (The desired cost point is To Be Determined.)

o This challenge could take up to three years or potentially even longer.

Solar Cooktops: An efficient cooktop that can deliver 1000 WH for at least three hours which will enable cooking without solid or liquid fuel. The product should be able to store heat and deliver on demand without going through the conversion of solar heat to electricity and then back to heat. The entire system including solar elements must be economically viable and priced to be less than Rs. 9,000 (equivalent cost of cooking using natural gas or kerosene for two years, assumed to be about Rs. 4,500 per year). This will go a long way to minimize deforestation and usage of kerosene in the country. Please note that solar cooktops are different than solar cookers. Another option is to integrate this solution with gas based cooktops allowing usage even during continuous monsoon days. An additional benefit is the reduced dependency on imported natural gas.

o This challenge could take up to three years or potentially even longer.

Strengthen the Existing Structures: An efficient strengthening technology needs to be developed that could considerably strengthen the buildings and civil infrastructure at 10% of the replacement cost. This will not only extend the life of the existing structures, but will also bring them within the safety margin. It will also provide protection against natural disasters such as earthquakes, tsunamis, floods, and cyclones, and reduce the risk to national security.

o This challenge is expected to be solved within 18 to 24 months.

Efficient air conditioning: If power consumption of a room and/or industrial air conditioners can be reduced by 60% with a novel innovation while maintaining the price parity with existing solutions, it will reduce the overall (and rapidly growing) power generation requirements by several gigawatts hour per year. To avoid any confusion, the expectation is to have identical functionality and same or better remaining specifications as the existing conventional AC units. Furthermore, it will have a dramatic impact on the carbon footprint.

o This challenge could take three years or potentially even more.

Each of the above challenges when solved will also have a huge export potential roughly 4 times the size of the Indian market.

6. Grand Prizes Management Mechanism:

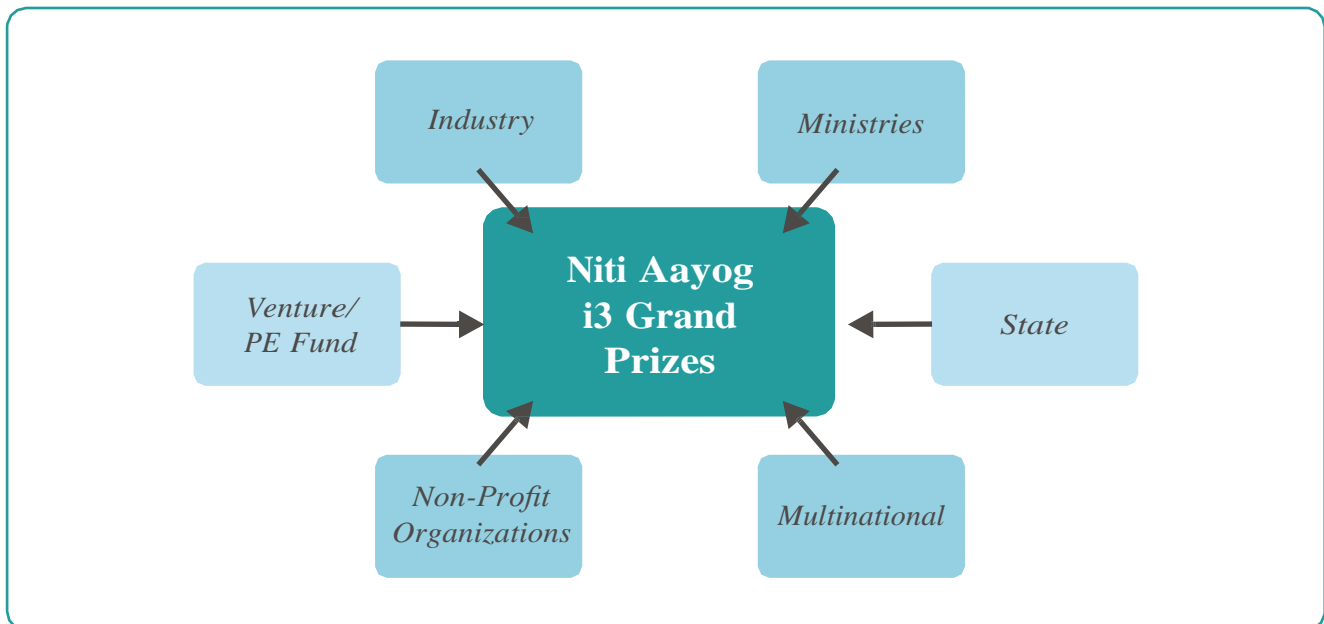
Ideally, “i3” should become a focal point for grand-prizes as individual ministries such as Science and Technology, Bio-technology, MoD, or private companies both domestic and multi-national, or Non-profits. States should also be able to add their own grand prize challenges as well, as shown in the figure below. Furthermore, non-government entities should be encouraged to increase the government announced award amounts. The initial list that is supported by the government money is recommended above. Having one focal point will help create broad awareness about the efforts being made to solve the key problems to the two key constituencies;

- The public at large who will benefit from it; and
- The scientific/entrepreneurial community interested in working on these serious challenges.

A common point also enables a consistent approach to administer the process. The award amount will be determined for each project subject to its potential impact and the likely difficulty in addressing it. There should be a minimum threshold in terms of award amount so that the i3 Grand prize administrative entity is not overburdened.

The process from clearly defining the problem to rewarding the best solution has to be laid out. The detailed specifications, milestones, and time lines must be defined beforehand. It should take no more than 3 years from start to finish. Smaller amounts of prize money are awarded earlier in the program named phase 1 to provide funding to the most promising teams. One of the key goals is that only those teams with ideas that have a meaningful shot of success within 26 months are awarded in phase 1. Eventually a group of 1 or 2 finalists would be chosen for final testing, and the team that meets the detailed specifications after undergoing rigorous testing would win. The total award amount per grand challenge could range from Rs. 10 crore to Rs. 30 crore.

Figure 30:



7. Process

Proposals will be invited for each project and shortlisted by the subject matter committee as described below. In phase one, up to 5 proposals per project will be short listed and 25% of that project's corresponding prize amount will be distributed equally to those short listed. In phase two, a winner will be picked (maybe 2) who meet the requirements laid out and the remaining 75% of the prize money is provided to the winner (s). The expected completion is within 3 years of the i3 grand prize announcements including the testing. It is expected and understood that some projects may finish earlier than three years, and whereas, some may not succeed within the stipulated time frame. An overall 50% hit rate should be considered a decent success for this i3 program. Those who are not short listed but wish to continue their work at their own time and expense remain eligible to submit their final product for consideration. In fact, there could be some who choose not to participate in proposal stage at all but may independently work on it or already be working on it should also be eligible to submit their final product within the guidelines.

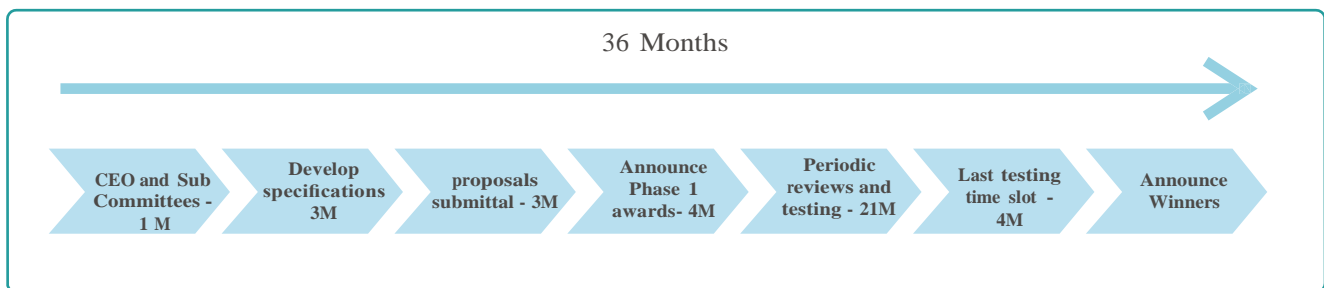
The timelines are shown below in the figure below and the steps are as follows:

- The CEO and the sub-committees are formed within the first 30 days of the i3 grand prize award announcements.
- The specifications by the respective sub-committees should be completed within subsequent 3 months.

The proposals should be submitted to the i3 organization within next 3 months.

- Review and short list selection based on the technical feasibility/strength of the proposals will happen in next 4 months thus completing phase 1.
- Within the next twenty one months the final solutions are submitted by the teams selected and/or by others who may not have been selected, or chose initially not to participate. For the clarity purposes, it should be noted that a team can submit their final solution anytime within the 21 month window. Testing is performed after submittal against the specifications in the subsequent 4 months. The first one to meet the defined goal is the winner.
- Maximum time allowed for completion from beginning to end is 3 years.

Figure 31:



8. Eligibility:

Eligibility requirements described below are applicable for the government funded grand-prizes. Eligibility for the private sector funded prizes is determined by the entity funding the award but at minimum will be as follows. Anyone with “Indian Origin” is defined as an Indian citizen or of Indian descent (NRI) regardless of the passport he/she carries. The criterion is as follows:

- Any individual of “Indian Origin” ; or
- Any start-up/enterprise based in India; or
- Any group of individuals in which the project lead person is of Indian Origin as defined above; or
- Any university in India or abroad but the project lead person is required to be of Indian Origin; or
- Any enterprise that is based overseas in which majority is owned by person(s) of Indian Origin.

If the project is being worked overseas then there should be at least one credible technical person based in India, actively participating in the research/development of the project.

Anyone associated with the i3 grand prize organization as a board member, CEO, employee, subject matter expert, advisor, or consultant or their immediate family can neither participate nor can have any financial interest in any team.

9. Commercialization of the Winning Solutions:

By definition there is an urgent need to solve the problem in a manner that is economically viable. Hence, there should not be shortage of funding to further commercialize these successful solutions from the private sources including venture funds, private equity, corporate funds, or other philanthropic funds. The solutions will have wider applicability across the globe potentially helping 5 billion people and thus sources of funding can be from anywhere. The projects that are funded by the government money could be further assisted by initial volume procurement by the government but should not be necessarily guaranteed. Those projects for which the award is funded by the government are mandated to manufacture the products in India further augmenting “Make in India” campaign. It is recommended that AIM collects 3% to 4% royalties on gross sales from the prize recipients.

An active effort should be made to encourage private sector to add their grand-prizes for their favorite projects.

Intellectual property so generated should belong to the inventors; whether an individual, or a group or someone at an enterprise that came up with the IP.

10. Proposed Administrative Structure:

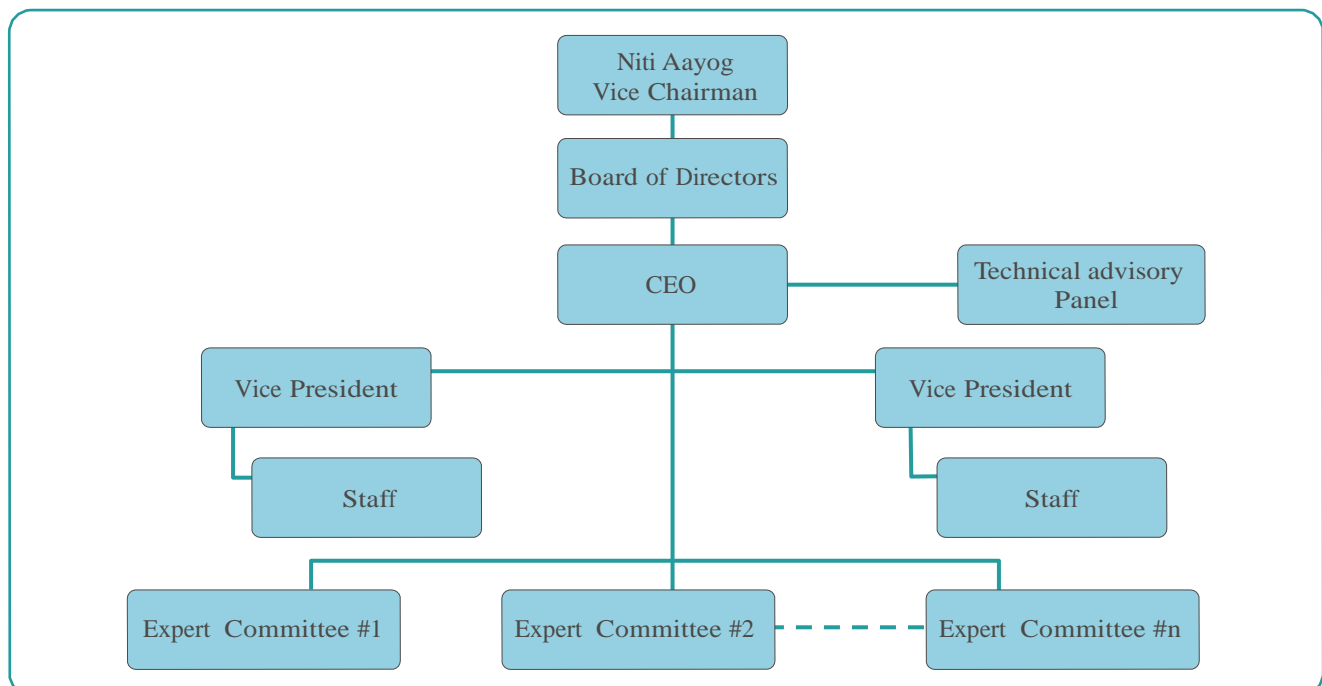
Please see the proposed organization chart in the figure below. The program should be headed by a full-time CEO who is responsible to manage the day-to-day operations. The CEO is helped and advised by a board of directors with a macro view of the pressing needs and aspirations of the people. The CEO should have a strong science/engineering background and ability to work closely with the ministry of science and technology, other government departments, and large number of top-notch scientists, engineers and entrepreneurs. Ideally, this person should not be a government employee.

The board will consist of 7 members, 3 from the outside, CEO, one person each from Niti Aayog, the Department of Industrial Policy and Promotion, and Ministry of Science & Technology. The board will work with the CEO to determine the prize amount for each challenge for which the Niti Aayog is providing the money. In general, the entity that offers the prize determines the amount.

The CEO will be assisted by a small technical advisory panel that will help in bringing in subject matter experts for each project. This advisory panel could also include representatives from prominent consulting companies working on pro-bono basis. Each grand challenge will have a sub-committee of three subject matter experts who will draft the detailed specifications, test methodology, and verification mechanism. They also will evaluate the proposal received and short list the most attractive ones. The subject matter experts can be in India or abroad and of any origin - Indian citizens, NRIs of non-Indian citizenship or neither. One of the key functions of the subject matter experts is to draft a thorough, accurate, and unambiguous set of specifications for their corresponding challenge. Any decisions in the sub-committee will be made by a majority vote. The selection of the members of the sub-committee is one of the most critical functions that will determine the success of the grand prize program. The members of this sub-committee are not only top technical experts in the chosen project area but also are expected to be held at the highest standards, avoid any controversies and/or any conflict of interest.

Initially, i3 can be housed at a university such as the Indian Institute of Science, Bangalore, and later on can have its own space or be co-located at a campus.

Figure 32:



11. Campaign to Create Awareness:

It's important that a significant awareness campaign is carried out to the key constituents:

- Public-at-large to whom will be immensely helped by addressing these problems
- The scientific and entrepreneurial community including researchers, students, or start-ups.

We not only need to address the serious challenges but also create a sense of self-confidence that we can solve our problems and foster a long lasting environment in which innovation becomes an integral part of the thinking.

The following is proposed :

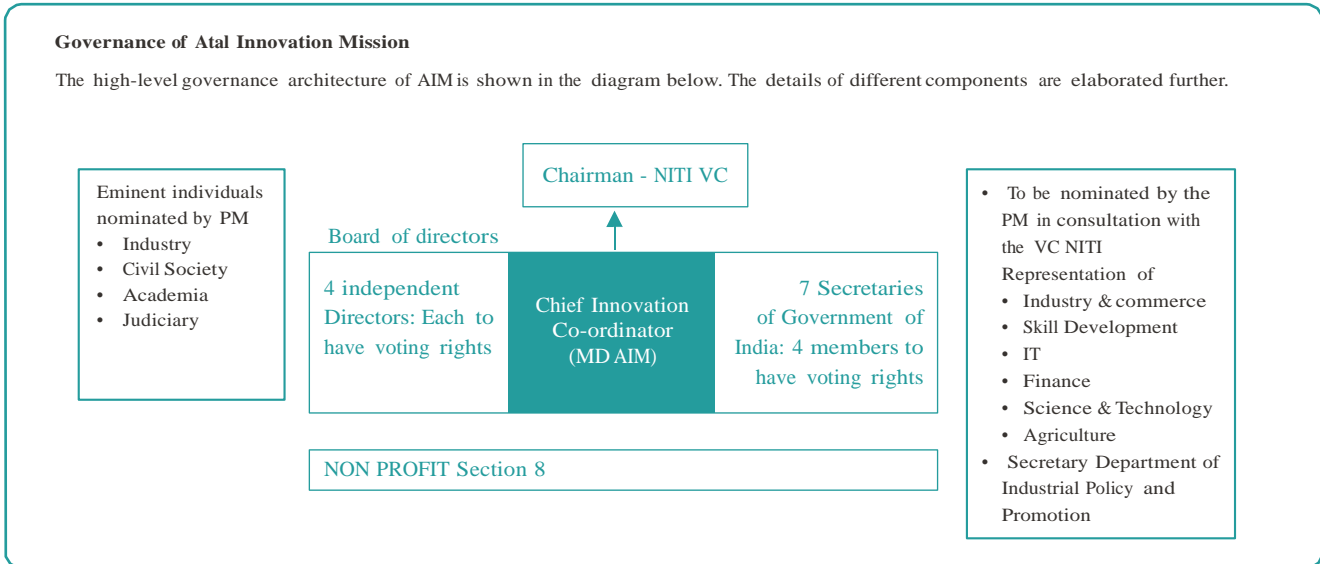
- An easy to use website with relevant information.
- A reputable PR firm should be hired to promote the campaign mostly in India and some outside targeting both broader audiences and the scientific community. This outreach should be made to English, Hindi and regional language media outlets. The target should cover print, TV, and social media.
- An extensive outreach by the committee and the CEO to all major technology institutes to popularize and answer questions at the grass root level to both faculty and students.
- At least once a quarter hold well-advertised conferences at a regional level inviting the scientific community, private sector, and investors.
- Engage state governments to communicate the message down at the high school level.
- Couple of brand ambassadors with wide name recognition and reputation will provide additional reputation.
- It may be beneficial to get pro-bono services from glamor world celebrities to bring about a broader change along the lines of “ Innovate, invent, invest in India” . Their job is to make it fashionable to “ Innovate” !
- Prime Minister calling on the scientific community at appropriate occasions will help considerably.
- Lastly, extensively promote the successes and the teams behind them as heroes.

Appendix F

Detailed Explanation of the Atal Innovation Mission Organization

The high-level governance architecture of AIM is shown in the diagram below. The details of different components are elaborated further.

Figure 33: Recommended Structure of the Atal Innovation Mission



1. Chairman – VC NITI Aayog shall serve as the chairman of AIM board.

2. 07 Government Functionaries would serve as Directors on the board of AIM. These functionaries shall be no less than Secretary level from the following Ministries:

- Secretary Skill development
- Secretary Industry and commerce
- Secretary IT
- Secretary finance
- Secretary science and technology
- Secretary Department of Industrial Policy and Promotion
- Secretary Agriculture

3. 04 Independent Directors – chosen from outside of Government would serve on the board of AIM.

4. Chief of Innovation/MD (competence, experience, abilities):

- Proven capability to run an organization to deliver results with very strong people skills
- Worked with the Government system and or has experience in Government working
- Global experience– 5-7 years in a global company, fund or research institution
- Commercial/entrepreneurial orientation – experience of working in, starting up or leading a successful business or service line
- Institution-building experience – Experience in managing high quality professional teams and/or building an institution
- Academic qualifications – at least a post-graduate degree in a professional field such as science, engineering, management/business/commerce, law or medicine

5. 04 Advisors to the Chairman or Chief of Innovation/MD:

Individuals with large experience of innovation, wealth creation, intense knowledge of technological changes, very highly respected as individuals, large contribution by innovation and entrepreneurship to the country and or the world, figures to whom people look up for advise guidance and help.

6. Besides this let us have a number of advisors to the board on subject like:

- a. Finance and Financing
- b. Legal
- c. System and processes
- d. Culture and team building
- e. Intensive knowledge of environment

7. Working Groups: AIM would have four working groups to execute the different functions to perform various activities related to innovation:

- a. Idea and Networks: This group shall undertake outreach activities identifying innovations across the spectrum of sectors, screening and shortlisting for scalability, handholding and building entrepreneurial ecosystem for selected ideas. It shall institutionalize collaboration among national and international academia and civil society. This group shall be responsible for organizing and creating “grand challenge” for Indian needs of innovation.
- b. Angel Funds: A fund of funds, ensure effective venture capital and angel funding for innovations/disruptive ideas. This fund is used to build scale of enterprises with innovations which have transforming impact.
- c. Governance Innovation: Group responsible for bringing leading international practices of good governance and encourage intrinsic innovation for solving daily governance challenges.
- d. Missions (or Special Initiatives) group: Group will take ideas from concept to implementation, with targeted outcome based approach with support from all levels of governance. Each mission may draw members from other AIM groups to ensure continuous learning at AIM. To help build credible AIM brand as benchmark to Government secretariats, they will also be responsible for identification, assessment and giving necessary support for creation of Indian Googles and or GEs through innovation, research and creative destruction.

8. Empowerment:

- a. Culture of inter-disciplinary, cross-functional teams designing initiatives end-to-end
- b. “Lab” culture – bring cross-functional expertise together to brainstorm and agree on a solution, not solve problems in a sequential and hierarchical way
- c. Externally oriented organization – combining innovators from universities, consultants and private sector enterprises with innovators in government
- d. Output orientation – capacity created for defining and measuring indicators of success for AIM’s initiatives and for other bodies/agencies
- e. Focus on 2-3 big initiatives at a point in time
- f. For special initiatives: “Performance contract” jointly for Chief of Innovation along with relevant Secretary; Budgetary powers delegated to AIM; AIM works with Ministry on a Detailed Action Plan; AIM ensures cross-functional Implementation Teams created; Steering Committee architecture set up to make decisions cutting across different silos; AIM ensures measurement, monitoring and review on a monthly basis, and reported to the Steering Committee.

9. Principles of working:

- by and large do not execute themselves
- create ability to identify root causes
- enable organization capability of the Department where this is being done
- work with measurements of outputs
- teach to fish do not give free fish
- giving the right systems and processes for working improvement
- Enable innovation – “ handholding over hands-on”
- Identify, nurture ideas to be institutions/enterprises of future
- Engage industry and academia internationally
- Facilitate resolutions to enabling initiatives with government
- Bring industry, academia, civil society, and Government together
- Harmonizes existing innovation initiatives
- Learn from global – build local on what exists – do not reinvent

10. AIM work:

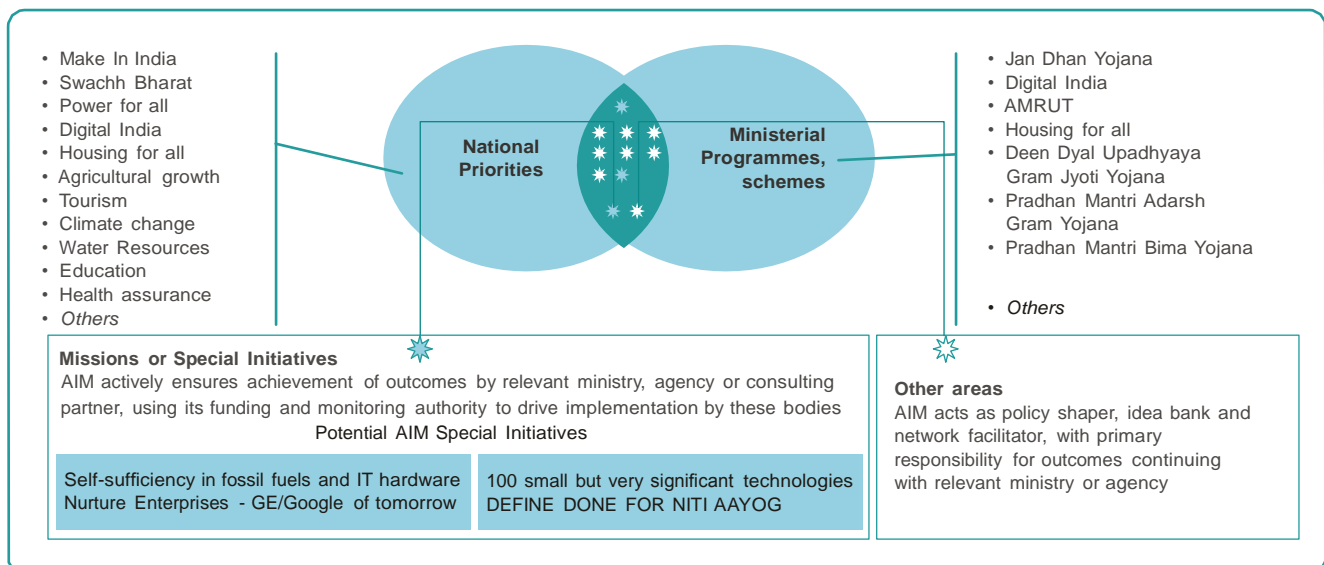
There are multiple aspects of the work area where AIM would be able to create value towards the objectives of economic growth and increased prosperity. It is envisaged that AIM shall undertake two broad types of work – Advisory and Implementation.

In Advisory nature of AIM work, the organization shall identify ideas and provide recommendatory inputs to the Ministerial secretariats or state governments. Here the role of AIM shall be that of a policy shaper, idea facilitator, and the actual responsibility for outcomes shall vest with the relevant ministry or government body.

In Implementation aspect of AIM work area, the organization shall identify critical path breaking innovations where it would actively pursue implementation in coordination with the NITI Aayog and the Prime Minister’s office. Some examples of these special initiatives are:

- Identify and encourage indigenization of technologies for self-sufficiency in fossil fuels and IT hardware manufacturing
- Nurture an idea to be an enterprise tomorrow equivalent to an Indian GE or a Google through innovation, research and creative destruction
- Identify 100 small and significant technologies for rural upliftment in Indian model

Figure 34:



11. Measures:

Organizational Metrics

- a. Innovative ideas seeded, funded, and mentored until private interest – their impact in terms of output, jobs and value to citizens
- b. Missions undertaken – achievement of outcomes/outputs
- c. Number of global experts in network
- d. Global events convened

National Innovation Metrics

- a. Global recognition e.g., Ranking on global Innovation Index
- b. Top research citations for Indian work
- c. Number of Patents per capita
- d. Number of successful Indian GEs and Googles promoted
- e. New enterprises funded
- f. Number of ideas translated from laboratories to markets
- g. Private investment in R&D
- h. Adoption rate of technology (for select focus areas)
- I. Productivity outcomes (for select focus areas)
- j. Impact on Job growth
- k. Public awareness and acceptance within India
- l. Number of successful grand challenges with large impacts

Endnotes

- ⁱ Tarun Khanna, “The Business of Inclusion,” *Forbes on the Web*, May 29, 2010, <http://forbesindia.com/article/ideas-to-change-the-world/tarun-khanna-the-business-of-inclusion/13682/1>, accessed August 2015.
- ⁱⁱ Paul M. Romer, “The Origins of Endogenous Growth,” Winter 1994. *Journal of Economic Perspectives—Volume 8, Number 1—Winter 1994, Pages 3-22*, <http://www.eco.unibs.it/~palermo/PDF/romer.pdf>, accessed August 2015.
- ⁱⁱⁱ Tim Kaene, “The Importance of Startups in Job Creation and Job Destruction,” *Kauffman Foundation Research Series: Firm Formation and Economic Growth*, July 2010, <http://www.kauffman.org/what-we-do/research/firm-formation-and-growth-series/the-importance-of-startups-in-job-creation-and-job-destruction>, accessed August 2015.
- ^{iv} Tim Kaene, “The Importance of Startups in Job Creation and Job Destruction,” *Kauffman Foundation Research Series: Firm Formation and Economic Growth*, July 2010, <http://www.kauffman.org/what-we-do/research/firm-formation-and-growth-series/the-importance-of-startups-in-job-creation-and-job-destruction>, accessed August 2015.
- ^v Committee on Angel Investment & Early Stage Venture Capital, Planning Commission, *Creating a Vibrant Entrepreneurial Ecosystem in India*, June 2012, http://www.socialimpactatbain.com/Images/Indian_Planning_Commission_Report_2012.pdf, accessed August 2015.
- ^{vi} Ernst & Young, “Home—Services—Strategic Growth Markets—The EY G20 Entrepreneurship Barometer 2013,” Ernst & Young Web site. <http://www.ey.com/GL/en/Services/Strategic-Growth-Markets/The-EY-G20-Entrepreneurship-Barometer-2013>, accessed August 2015.
- ^{vii} FICCI and Nathan Associates, “Nurturing Entrepreneurship in India,” (August 2014), <http://www.ficci.com/publication-page.asp?spid=20432>, accessed August 2015.
- ^{viii} European Commission—Enterprise and Industry, “SBA Fact Sheet Germany,” European Commission, http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/files/countries-sheets/2008/germany_en.pdf, accessed August 2015.
- ^{ix} V. Raja, “We Need a Sharp Policy Intervention,” *Hindu Business Line*, October 8, 2014, <http://m.thehindubusinessline.com/opinion/we-need-a-sharp-policy-intervention/article6478803.ece/?secid=11682>, accessed August 2015.
- ^x Gupta et al., “From Poverty to Empowerment: India’s Growth Imperative for Jobs, Growth, and Effective Basic Services,” McKinsey & Company, http://www.mckinsey.com/insights/asia-pacific/indias_path_from_poverty_to_empowerment, accessed August 2015.
- ^{xi} Gupta et al., “From Poverty to Empowerment: India’s Growth Imperative for Jobs, Growth, and Effective Basic Services,” McKinsey & Company, http://www.mckinsey.com/insights/asia-pacific/indias_path_from_poverty_to_empowerment, accessed August 2015.
- ^{xii} Richard Florida, “The World’s Leading Startup Cities,” The Atlantic City Lab on the Web, July 27, 2015, <http://www.citylab.com/tech/2015/07/the-worlds-leading-startup-cities/399623/>, accessed August 2015.
- ^{xiii} Marten Carstens, “India’s Entrepreneurial Landscape according to Ernst & Young,” *Ventureburn*, January 22, 2014, <http://ventureburn.com/2014/01/indias-entrepreneurial-landscape-according-to-ernst-young/>, accessed August 2015.
- ^{xiv} José Ernesto Amóros and Niels Bosma, “Global Entrepreneurship Monitor 2013 Global Report,” 2014, <http://www.gemconsortium.org/docs/3106/gem-2013-global-report>, accessed August 2015.
- ^{xv} Invest India, “Automobiles,” <http://www.makeinindia.com/sector/automobiles/>, accessed August 2015.

