National Innovation Ecosystem

by

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Linking Science, Technology & Innovation (STI)

Science provides the base for technology, which in turn triggers technology-led innovation. For instance, it was the science of creation of single crystals of silicon carbide and gallium nitride that led to the creation of cell phone displays. However, this journey from mind to marketplace, or from invention to innovation, needs a robust national innovation ecosystem. This essay is all about building not just `best' practice but `next' practice Indian innovation ecosystem.

What is India's global standing in innovation? Global Innovation Index (GII), which ranks[(1)] 140 plus nations is a good indicator. India kept on slipping in its rank from 62 (2011) to 64 (2012) to 66 (2013) to 76 (2014) to 81 (2015). And the good news is that it is rising now from 81 (2015) to 66 (2016) to 60 (2017) to 57 (2018).

But let's look at these ranks in a context, since many times, what counts does not get counted and what gets counted does not count.

India leads the world in frugal innovation, reverse innovation, Gandhian innovation. Indian innovation has shown the way to getting more performance from less resources for many more people[(2)]. India has shown the way on grass roots innovation, which is innovation by the people for the people[(3)].

`Denial driven innovation' has been the forte for India, because for love or for money, technologies were not available for our endeavours in space, atomic energy, defence, etc. Despite this, from supercomputers to nuclear reactors to missiles to space

exploration technology, India has done wonders. Recently, India became the first nation to succeed in its very first effort in a Mars Orbiter Mission. Further the cost of this mission was just 10% of that of USA's similar mission, a brilliant case of innovation with `affordable excellence'[4]. India created game changing innovation to achieve fastest and biggest financial inclusion by opening record number of bank accounts in the shortest time. India's rank will improve if the GII's ongoing efforts on putting in a matrix that measures both technological and non-technological innovations bear fruit.

Journey so far in Science, Technology & Innovation

In order to judge the current state of innovation in India. Let's first reflect on our journey so far in science, technology and innovation.

Jayant Narlikar listed[5] what he considered as the top 10 achievements of Indian STI in the 20th century.

In the pre-1950 era, his list includes Srinivasa Ramanujam, Meghnad Saha, S. N. Bose, C. V. Raman and G. N. Ramachandran.

Post-1950, the list includes green revolution, Indian space programme, nuclear energy, high temperature superconductivity mission and transformation of the chain of 40 laboratories of CSIR in late 1990s.

Pre-1950, it is all individual scientist driven. Post-1950 it is all driven by government funded large scale initiatives.

Interestingly, the list does not contain any breakthrough in research and innovation from industry, unlike the rest of the world. For instance, making ammonia by Haber-Bosch process by an industry leader BASF was listed as the top most invention of the 20th century, since the nitrogenous fertilisers helped feed billions. India had no BASF, no

Google, and no Apple in the 20th Century. How do we change that in the 21st century? This essay focuses on this challenge.

Why did India lag in innovation in the past?

First and foremost, before 1991, in a protected economy, there was no competition. Import substitution was the objective and, therefore, there was no incentive for creating new innovative products.

Second, although Indian science created potentially monetisable knowledge, that science was monetised by others outside India, not in India and by Indians.

The Raman Effect was discovered in India. But its application in terms of Raman scanner was done outside India. The iron-mercury-ion coherer, which formed the basic platform for wireless technology was created by Sir J.C. Bose, but wireless technology is attributed to Marconi from Italy. Why? Because Sir J.C. Bose refused to file for patents as it was against his principles. Marconi, though he came later, filed them.

Third, and most important, we missed the presence of a powerful national ecosystem comprising physical, intellectual and cultural constructs. Such ecosystem includes idea incubators, technology parks, a conducive intellectual property rights (IPR) regime, smart and fast IPR capture systems, balanced regulatory systems, strategically designed standards, proactive government support systems (including aggressive public procurement policies for indigenous innovations), industry leaders who believe in innovation-led growth and invest heavily in R&D, scientists with an aspiration to become technopreneurs, potent inventor–investor engagement, ‘adventure’ capital and passionate innovation leaders.

Even if we have an innovation ecosystem, there are some fundamentals to assure success in innovation. India must increase its efficiency of moving from mind to marketplace with assured success.

ASSURED Innovation Framework for Successful Innovation

Here is an ASSURED innovation matrix that we propose for assured success[6].

ASSURED stands for the following:

A (Affordable)
S (Scalable)
S (Sustainable)
U (Universal)
R (Rapid)
E (Excellent)
D (Distinctive)

A (Affordability) is required to create access for everyone across the economic pyramid, especially at the bottom. Scalability follows affordability.

S (Scalability) is required to make real impact by reaching out to every individual in the society, not just a privileged few.

S (Sustainability) is required in many contexts; environmental, economic and societal.

U (Universal) implies user-friendliness, so the innovation can be used irrespective of the skill levels of an individual.

R (Rapid) refers to speed for the journey from mind to market place. It also refers to products, e.g. diagnostics within minutes rather than days.

E (Excellence) in technology, product quality, and service quality is required, not just for the elite few but for everyone in the society, since the rising aspirations of resource-poor people for high quality also need to be fulfilled.

D (Distinctive) innovation is required because `me too' products and services do not survive in the market place.

So first and foremost, India should use a suitably `quantitised' ASSURED framework for assessing, funding and monitoring everything from start-ups to government funded

projects to in-house industry projects. Mashelkar and Pandit[7] have shown as to how the ASSURED framework can be used for a judicious evaluation of successful as also unsuccessful innovations.

Speeding the Mind to Market Place Journey

1. Ideas need to be incubated. Therefore, we should build incubators across every Indian university, clusters of colleges, etc. There should be innovation clusters, which are sector specific, which bring all innovation players with domain expertise from academy, from industry, from finance, etc., together. There should be nationwide Technology and Innovation Parks. There is a need to increase angel funding, early stage financing as also venture capital by an order of magnitude.

2. Besides formal system of innovation in universities and research labs, there are informal systems, where innovation is done by the people for the people – grass roots innovation[8,9]. Micro-venture capital funds to create small enterprises and local jobs as also special funds to link particularly innovative informal innovation with formal systems to explore the possibility of larger scale impact need to be created.

3. Even today reporting requirements for research and innovation in companies' annual reports include technology absorption, foreign exchange saved, etc. This is an old mindset from the import substitution era. The 'ask' now has to be in terms of new IP created and monetized, new technology created and commercialized or licensed, etc.

4. Over the past three decades, the Indian government has expressed an intention to raise the nation's R&D investment to 2% of GDP. But it has stubbornly remained at less 1% for the past three decades. The reason given (justifiably though) is that in sharp contrast with advanced nations, in India most of the funding (around 70%) comes from the government. So industry must be

incentivized any many innovative ways to increase its spend. But at the same time, investments in research in Universities must be significantly enhanced. The Research and Innovation Bill 2012' which deals with `Protection and Utilization of Intellectual Property emerging from Public Funded Research' needs to be taken forward in an appropriate form to facilitate the process of vast value creation through commercialization of public funded research, as other advanced national have done, Bayh Dole Act of USA being just one case.

5. To spur R&D in Indian industry, tax incentives to private sector R&D efforts in line with the OECD countries must be given. The recent move to reduce the weighted tax deduction should be reversed. Further we must provide judicious government support in a public-private-partnership mode, especially for risky science-led-innovation-based new product development that is aligned with national priorities.

Fundamentals of Designing an Innovative Public Procurement Policy

An innovative public procurement policy is needed `for' innovation and 'of' innovation. We must incentivize both supply and demand.

India has incentivized supply through creation of numerous national research and technology organizations that it funds. It has created schemes for part financing 'technology led businesses'. Examples include NMITLI[(10)], Biotechnology Industrial Research Assistance Council[(11)],Technology Development Board[(12)], etc.

We also need aggressive demand side initiatives. With large procurement budgets, the Indian government can not only be the biggest, but also the most influential and demanding customer.

Moving Forward

Public procurement of innovative goods and services can induce innovation by specifying levels of performance or functionality that are not achievable with 'off-the-shelf' products, because such exacting demands can be only met by innovation.

The government approach could be based on three pillars.

First, government could act as the 'first buyer' and an 'early user' for small, innovative firms and manage the consequent risk, especially for those products and services, which meet Government's stated goals (e.g. TB free India by 2025). They would thus provide the initial revenue and customer feedback firms need to survive and refine their products and services so that they can later compete effectively in the global marketplace.

Second, the government can set up regulations that can successfully drive innovation either indirectly through altering market structure and affecting the funds available for investment, or directly through boosting or limiting demand for particular products and services.

Third, government can set standards that can create market power by generating demand for innovation. Agreed standards will ensure that the risk taken by both early adopters and innovators is lower, thus increasing investment in innovation. The standards should be set at a demanding level of functionality without specifying which solution must be followed. By not prescribing a specific route, innovation is bound to flourish.

Roadmap for Creating Innovative Public Procurement Policy

The following five point road map is suggested.

1. The policy should be based on 3 pillars of talent, technology and trust. Transparency is a prerequisite to trust. To achieve this, a legal framework should be designed, which should include easily understandable definitions, guidelines and templates based on the ASSURED matrix (fully quantitized so that there is no scope for ambiguity or subjectivity) highlighted earlier. This will facilitate smooth and speedy implementation.

2. All the ministries should be mandated to publish long-term demand forecasts, engage in continuous market analysis to identify potential breakthrough solutions, offer professional training on legal options to promote innovation, and foster a strategic dialogue and exchange of experiences between procuring agencies, end-users, industry, and procurement agencies.

3. Procurement agencies from ministries should be given specific targets for innovation procurement. (For example, the progressive Maharashtra State Start-up Policy[13] mandates all public sector undertakings to have at least 10% of their public procurement from start-ups). Provision of annual budgets, dedicated funds and stimulating financial incentives, especially for public-private partnerships, will have to be a key part of the execution plan.

4. For speedy implementation, an ‘Innovation Procurement Platform’ as an online hub should be created. It will help procurers, policy makers, government authorities, innovators, and other stakeholders to fully utilize the power of public procurement of innovation. The platform could comprise a website, a procurement forum and a knowledge resource center.

5. To reduce possible loss and damage, robust risk management and impact measurement systems will have to be put in place. Powerful e-procurement and IT tools should be used to carry out proper risk assessment.

Finally

The importance of innovation at a policy level was late in coming. We progressed from Science Policy Resolution (1957) to Technology Policy Statement (1983) to Science & Technology Policy (2003) to Science, Technology & Innovation Policy (2013). After decades of Science Advisory Council to Prime Minister (SAC-PM), the new advisory committee just formed is Prime Minister's Science, Technology and Innovation Council (PM-STIAC). So innovation is now moving from the periphery to the core.

Indian Government has come out with very visionary `start-up India' initiative backed up by progressive policy support system. Ambitious programs like Atal Innovation Mission at a national level, formation of State Innovation Councils, Atal tinkering labs for children, Atal Incubation Centers etc. are getting formed. All this augurs well.

Most importantly, a new value system must be built that vigorously promotes, generously supports and rewards handsomely, science that solves problems, technology that transforms and innovation that impacts the society.

The emphasis in this essay has been on building a national innovation ecosystem that will inspire India to become an innovation leader and not a follower; on Indian innovation creating game-changing products and services that are new to the world and not just new to India. In other words, not just a `best practice' but a `next practice' national innovation ecosystem.

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