

INDIA :: Now, Current affairs, Whats happening in India, India News



Can India produce billion-dollar innovations?

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India has made rapid strides in the world of research and development in the last few years, but are its innovations world-beaters? In an era that has been dominated by American innovations, can Indian scientists and technologists make a lasting impression? What will it take to institutionalize innovation in India?

In this 4-part series beginning today, Arindam Banerji discusses what will it take Indian scientists and technologists to start producing innovations that become large sources of wealth generation for India, India Inc and Indians.

Do me a favor: pick up that cell phone near you, and think. Think hard about that phone; think how this itsy-bitsy device has changed your life.

The truth of the matter is that everywhere -- from Prague to Quito -- people like you and me have had their lives changed and their social interactions transformed; thanks to this innovation.

Okay, cellphones were not exactly tiny when they were first introduced, but that's missing the bigger picture.

You see, it is not just the cellphone alone. Think about the photo-copying machine you use at work, that MRI equipment your elderly relative had to be scanned under, the computer you work on, the Internet you use to keep in touch with your friends, and on and on and on.

All these discoveries and inventions have fundamentally changed how many of us live and work; they have also helped generate immeasurable wealth for companies, individuals and nations that have managed to leverage them appropriately.

So, here's my question for all of us: when will Indian scientists and technologists working in current day India, start producing such innovations that become large sources of wealth generation for India, India Inc and Indians?

What will it take for us to get there?

But, where is 'there'? How do we know when Indian innovation indices get there?

A couple of days ago, I was cleaning out my storage closet: ancient papers, empty boxes and that somewhat crumpled Forbes magazine. You see, Forbes magazine had, a couple of years ago dedicated much of a special edition to listing out 85 years of mostly American innovation (a few examples in the list are not US-based).

I have to admit, once you view that entire Forbes article on innovations -- from an economic as well as social impact standpoint -- the list is overwhelming.

And as an Indian, you keep wondering -- why not in India? Why not, indeed!

So, as a measure, I have used little tables of data from that edition as a way of calibrating our discussion on Indian innovation. In a sense, it provides a good backdrop for measuring where we are and how far we have to go yet, and what this century of Indian innovation could look like.

But, isn't India innovating... ?

"I remember being a part of a Committee that reviewed the CSIR of South Africa in 1997. I remember going to their satellite-tracking center outside Pretoria. I asked them: "Tell me, which is the best satellite image that you get?" They took me to a corner and showed to me the imagery, which they claimed had the finest resolution. Then I discovered that those pictures were taken from the satellite IRS-1C. My friends, I am proud to say that I in IRS-1C stood for 'India.' Should we not be proud that a developing nation such as India was producing the finest satellite imagery in the world?" -- Dr. Mashelkar, Director, Council of Scientific and Industrial Research.

Bluntly speaking, Indian research and development has made tremendous progress over the last decade or so and the proof of this increasing Indian ingenuity is literally available in every sphere that you can think of. Clearly, I cannot go into every aspect of this, but let me at least try to delve into a few representative symptoms.

R&D Market Size: "R&D (research and development) outsourcing market for information technology in India is estimated to grow to \$9.1 billion by 2010 from \$1.3 billion in 2003, according to research agency Frost & Sullivan. The R&D outsourcing market for IT in India is estimated to grow from the present size of 1.3 billion dollars in 2003 to \$9.1 billion in 2010 at a compounded annual growth rate of 32.05 per cent, Frost & Sullivan, which undertook the study for the department of IT, said in its report. The R&D outsourcing market for telecom in India is slated to grow from \$0.7 billion in 2003 to \$4.1 billion in 2010 at a CAGR of 28.73 per cent, it said."- rediff.com

Earth-changing Innovations: "A research team at the National HIV Reference Centre in the All India Institute of Medical Sciences is developing a vaccine against HIV. The vaccine, called the HIV-1 DNA, has worked on mice and monkeys. The team led by Dr Pradeep Seth is now waiting for clearance to start clinical trials on humans." -- Hindustan Times

Disruptive Research: Outlook India has just published this excellent piece on some of the disruptive research that they found in various parts of India -- I have faithfully reproduced them in this table here:

Technology	Innovator	What it does
Compact Media Center	Prof. Kirti Trivedi, IIT-B	Puts a comprehensive home entertainment system into a little box at a fraction of any competitive manufacturer's cost. And that 25-ft screen.
New combustion chamber design	Somender Singh, Mysore	Dramatically improves fuel efficiency and acceleration of your car or bike
String theory	Gautam Mandal, Sunil Mukhi, Avinash Dhar, Sandip Trivedi et al, TIFR; Ashoke Sen, Harish Chandra Institute, Allahabad	Identifies the fundamental building block of all matter, explains the laws of the universe
Software to digitize radio signals	Professor Ashok Jhunjhunwala & team, IIT-Madras	Lets you surf the Net?traveling at 120 KMPH.
Nanotubes	Prof Ajay Sood and team, IISc, Bangalore	Helps create astonishingly sensitive devices with applications ranging from stealth to fighting disease
Script Mail	Shekhar Borgaonkar and team, Hewlett Packard, Bangalore	You can input a command into a computer the most natural way?by writing. In the language you know
Food, and processing	CIFTRI, Mysore	Automate <i>dosa</i> - and <i>idli</i> -making, match your diet to the needs based on your genes.
Food preservation	Defense Food Research Laboratory, Mysore	Keeps your food sealed, safe and nutritious for months on end.
Bitumen polymerization using plastic waste	K. Ahmed Khan, Bangalore	Makes hard-wearing roads, helps tackle the menace of plastic waste
Intelligent language translation, text-to-speech processing	IIT, Hyderabad	Tackle the complex challenge of translating English into Indian languages

Unique corporate efficiencies: "What do global giants like General Electric and Motorola have in common with a humble tiffin delivery network comprising 3,500 dabbawallas who deliver 150,000 lunch boxes to citizens in Mumbai each day? The dabbawallas have the six sigma rating or an efficiency rating of 99.999999, which means one error in one million transactions. This rating has been given to them by Forbes Global, the famous American [business](#) weekly. Now, these are largely illiterate dabbawallas.

Their secret lies in a coding system devised over the years. Each dabba is marked in an indelible ink with an alphanumeric code of about 10 characters. In terms of price and the reliability of delivery, say compared to a Federal Express System, dabbawallas remain unbeatable.

Their business models have become a class room study in some management institutes." -
- Dr. Mashelkar, Director, Council of Scientific and Industrial Research.

Entrepreneurial Spirit: "Lijjat Papad, started by seven housewives on a rooftop, now has 40,000 working women and a turnover of Rs 300 crore (Rs 3 billion). N R Narayana Murthy put together Rs 10,000 and started Infosys in his small 700 square feet apartment. Its market capitalization, at one point of time, was more than Rs 60,000 crore (Rs 600 billion). Infosys has become a pride of the nation today." -- data from Arun Shourie's speech.

Competitiveness Index: "India jumped 16 places to claim the 34th position in the latest IMD World Competitiveness Yearbook (WCY) 2004 as it gained significantly on various parameters, such as economic performance, government efficiency and business efficiency, but still lagged on the infrastructure front.

There is more good news. India is developing its competitiveness in software operations, manufacturing, entertainment and financial services.

The country moved up 10 places to be ranked 12th in economic performance with a score of 62.59 out of a maximum of 100. In government efficiency, the country improved its rank from 43 in the year 2003 to 33 this year.

But the best performance came in business efficiency, where it has been ranked 22nd in the latest yearbook compared to the 51st position in 2003.

In fact, India has outsmarted China in this category which was placed at 35th position this year compared to 46 in 2003." -- Economic Times

India's potential as an innovation hub: Dr R A Mashelkar, Director General, Council of Scientific and Industrial Research, said here on Tuesday: "India is becoming a global research and development hub especially for the companies from the West. Over 100 companies around the world have set up their research and development centers in the country during the last five years," he said. The demographic shift in the western world favors a country like India. With its relatively favorable demographic profile of a large proportion of working and talented young people, India can become a global innovation hub, from which outsourcing of innovation could be done.

I've stayed away from hyping up Indian brain power that inhabits and in many cases drives some of the premier centers of innovation across the globe. While this is indeed impressive, such glowing presence does not address the questions that I asked at the beginning of this missive.

So, I come back to questioning the basic premise.

But, is this progress good enough . . . ?

The changes taking place in Indian R&D are indeed impressive and in some cases, like the Indian pharma -- the research and products are indeed world-class. But let us measure ourselves, before we get too far ahead of ourselves.

Again the attempt is not to denigrate the work of some of these great Indian scientists but to be able to calibrate ourselves and see how far we still have to go.

And, to be sure, the AIDS vaccine, if it works well, can out-strip most of the US innovations that we see as of now.

How about this?

ISRO -- the Indian Space Research Organisation -- is the result of Dr Vikram Sarabhai's vision. Its first rocket, like the one in the picture, was launched 40 years ago. Over the past 40 years, a multi-disciplinary group of electronics, mechanical, electrical, civil and chemical engineers has designed and built 32 satellites and three generations of launch vehicles culminating in the GSLV.

This was done with almost totally indigenous R&D, battling US sanctions. Each time that a technology or component was unavailable, ISRO went ahead and developed it on its own. ISRO's satellites help India in telecom, television broadcasting, weather forecasting, disaster warning, telemedicine, education and fishery. Technologies in areas as diverse as optics and artificial limb manufacture have been developed and transferred to Indian industry.

Jamsetji Tata wanted to make textiles in Nagpur in the 1800s with the cotton grown there. Nagpur had no textile industry then, and in Manchester Jamsetji was told that Nagpur's weather was not suitable as it was too dry. He said, 'Alright, I will bring the Manchester weather to Nagpur.' He imported humidifiers and started India's first textile mill in 1874.

When Jamshetji started the Tata Iron and Steel Company and wanted to export steel rails to Britain, a Britisher called Sir Frederick Upcourt said, 'Do you mean to say that Tatas propose to make steel rails to British specifications? I will undertake to eat every pound of rail that they make, if they do that.' The Tatas did manage to make steel rails and export them to Britain. Upcourt must have developed a massive case of indigestion). In World War II British tanks were called Tatanagars because the steel was made in Tatanagar.

To paraphrase Nilekani, Vikram Sarabhai and Jamsetji Tata got an idea, put together a team, raised the capital, created a product, and mainstreamed it. They did it sitting in India, 40 years and 125 years ago respectively, when India's technical capabilities were far less than they are now.

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