It's Time to Invent in India

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In India, we have a huge pool of scientific manpower, and our scientists and engineers are proving their mettle in Silicon Valley and elsewhere. And yet where our innovation output is concerned, we're performing way below our potential and have failed to produce any path-breaking research. India also trails behind other BRICS countries like China and South Africa in global innovation rankings. With innovation being considered a major driver of growth and crucial for maintaining a competitive edge, it is time to take stock of the barriers to quality research and innovation in India.

"In 2000, both India and China invested 0.8 per cent of their GDP in science and research. By 2010, China's investment had risen to close to 2.0%, while India's was still at 0.8%. Now, India has moved up to 0.9 while China's investment is 2.8%." This is what the Nobel Laureate Prof. David Gross pointed out when he delivered his Nobel Laureate talk at the 103rd Indian Science Congress held in Mysore in January this year.

The statistics presented by Prof. Gross highlight how China, though a late starter in investing in Research & Development as compared to India, has overtaken India's R&D spend that is currently stagnating around 0.8% to 0.9% for over a decade.

In the case of India, it is not only the government, but also the private sector that has not kept pace with R&D investments in the developed world and also some of the BRICS countries.

Though innovation is a driver of long-run economic growth, it is tremendously expensive. But if neither the government nor the private sector makes adequate investments in R&D, then how can we innovate in India? Lack of funding however is just one of the multiple reasons why India is lagging behind in scientific research and innovation.

The R&D scenario in India

We have a long history of running modern scientific research institutions going back to the early years after independence with the country's first Prime Minister Jawaharlal Nehru, a staunch supporter of science and basic research, promoting the infrastructure for government led R&D in India.

Government-funded research institutes: The Council of Scientific & Industrial Research (CSIR), India's leading industrial R&D organisation was formally constituted in 1942 and got a further boost after independence. It has a pan-India presence and is the largest chain of civilian laboratories in the world. But lack of funding has stymied its growth and relevance to both India's masses and industry. Though its laboratories made contributions to the Indian pharmaceutical and chemical industries dur-

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ing the import substitution era, not much of the research done by CSIR has been commercialised.

In recent years, multinational sponsored programmes too have dwindled, leading R. A. Mashelkar, the former Director General of CSIR to remark, "CSIR now has to reinvent itself and become a knowledge partner of industry." The same is true for other government-funded research institutes in the country.

Tradition of 'jugaad': On the other hand, the Indian tradition of 'jugaad', of making do with what we have, of improvising to overcome problems is also reflected in the way innovation is done in the country. We have proved that we are good at developing incremental improvements in products and processes in areas such as drugs and pharma including generics, and in low-cost and reverse innovation. Frugal innovation has helped us develop cost-effective, high quality health solutions like for example a recombinant hepatitis B-vaccine and surgeries for a fraction of the price at which these are offered in western countries, the $2000 TATA Nano - the world's cheapest family car, and the Mangalyaan (Mars Orbiter Mission).

Similarly, Indian outsourcers like TCS, Infosys, and others are harnessing the creative capabilities of our software engineers to develop thousands of cost-effective software products and solutions for their western clients. But the intellectual property rights to what they develop do not lie with the Indian companies as they only do the backend developing. The western MNCs develop the patent for the full software system and then sell it back to us and the world.

Today, thanks to the availability of a large pool of world-class talent at competitive rates and our high growth domestic market, India, like China, is emerging as a preferred destination for imported R&D, mainly from the US. Western MNCs like GE, Dell, and others have set up innovation centres in India which modify their products to offer cheaper and more suitable replicas for Indian consumers and the world.

However, the jugaad-style innovation cannot take us too far. For true wealth creation and establishing a competitive edge on the world stage we need to produce cutting-edge research, something that is just not happening in India.

This was highlighted by N. R. Narayana Murthy, Chairman Emeritus, Infosys, while addressing the students of the Indian Institute of Science (IISc) recently. He said not one invention from India has become a global household name, not one technology has transformed productivity, not one idea has led to 'an earth-shaking invention' globally in the last 60 years.

Obstacles to innovation in India

According to the 2015-16 Global Competitiveness Index, India still trails behind Asian countries like Israel, Japan, Singapore, Korea, Malaysia, and China in the area of Innovation, one of the 12 pillars of competitiveness.

The truth is we have talented and resourceful scientists and research students in India. What they lack is the right ecosystem for producing meaningful research. Here's a list of the major barriers that are holding us back.

1. Funding

With India investing barely 0.9% of its GDP in R&D, our scientific institutes receive a mere fraction of the funding received by their counterparts in many other countries. In 2014, our R&D investments stood at around $20 billion. Compare this to China's around $200 billion and the USA's around $485 billion.

In 2014, China's Huawei spent about 14% of its revenue –$6.6 billion (approx. ₹440 billion!) - on R&D, beating even Apple and Oracle in R&D investments. In contrast, in the 2014-15 budget, CSIR was allotted ₹2.28 billion. However, it needs to be said that with due commitment, even with lesser finances, there can be great achievements. Our scientific human resource and other costs are significantly less compared to Western countries.

2. Education system that's not innovation-oriented

Our education system places a greater emphasis on respecting authority and passing examinations rather than on problem solving or fostering creativity. Students are discouraged from asking questions or thinking out-of-the-box, and are not trained to apply the knowledge they acquire. Consequently, most of our graduates can only

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tweak solutions developed elsewhere but not create anything new. We need a change in the existing feudal set-up and an educational system that nurtures the spirit of innovation.

In his speech at the Indian Science Congress, Prof. David Gross too had stated that India needs to make sustained investments in basic science right from the school level to higher education. The fact that not a single Indian institute of higher education figures in the list of the top 100 world universities reflects the quality of education and research in our country.

3. Meagre investment in R&D by the private sector

Currently, the Government accounts for around 75% of Gross Expenditure for R&D (GERD), with the private sector contributing just 25% to 30%. In 2015, Indian companies across sectors spent just 0.52% of their turnover on R&D.

The active support of the private sector is essential for fortifying India's R&D base and increasing our overall investment in scientific research to 2.8% like China. But despite attractive government incentives even major companies are not ready to engage in R&D activities more vigorously. Rather, many have established in-house R&D facilities only to get the hefty tax breaks offered by the government.

Industry-academia collaborative R&D is critical for developing more efficient innovation systems in the country, expanding the industrial relevance of research, facilitating the development of innovative products and technologies, and commercialisation of R&D outputs.

On the plus side, in recent times, some of the big name companies like the TATA group, Mahindra & Mahindra, the Aditya Birla Group, Godrej, and CIPLA, and some of the smaller ones like Transpek Industries, and Gharda Chemicals are seen to be focusing on investing in world-class R&D, developing innovative products and processes and commercializing them.

4. Insignificant industry-academia collaboration

In countries like the US, it is not just federal funding that drives university research; large private companies too invest in such research besides engaging in collaborative R&D activities. Industry-academia collaborative R&D is critical for developing more efficient innovation systems in the country, expanding the industrial relevance of research, facilitating the development of innovative products and technologies, and commercialisation of R&D outputs.

In India, except for the IITs to some extent, the ICT in Mumbai, the R&D labs of most regional institutes are working in isolation without adequate interactions and links with industry.

5. Intellectual Property Rights

It was only from the years 1999, 2002 and 2005 that India made amendments to its 1970 Patents Act, transited to product patents and aligned it to comply with TRIPS agreements. Though the earlier process patents regime aided the development of a strong generics pharma industry, it did little to foster development of NCEs. Certain provisions of Indian patent law that defines patentability of inventions (Section 3d of the 2005 Act) and the granting of compulsory licences – a provision that enables a country to suspend patent privileges in cases where the best interest of their citizenry are at stake – has met with opposition from Western companies. Another bone of contention is data exclusivity by which all clinical & trials data remain exclusive property of the researcher or research company and cannot be accessed by a generics company for 5 to 10 years. India is in the process of bringing a law on this.

The US Chamber of Commerce's Global Intellectual Property Center placed India second-last among 30 countries in its International IP Index 2015. Robust IP rights support innovation and result in more patents being filed as in countries like the US and Japan. The recent attempts to introduce reforms in India's IP policy by the PM to improve India's business and innovation environment are positive developments. A new IPR policy is in the making with the final draft circulating for inter-ministerial consultation.

6. Lack of an India-centric approach to innovation

In India today, the captive R&D units of foreign MNCs are carrying out much more research than Indian companies. However, most of such research is directed towards world markets or involves tweaking foreign-made innovative products for selling to Indian markets. We require scientific research that makes Indian needs a priority.

When he met 30 leading scientists in India in August last year, Prime Minister Modi asked them to focus on solving national problems. India has multiple problems that need addressing. But not much research is directed towards solving these. For example, smart fabrics that are dust-proof, stain-proof, and easy to wash would be useful for our farmers, while weather-proof, low cost housing construction and cures for endemic diseases would be beneficial for the Indian masses.

Then again, innovative solutions are badly needed in the Indian pharmaceutical industry that is the fastest-growing in the world. At the National Chemical

Laboratory in Pune, Dr. Anil Kumar and his team of young researchers are tackling the problem of pollution caused by organic solvents widely used in the pharma industry. They are working on deciphering 'on water' and 'in water' organic reactions, and understanding how aqueous solutions can replace organic solvents. More of such R&D initiatives are needed in the Indian chemical industry.

Prof. Gross, said that for Make in India to be a success we also need Discover in India and Invent in India for developing newer technologies.

7. No proper promotion of science and innovation

Ever since the first Indian Science Congress was held in 1914 (initiated by two British chemists, J. L. Simonsen and P. S. MacMahon), we hold this event each year for promoting a scientific temper in the country and stimulating scientific research. According to many present-day scientists, the event needs to be re-invented to include a larger audience so that scientists understand the needs of society and people know what scientists are doing.

How much the Science Congress has achieved is hard to tell. Today, many prominent Indian scientists like Venkatraman Ramakrishnan who won the chemistry Nobel in 2009 are doing their research in institutions in western countries.

Early this year, Ramakrishnan had dismissed the Indian Science Congress as a circus where very little science is discussed. It is ironical that while at last year's Science Congress some Indian scientists were more bent on presenting scientific papers claiming that aviation technology and interplanetary travel was developed in ancient India, we are still struggling to commercially launch our first airplane prototype. In contrast, countries like Brazil are manufacturing aircrafts and selling them to Indian companies. And while we're still dwelling on our achievements in a mythological past, China is already globally acknowledged as a manufacturing and innovation heavyweight. China is not only manufacturing everything from Christmas lights to Diwali lamps for the world, it is also making in India and carrying out R&D in India.

A bright spot at this year's Science Congress however was a statement by the Prime Minister that the government intends to 'make it easier to do science and research in India'.

Exploiting the 4th Industrial Revolution to unlock our growth potential

If India has to become globally competitive, it cannot do so without fostering a culture of innovation in the country. Now the Fourth Industrial Revolution could empower us to further accelerate our economic growth.

According to Klaus Schwab, Founder and Executive Chairman, World Economic Forum, the world is on the brink of a technological revolution that he calls the Fourth Industrial Revolution. The First Industrial Revolution used water and steam power to mechanise production; the Second used electric power to create mass production; the Third was the digital revolution using electronics and information technology to automate production; and now, Schwab says, the Fourth Industrial Revolution that is underway is fusing technologies, and linking the physical, digital, and biological spheres. He says it is this rapidly evolving revolution that has the potential to transform entire systems of production, management, and governance.

We were not in a position to take advantage of the first three revolutions in time. Now we cannot afford to miss out on benefiting from the fourth. As Schwab puts it, "Ultimately, the ability of government systems and public authorities to adapt will determine their survival."

According to the latest Global Competitiveness Index, India is among the least digitally connected countries despite having immense capabilities in the digital field. There is a need therefore to understand the demands of a changing environment. We have the necessary technology and talent. We just have to leverage the multiplier effect of the interaction between different technologies and link this to chemistry for enhancing our R&D activities and empowering our economy. Such innovation could also enhance the quality of life of the people of India.

Coming back to Prof. Gross, his Nobel Laureate talk also included an important comment. He said that for Make in India to be a success we also need Discover in India and Invent in India for developing newer technologies.

Worth taking note of. For if we want to join the big league, 'Invent in India' is the way to go.