# The lack of quality research in India

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India is a country with several renowned institutions like the IITs and IISc, Bangalore, that train world-class students. The unfortunate part of this training has been the fact that many of these graduates preferred to settle down and work overseas. This was basically due to the fact that the knowledge gained by them was appreciated and used better overseas, with more avenues for intellectual stimulation and growth. Unfortunately, these avenues were lacking in India, as the industries or academic/research organizations did not need them, except possibly in the nuclear, space and defence fields. Despite success in some fields, we cannot boast of a completely indigenous product which we can be proud of, that is also world-class. Right from the materials to the sensors and sometimes even minor parts are imported. Most of the characterization equipment are imported. The state of affairs in most laboratories is such that the few graduates who had stayed back feel that they have made a mistake.

Today, a larger percentage of these 'world-class graduates' do not take up teaching/research but opt for higher paying jobs in India, which actually kill their knowledge gained. The fact that the knowledge gained will not be used kills the motivation to learn, which in turn kills the motivation to teach. This unfortunate trend is happening when the Indian industry is in dire need of these graduates and is creating 'knowledge jobs'. We need to stop this trend. Higher pay for these knowledge jobs and for teachers could possibly reverse this trend.

Creation of these knowledge jobs, with higher salary, might help us climb the knowledge ladder as the Indian industries have a lot of catching up to do for this ever-increasing gap. This is also the fate of our research/academic organizations, where we are in the 'catching up' or 'follow others' mode. The Government and, to some extent, the Indian industries have realized this and are pumping in a lot of money for R&D and equipment. The Government had funded some institutions about 20 years ago in a similar effort. This did increase the quality of research as well as students; but this could not be sustained as these 'quality students' migrated overseas and also due to the fact that the Government could not provide funds in the 1990s. Thus, the country as a whole did not benefit. The situation today is similar, but the outcome may not be bad since the industries and R&D laboratories of MNCs can absorb this manpower.

When money was pumped in 20 years ago, the culture of publishing papers was ushered in. The money pumped in also created the haves and have-nots. People who had access to equipment did good research. The others continued what they were doing or just stopped doing things. As 'publish or perish' was the motto, even globally, those who published papers continued to publish even though funding in the 90s reduced to a trickle. This trend continues even today, but with other terms thrown in; the 'impact factor', the 'citation index', and now the 'H index'. The 'H index' is basically the number of papers cited that many number of times[1]. About 84% of the Nobel laureates in physics have an 'H index' of more than 30, clearly indicating that only consistent cutting-edge research can take you far[1]. A multiple factor criterion, which included quality of education, quality of faculty, research output and size of institution, was used to rank universities around the world[2], and only the 'Engineering/ Technology and Computer Science' of IISc came in the top 100. A sad state of affairs indeed, even in terms of the quality of publications. The 'publish or perish' motto is also creating a dangerous trend, where the faculty tell the students what to do, get the results, write papers and get them published. The faculty get their promotions and become 'successful'. The research scholar, with say five papers, gets a Ph D degree, but is actually a 'research coolie' who does not know how to design an experiment, analyse the results, write a paper or proposal, or present his work. In the real world, this research scholar is a misfit and at best becomes a 'research worker'. Such a trend exists in many laboratories where the junior carries out the instructions of the senior. In the process a vacuum is created and when the senior retires there is no one to lead the laboratories or organizations.

Patenting is a new mantra to gauge the worth of a person or his organization. In India, which spends less that 1% of its GDP on R&D, the total money spent from 1995 to 2005 on R&D was around Rs 140,000 crores[3]. About 80% of this is from Government sources. The MNCs have spent around Rs 6000 crores (US$ 1.5 billion)[4] from 1998 to 2003. Assuming that they spent another Rs 6000 crores from 2003 to 2005, the total money put in by MNCs into R&D during the same period would be around Rs 12,000 crores. But out of the top 50 patents in the period from 1995 to 2005, 44 were from MNCs, four from Government laboratories and two from private Indian industries[2]. A conservative calculation comparing the cost of a top 50 patent from a Government laboratory, Indian private industry and the MNC would make a Government Laboratory patent 100 times more expensive and a private Indian industry patent 40 times more expensive than that of a top 50 MNC patent. Interestingly, the number of patents filed by Indians and 'foreigners' is not very different[3]. It is also a fact that the same Indian people, with similar background, while working in an MNC become more productive. In the present Government system we neither publish quality papers nor do we have quality patents. Something is seriously wrong.

Doing cutting-edge research on a sustained basis with better characterization equipment is essential. And we have to catch up with countries like China and Korea. Further, nowadays equipment are much more sophisticated and expensive, and the era of the haves and have-nots has come back. The cycle of events that happened 20 years ago is now repeating again, maybe with a lesser intensity. To break out of this cycle we need to do two things: (1) Have a much larger number of basic equipment to do basic work and a few centralized, high-end equipment to do high-end work; (2) The industry will have to play a much bigger role. But, most likely, we will still be in the catching-up process and will always be at the mercy of the equipment suppliers. And

we have an impotent system to contend with.

The problem can be solved to a certain extent if we start designing the basic parts and materials that go into making a product and characterization equipment. Only such a strong technological foundation will help us break from the past and come to the forefront. We have built these institutions on a weak foundation, which is getting weaker by the day. Apart from massive funding, a change in mindset is also necessary. We should not look for cheap indigenous alternatives. We should look to build world-class equipment to sell in the world market. We also should follow the philosophy where 'budget overruns' are tolerated, but 'time overruns' are not. Today, the philosophy is, in most cases, the opposite. In the past several half-hearted attempts to make equipment and sensors have failed, because the effort was half-hearted in the first place.

We should have a system where R&D, design and manufacturing happen simultaneously, maybe except during the initial stages. Such a system will not only help save time, but also help in continuous innovation which is essential when product life cycles are as low as six months. And the system has to be far more dynamic than what it is now.

Possibly it is time to build a whole new organization that takes up designing and building equipment and allied products. An organization that trains quality manpower and is accountable with respect to both time and money. An organization that has both a scientific outlook and an engineering temperament, and helps other institutions strengthen their foundation. Such an organization will also help strengthen our higher education programme, which is in doldrums today.

1. Hirsch, J. E., *PNAS*, 2005, **102**, 16569–16572.
2. http://ed.sjtu.edu.cn/ARWU-FIELD.htm
3. http://dst.gov.in/majorhighlights.pdf
4. Editorial, *Indian Express*, 9 October 2007.

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