

Is the Indian hound vegetarian: effect of the S&T dilemma on the Indian economy*

Satish Chandra

The English phrase ‘Running with the hare and hunting with the hound’ has interesting connotations when we consider the present Indian science and technology (S&T) structure. For some, there exists a real possibility of India revisiting its economic crisis in 1991 that then led to economic liberalization. In 1993, *Current Science* had published a series of articles on S&T in a liberalizing economy¹⁻⁴. These articles signified the sense of urgency then. Actually, the present economic situation is equally concerning. Some of those articles in *Current Science* indicated a need for flexibility at the top end of the so-called S&T hierarchy. This hierarchy is best described in the form of technology readiness levels (TRLs). NASA produced a successful structure for inducting technology into the real world (Figure 1)^{5,6}. This framework requires a number of institutions and groups to work together to bring a technology to the market and influence economic activity. Historically, much of Indian S&T has been focused at the lower TRLs 1 and 2, given the need to emphasize discovery and innovation: newness. However, it is only TRLs 7-9 that have direct impact on economic growth in the short term.

In hindsight, the question is where in the S&T hierarchy, India should have emphasized most over the last two decades? And if it did, was there clear progress, such that direct impact on economic growth was visible? Some would argue that there is a serious dilemma in emphasis and focus with regard to science versus technology, especially when looking for results in the short term.

Fundamentally, the issue is in the philosopher versus road-sweeper hierarchy that sometimes can be seen in the Indian S&T effort. That hierarchy is essentially knowledge-driven, for its own sake, irrespective of whether there is a real possibility of acquiring power only through knowledge, a rather naive interpretation of the school phrase: knowledge is

power. The only example in contemporary history could be North Korea, as it apparently used science to develop technology for a bomb and a missile, even as many went hungry. Whether it has real power is of course a matter of debate. On the other hand, the emphasis on using manufacturing and industrial effort to generate employment and build a strong foreign exchange reserve should not be lost. This is essentially what China did after Deng Xiao Ping’s liberalization in 1978, by concentrating on manufacturing for export. In fact, South Korea and Taiwan have been doing so since the 1960s. Only now are those countries laying higher emphasis on basic scientific research.

Working at the top end of the TRL hierarchy may not be what a philosopher or a scientist does. (A scientist is one who only does what is not routine, as the oft repeated phrase in our scientific establishment goes.) There is this belief, or conventional wisdom, that by working at the top of the TRL structure, there is

little possibility of new ideas or innovations and hence little contribution to economic growth. I draw attention to an article in *Current Science*⁷ on citations and the relation to GDP, and emphasis of many industrial research laboratories on papers in *Nature*, etc. as measures of correlation between economic growth and basic scientific research. On the ground, it is difficult to support that position, when we view this in short-term time-scales (say two decades).

Historically, scientific establishments that work at the top end of the TRL are regarded to be building capability and have hardly any scientific content, especially when viewed by those exposed only to low TRLs. On the other hand, technological capability appears the vital ingredient for economic growth and for percolation of wealth, in fact saving important foreign exchange in many areas including the defence sector. Some discussion revealed that excessive emphasis on the lower TRLs, led to assumptions that were not appropriate to the real world, amusingly titled ‘spherical cow research’⁸.

There is a need to ask that honest question of what brings a country economic comfort, not power. For the discerning, the English lexicon offers insight into the sociology of S&T, especially with regard to technological power. The answer, in my opinion, is to bring in basic necessities, respect for the environment, medical help at affordable cost, all party to economic comfort. Again, benchmark indicators for economic comfort of a country, could be reasonable inflation, decent balance of payments position, etc.

As economists see it, food and non-food consumption/expenditure patterns have fundamentally changed in the country (irrespective of the Food Bill). This really is the reason why the present economic issues have hit us based on the type of imports into the country. However, hidden in the consumption patterns are extraordinary opportunities to work at the high TRLs in a globalized economy, with ideas and innovation, especially with frugal engineering.

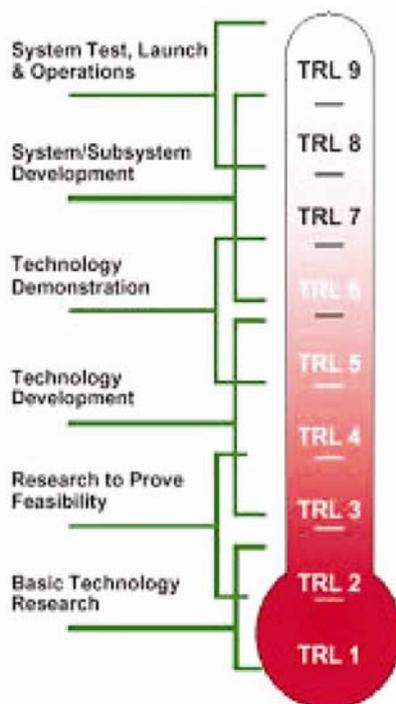


Figure 1. Technology readiness levels⁵.

*This note is the author’s personal opinion and does not necessarily reflect that of the employer.

The country has set up a number of institutes for scientific education and research (IISERs). It is expected that a scientific temper will pervade the younger generation. This will indeed provide long-term abilities to be curious, enabling them to discover new phenomena, develop insights into the secrets of nature and the like. However, an immediate concern is the millions of engineers this country has undertaken to churn out. It is tough for a recently graduated engineer to enter curiosity-driven research, because much of engineering education is about conforming to near straitjacketed processes, on the shop floor or design offices. So, the emphasis should be to ensure a culture of generating designs and processes that are safe and optimal and have global application. Actually, given the much touted 'jugaad' culture, we need safe and optimal designs and processes first. Frugal engineering needs also to be safe and certifiable. One could become concerned if asked to travel in a jugaad designed aircraft or a car.

The role of CSIR, for example, is interesting, especially in the context of what was discussed in 1993 (ref. 3). Once, I was told, there was a S before the I and R in CSIR and it was important to know the scientific approach. While that was well, the fact is that engineers in CSIR who attempt to work at the high TRLs probably require motivation structures that are very different to those that exist presently.

For example, civil aircraft development in India⁹ which could have high economic multiplier effects has opportunities for manufacturing and industrialization, apart from value addition in terms of both high and low TRLs. However, this requires a pragmatic policy and

investment structure involving both the public and private sectors, in some ways taking a clue from the experience in the automobile sector. The ability of our establishments to design a proper public private partnership has not been successful in the past decade, even though it was once regarded as a panacea for most ills.

The structuring of S&T for the 12th Plan is equally interesting. The papers generated by the various S&T ministries are available to the public¹⁰. It is clear that investments planned are not small, but require clear separation of objectives based on TRLs. There is no point in believing those that are promising science research and low TRLs will make immediate contribution to economic growth.

So, is S&T a deserving combination is the question? An informed debate, in a sense, a sequel to the series of articles in *Current Science* in 1993 is probably required. An honest appraisal of why solutions perceived earlier have not fully succeeded is needed, or whether they were never fully implemented needs to be studied. To some, India has lost its magic¹¹ compared to what was promised in the last decade.

To my mind, while the present economic crisis could blow over, it will leave its effects. There is a need for fundamental changes in the technology management structure in the country. Attention will need to be paid at the top end of the TRL, with opportunities for cost arbitrage in a global partnership sense (the slide of the rupee will help that), better public and private partnership structures, and a reconciliation that time-scales for delivery of economic value at both ends of the TRL structure are very different. Hidden in this present economic crisis are unprecedented opportu-

nities though. The focus needs to be clear, transparent and fair to ensure that both ends of the TRL spectrum deliver value (irrespective of how differently it is measured, based on a consensus that is transparent enough to withstand an RTI). Honestly, it has never been possible to hunt with the hound and run with the hare, unless there are no concerns on delivery. After all, the hound is supposed to deliver a kill.

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Satish Chandra is in the Structural Technologies Division, National Aerospace Laboratories, Bangalore 560 017, India. e-mail: schandra@nal.res.in