Basic science and 'Make in India'

There is much talk about 'Make in India', nowadays. This was highlighted by statements made by four Nobel laureates and a Fields medalist Manjul Bhargava, at the Indian Science Congress held in Mysuru in 2016. David Gross recommended that we replace 'Make in India' by 'Discover, Invent and Make in India'. The Nobel laureates and Bhargava also recommended (i) increased investment in basic science (Gross), (ii) need for a long-term plan, since the incubation period for basic science to deliver goods is 10–20 years (Haroche), (iii) need for a cultural shift where people are oriented to pursuing science, which will also lead to discovering in India rather than just making in India (Bhargava), (iv) expand education ten times (Gross), (v) start science teaching early in schools (Schectman), which we already do and (vi) need to introduce financial schemes (Gurdon). The laureates have largely talked about basic science. Making in India has actually more to do with the complementary part of science and technology, namely manufacturing and less to do with basic science per se. They have emphasized that making without the backing of basic science is incomplete.

It is nice to know that the greats of science are in complete consonance with what our own scientists have been emphasizing year after year. Each one of the points mentioned above, has been explicitly expressed by our scientific community at different times during the last 50 years and continues to be done now. Homi Bhabha's address to the International Council of Scientific Unions (ICSU) in 1966 was a landmark speech on the subject. He emphasized the need to be able to do good mathematics and basic science, in order to develop good technology; he wrote, '...if much of the applied research done in India today is disappointing or of inferior quality, it is entirely due to the absence of sufficient number of outstanding pure research workers...'. He successfully built the programme of the Department of Atomic Energy on this premise. From Bhabha then to C. N. R. Rao now, many senior scientists of standing have emphasized this time and again. Though some steps have been taken by the various governments on the above-mentioned points, they are far from adequate.

Every Prime Minister in his inaugural speech to the Indian Science Congress repeats the need to increase investments in science like a litany, but does pretty little to accomplish the same. The net result is that the budget for science has remained flat at nearly 0.8% of GDP for more than a decade. We scientists have not succeeded in persuading the governments to raise the allocation. Real improvement will not happen without this. We have three Academies of Science based in Allahabad, Bengaluru and New Delhi, and they have work cut out for them; this should be their highest priority.

Is there any other way than the Central and State governments directly increasing this allocation? Governments have consistently shown that they will not do this in a hurry. Other models for funding are available from other countries. Every country which has made scientific progress in recent decades, from Korea in the east to the United States in the west, has substantially larger percentage input for R&D from non-governmental sources.

Industries are the prime beneficiaries of R&D in science and technology. It is fair, therefore, to expect them to contribute to this national effort. To my knowledge, this is less than 15% in India. It is important for the government to make sure, through an actionable policy that input for R&D from industries comes compulsorily up to about a figure matching that of the government in the next decade. If the government contribution is raised to say, 1.0%, the total can come up to about 2.0%, which will still be below that of USA today (South Korea spends 4.5%). Details of the scheme can be worked out in a straightforward fashion, as several models from different countries are already available.

Finally, let me briefly adduce to the requirements of real technological growth. An idea is born in a scientist's mind. The idea has to be validated by an experiment. Then one makes a prototype which is upgraded to an engineering model. This has to stand the test of the market in regard to quality and marketability (need, cost, affordability, etc.). Feedback from the user (market) results in improving the product or rejecting the same as non-viable. Each stage in the chain is likely to be more expensive than the previous one. Often it is possible that one does not start from an idea, but at an intermediate stage, as envisaged in 'Make in India'. Here one must make effort to understand the design, either from basic considerations or through reverse engineering. This is necessarily required for making any progress through innovation over the existing design. This last component is a must to 'Make in India' lead to real technological progress.

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Fungal endophytes: nature's tool for bioremediation of toxic pollutants

Industrial processes, agricultural practices and the use of chemicals in many areas of our daily life result in the deliberate and accidental release of potentially toxic chemicals into the environment[1]. Oil pollution as an environmental challenge has been widespread during the production, storage and transport activities. Similarly, accumulation of plastic waste is another major man-made problem today. It has been reported that more than 140 million tonnes of plastics was manufactured worldwide in 2001 alone[2]. Plastics have accumulated in almost all places of our environment