The Indian Innovation System

By Ragunath A. Mashelkar

Innovation is the key to the production as well as processing of knowledge. Indeed a nation’s ability to convert knowledge into wealth and social good through the process of innovation determines its future. The purpose of innovation is to create a new value for an individual, team or organization, or for a society at large. New values could be in the form of breakthrough products or services, new strategies, new processes and new methods for organization. We will discuss the issue of the Indian Innovation System, specifically linked to science and technology innovation.

The strong Science and Technology (S&T) base of India gives us the confidence that India has a sound S&T capacity. The credit for this goes to the great architect of this base, namely, Pandit Jawaharlal Nehru. To Pandit Nehru, science was not only a tool for economic development but also a means for the emancipation of mankind and the qualitative transformation of a stagnant society. The 1958 science policy resolution reflected his own belief beautifully: “It is an inherent obligation of a great country like India with its tradition of scholarship and original thinking, and its great cultural heritage, to participate fully in the march of science, which is probably mankind’s greatest enterprise today”. Indian S&T in the post-independence era has marched ahead in that spirit.

India today possesses a massive science and technology infrastructure spread across the country. With over 200 universities, 1500 research institutions and 5000 Ph.D.s being turned out every year, India is in an enviable position with regard to the S&T manpower. Scientific institutions have been set up and nurtured in many diverse sectors. These have included agriculture, atomic energy, electronics, environment, ocean, space, biotechnology, non-conventional energy sources, defence, health, and more. The chain of national laboratories, which was set up after independence, has built several core competencies in a large number of areas. All this gives India a marvellous launching pad, on which it can set up a really ambitious growth agenda.

Some achievements

Indian science and technology in the post-independence period is something to be proud of. Thanks to the “green revolution,” India is able not only to feed its masses but has enough to spare and export. The “white revolution” has made India the largest milk producer in the world.

With a comprehensive defense research and development infrastructure, India is among the few countries of the world, which makes the most sophisticated weapons
and weapon systems, including missiles of various descriptions and multi-barrel rocket systems. It has developed low-level tracking radar, night vision devices, and sophisticated ship sonar systems. An indigenous light combat vehicle and a remotely piloted vehicle are at an advanced stage of development. Today, India ranks among the few nations of the world that have a credible capability in space science and technology, including design and construction of satellites and launch vehicles. India’s capability in nuclear science and technology, including nuclear fast breeder reactors, has been the result of indigenous efforts. The entire range of technologies from prospecting of raw materials to the design and construction of large nuclear reactors is now available on a self-reliant basis.

There have been other proud moments in Indian science and technology. We had path-breaking developments in parallel computing, breaking into the export market for supercomputers. And India has unveiled the new, PARAM 10000 supercomputer, with a capability of 100 Gigaflops (100,000,000,000 mathematical operations per second). The open frame architecture of C-DAC’s PARAM 10000 places India in the League of Nations, which are expanding the frontiers of supercomputing to teraflop range. Presently, only the United States, Europe and Japan have such technological capability.

In the industrial R&D sector, India has achieved success in many areas. The Indian pharmaceutical industry, which was practically non-existent at the time of independence, has emerged as one of the most competitive producers of therapeutics in the world. It has contributed greatly to improving the standards of healthcare in the country and making modern medicine available to the people at an affordable price. India is a net exporter of pharmaceuticals, meeting more than three quarters of its requirements of bulk drugs and almost all of its requirement of formulations. Agro-chemicals is yet another area of success for Indian S&T. The industry, which was predominantly dependent on imports until the early seventies, is today self-sufficient in all matters of technology and production, thanks to the contribution of the indigenous know-how. In the area of petroleum refining and petrochemicals, the country has made some impressive strides. In the area of industrial catalysis, India ranks among the top few countries possessing world class capability for catalyst development and manufacture, in some cases, even exporting its technology to the USA and Europe.

The Indian leather industry has been transformed from a mere exporter of raw hides and skins a few decades ago to a vibrant, modern industry that ranks among the top five export earners. R&D has contributed to the entire range of technical activities from leather processing technologies for curing, dehairing, tanning and finishing (all environmentally clean), to process automation and modernization of tannery operations, and novel product design.
Other innovation systems

Many societies in India have nurtured and refined systems of knowledge of their own, relating to such diverse domains as geology, ecology, botany, agriculture, physiology and health. We are now seeing the emergence of terms such as ‘parallel’, ‘indigenous’ and ‘civilizational’ knowledge systems. Such knowledge systems are also expressions of other approaches to the acquisition and production of knowledge. They were, as yet, neglected by modern science, as the pharmaceutical industry has realized.

The growing dominance of a single view of the natural world as expounded by modern science will undermine these knowledge systems. Further, the process of globalization is threatening the appropriation of elements of this collective knowledge of societies into proprietary knowledge for the commercial profit of a few. These fragile knowledge systems need to be protected and enhanced through national policies and international legislation, while ensuring their development and proper use for the benefit of their holders.

In particular, a greater awareness about the cultural relationships between various knowledge systems needs to be created. A systematic and in-depth analysis of the parallelism of insights between indigenous and civilizational knowledge systems, on the one hand, and certain areas of modern science concerned with fundamental aspects, on the other will have to be launched. In particular, a strong linkage between the indigenous knowledge holders and scientists will be needed in the new millennium to explore the relationship between different knowledge systems. Some of the greatest opportunities are provided, especially in the Indian context, in the area of traditional medicine.

Examples of this new partnership between these two domains of knowledge are gradually emerging in India. Let us cite a couple of examples. The first is a medicine that is based on the active ingredient in a plant, Trichopus zeylanicus, found in the tropical forests of south-western India and collected by the Kani tribal people. Scientists at the Tropical Botanic Garden and Research Institute (TBGRI) in Kerala learned of the tonic, which is claimed to bolster the immune system and provide additional energy, while on a jungle expedition with the Kani in 1987. A few years later, they returned to collect the samples of the plant, known locally as arogyapacha, and began laboratory studies of its potency. These scientists then isolated and tested the ingredient and incorporated it into a compound, which they christened “Jeevani”—giver of life. The tonic is now being manufactured by a major Ayurvedic drug company in Kerala. In November 1995, an agreement was signed between the institute and the tribal community to share a license fee and to assign 2% of net profits to the tribe. The process marks perhaps the first time that cash benefits have gone directly to the source of knowledge of traditional medicines—the original innovators.
Grass root innovation

We need a particular focus on community knowledge and community innovation. To encourage communities, it is necessary to scout, support, spawn and scale up the green grass root innovation. It will generate employment on one hand and it will use natural resources sustainably through linking of innovation, enterprise, and investment. This will again require building up adequate linkages with modern science and technology and market research institutions. One will need new innovative models of development, employment generation, and conservation of natural resources.

We need to build more organisations like Gujarat Grassroots Innovation Augmentation Network (GIAN). GIAN has attempted to set up a venture capital fund for small innovation providing for its linkage with R&D and scaling it up into a viable enterprise. The recent effort by two science departments, which set up a Technopreneurs Promotion Program is also noteworthy, since it provides the much needed financial support for the first time to individual innovators, be it an artisan, a farmer, or a school boy. The establishment of the National Innovation Foundation is another step in the right direction, since it will help create a national register of these grass root innovators and will facilitate the process of taking these innovations to the market place. Eventually, it is the partnership of all the players, in the formal sector as well as the informal sector, that will make the Indian innovation movement happen. Two examples of this partnership are noteworthy.

India’s publicly funded R&D institutions are also participating in this grand endeavor. The experience of the Council of Scientific & Industrial Research (CSIR), which is the world’s largest publicly funded industrial R&D institution is worth sharing. CSIR is building new innovation models by forging unusual local partnerships, reaching out to the remote corners of India. A village called Athaoni, on the border of Maharashtra and Karnataka is the place from where Kolhapuri chappals come to us. They were until recently made by an age-old traditional technique. Scientists from the Central Leather Research Institute (CLRI) studied the process and helped them to reduce the processing time from 30 days to 10 days through the application of good science—the stamping process was standardized and certain innovative changes in design, based on computer aided techniques, were made to give more comfort to the wearer. But this was not a top down process. The oldest man in the village was consulted, he was convinced that the age-old traditions will have to change. Today several hundred artisans have been trained by CLRI. This has not only enhanced family incomes for the villagers but also changed their perception of science and development—in short a micro social transformation. CSIR has realized that in this innovation chain, it is not techno-economics alone, but the socio-economic and socio-cultural aspects that need to be taken into consideration.
India’s new S&T policy

India’s policy on science and technology would have to be directed along five lines. The first priority will be to use the great powers of science and technology to meet the basic human needs, particularly taking note of locale-specific situations; these would relate to food, health, water, energy, employment, shelter, and the like. The second priority would be to use science and technology to create wealth, both by enterprises as well as by individual Indian entrepreneurs. The third priority would be to embark on a major thrust in emerging knowledge based areas such as informatics, biotechnology, new and renewable energy sources, new materials and environment-related programmes. In all of these areas, India can make a major headway and surge ahead of the rest of the world. It would, then, use this position to its advantage in the global technological scenario. The fourth priority relates to strategic areas, where neither for love nor for money, technologies will be available to us. This would involve nuclear energy, defence research, and space science and technology. Fortunately, we have built self-reliance and enormous capabilities over the past few decades in all these areas. It is on this powerful base that India will make its confident march into the twenty-first century.

(Ragunath A. Mashelkar is director general of the Council of Scientific and Industrial Research, India. Visit: www.csir.res.in)