Innovation and the need for academia-industry linkages

Editorial in Chemical Digest, December 2008

By
Professor Arun S. Mujumdar

Innovation is no doubt the engine that drives national economic growth. While in the old economy individual companies could carry out all R&D in-house to support and develop new processes and products, globalization of the new economy requires a new model of innovation. Management Gurus generally agree that networks and collaborations spanning the globe is the new paradigm for economic growth. R&D is no longer centralized and confined to large corporations but it is now dispersed widely around the globe in medium and small scale firms as well. Many large corporations now seek innovative technologies internationally regardless of where they reside. However, conditions are not always conducive to carry out innovative work in various parts of the world. The world is getting flatter but is not yet flat enough when it comes to R&D effort and opportunities.

As R&D becomes more complex and expensive, it is natural to think of combining synergistically the limited financial and human resources scattered around the world to tackle major projects. Industrial R&D can be, and increasingly should be, supplemented by academic research. As the share of basic research by industry has declined steadily (to just about 4 per cent in USA and much lower elsewhere) the number of university-industry ties has increased according to data for the USA. Smaller firms cannot afford to carry out basic research and yet they depend on such research for their long term profitability or even survival. Furthermore, innovation has become more cross-disciplinary and hence more difficult for smaller firms. Academic institutions by their very nature of interdisciplinary faculties and large pool of talent both professors and students are ideally positioned to help small and medium size enterprises meet their R&D and innovation needs cost effectively. It is also easier for academic institutions to network collaboratively rather than competitively. On the negative side, industry may look at this as a problem in maintaining confidentiality and IP rights.

The formation of networks can be a positive-sum game, if properly designed. A well-organized network of collaborators with diverse skill sets can exceed the performance of the sum of individual members' performance in a network. Research collaboration should be central to the theme of industrial innovation and the rapidly developing nations like India need to leverage their large talent pool of engineers and scientists. Managing this pool is the key to success in this globalized world. As financial and human resources become scarcer and more expensive, it will be increasingly necessary to forge synergistic alliances across geographical boundaries. Such alliances may involve universities, industry, government laboratories or even individual researchers.

Indian science and engineering institutions are fast catching up with their counterparts in the developed world although there is still some way to go. In some areas e.g.

information technology, computer science, biomedical engineering etc there is already a trend to outsource high end R&D to India because of the large talent pool available; it is no longer due only to just cost advantages which are fast fading. I believe that as India marches on progressively to higher living standards the need for innovative R&D will be enhanced. Indian industry needs to link closely with academic institutions to support both basic and applied research. It is necessary to move beyond only consulting and trouble-shooting projects although they are no doubt valuable. The time scale of technological innovations- even incremental ones - can be long. Hence a start must be made sooner than later.

Academic institutions can play the dual role of producing valuable IP as R&D output while generating an even more valuable product during the process viz. highly qualified researchers who can contribute to a wider variety of industry problems over a long period of time. Initially, a succession of incremental innovations can accumulate to provide significant technological advantages. However, the larger firms will need to look at longer timeframes when disruptive technologies may appear anywhere in the world and affect their profitability due to globalization and disappearance of trade boundaries and protection. They must invest in advanced R&D with a longer time scale.

One troubling stumbling block to stronger academia-industry links is the recent trend even among developing countries, to relate academic research performance of researchers to publications in high impact-factor (as opposed to high impact per se) journals even in engineering disciplines. Since science journals, for reasons widely discussed in scholarly bibliometric studies, tend to have much higher impact factors as defined by ISI, academics tend to prefer to work under government grants so that they can publish their work in such journals without having to address the needs of industry. Industry-sponsored R&D projects do not typically lend themselves to such publication avenues. Unfortunately, academic institutions do not recognize generation of new technology or IP adequately to offset this trend, which will only become stronger and academia and industry will move apart before they move closer again. I hope that Indian universities do not fall into this “trap” most other countries have fallen into, since it is hard to recover from such a fall. It is like quicksand; the deeper one sinks into it with every attempt to extricate oneself from it.

Developing effective linkages between academia and industry is no simple task. Industry R&D is understandably motivated by the need to make a profit. It is well known that academic institutions are non-profit organizations. The expected time scale of industrial R&D is very short by the academic time scale of a typical PhD thesis, for example. The expected outcomes of industry R&D are better products or processes, while those of academia are a set of publications and researchers. Thus, special effort needs to be made by academic administrators, granting agencies, academics and industry to find a common ground so that needs of both parties are satisfied to an optimal if not maximal level. It is important for industry to fund basic research as well since this is in their long term, if not immediate, interest. Industries in India need to take a bold step and benefit from the talent pool residing in India's universities. R&D is often driven by the need to innovate. Academics tend to emphasize the R while in industry it is typically the D that is in the

driver's seat. Research by its very nature is risky. Risk-averse conservative industries therefore wish to minimize the risk when possible. It is not uncommon to find that truly radical innovations are not readily accepted by industry; most would prefer to be second or even third in adopting revolutionary innovations in technology despite the economic benefits they may offer. Businesses trend to adopt incremental innovations more readily.

Many modern day innovations like computers, telecom and electronic gadgets are the result of a series of incremental innovations made collaboratively by numerous individuals and several companies from different parts of the world. Due to the fusion of various sciences and engineering in frontier technologies be it stem cells or nanotechnology or other emerging developments, no one inventor can dominate the market today. In fact, business leaders and corporations who market products and services based on such disruptive technologies receive fame and fortune that went to inventors earlier. Today it is harder to identify individual inventors and inventions due to their complex collaborative and incremental nature, which also leads one to conclude that the rate of innovation is declining.

In the process industries, a number of examples can be cited of major innovations in thermal drying technologies that have made little or only nominal inroads in industrial practice. As I have hypothesized earlier, a part of the reason for this state of affairs may simply be the long "half-life" of dryers and drying technologies. Industry with short half-lives of technologies tend to adopt innovations more readily e.g. computer chips, biotechnology, pharmaceuticals etc. Their survival depends on R&D. Superheated drying technologies are a case in point. Despite their well known advantages, such technologies have yet to make a strong entry in industry; only a few industries have adopted such drying technologies. On the positive side, as the energy costs escalate such energy-saving drying technologies will find a higher level of acceptance in industry.

Of course, this conclusion is not shared by many. Maybe it is due to the fact that we often neglect the numerous incremental innovations that go into today's products such as cars, airplanes, electronics etc and do not recognize them as innovations.

To conclude, we must not underrate incremental innovations or enhancements to technology; cumulatively they can add up and make a big difference. What is even more significant, such increments are more acceptable and are actually more likely to be implemented by industry. While we in academic ivory towers are constantly dreaming up radical or revolutionary technologies based on the latest advances in the sciences, it is the incremental innovations that penetrate industrial practice and make a real difference to society. Clearly, a balance is needed between various levels of technological and engineering innovations so we have appropriate R&D allocations for both radical and incremental innovations. India has an important role to play on the industrial R&D scene. It is the radical innovations which will bring India to the forefront in the long run, while in the short term the importance of enhancing technologies through incremental innovations cannot be overemphasized.