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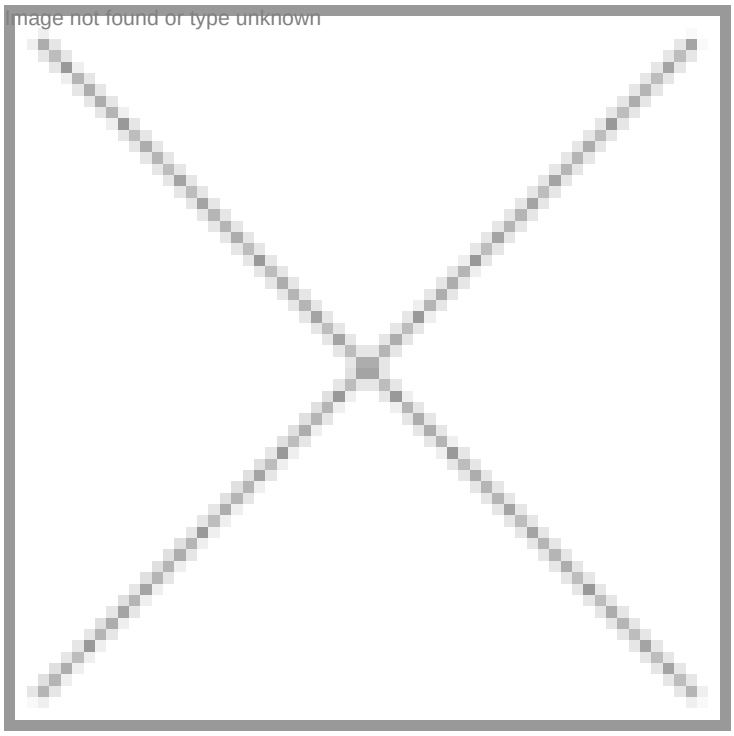
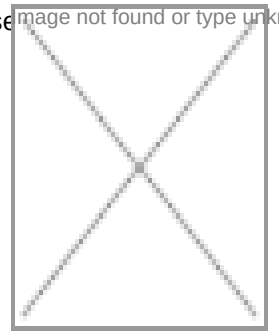
Intermeshing innovations and enterprises

12 February 2004 | News





Continuing the theme of building an "Innovative India", Dr R A Mashelkar makes another strong case for creating strong linkages between innovators, entrepreneurs and financial investors.

To encourage communities, it is necessary to scout, support, spawn and scale up the green grass root innovation to generate employment and use natural resources sustainably through linking of innovation, enterprise and investment. This requires building up adequate linkages with modern science and technology and market research institutions. In short, one needs new models of development, employment generation and conservation of natural resources.

In this connection, one looks with hope to organizations like the Gujarat Grassroots Innovation Augmentation Network (GIAN). GIAN has attempted to set up a venture capital fund for small innovations providing for its linkage with R&D and scaling it up into viable enterprise. The National Innovation Foundation set up by the Government of India has launched several programmes to support and encourage grass root innovators and most importantly, to build the bridge between the grass root innovators and modern science.

If we look at the scientific knowledge domain, we find that borderless science has already arrived. We see that discrete boundaries no longer exist between various natural sciences such as physics, chemistry, biology, mathematics, etc. Explosive advances in adjacent sciences are shaping up the future of core disciplines. New paradigms of "seamless sciences" and even "seamless engineering" are emerging. Take as a specific example, sub-disciplines such as inorganic chemistry, biological chemistry, organic chemistry and physical chemistry. The 1987 Nobel Prize winning work of Lehn, Cram

and Pedersen led to the elucidation of molecular recognition and to the whole new area of supramolecular science and engineering. This work was entirely possible, because they made the boundaries between these four sub-disciplines vanish.

Today, more than ever before, we not only need "borderless science" but also need "borderless thinking" for problem solving. Yet we find that we work and think in isolation.

Let me illustrate this by taking up a problem that we encounter in our everyday life, namely mixing.

Getting the right mix

Mixing is a challenge in diverse disciplines. In the case of astrophysics, one is concerned about the mixing of the interior of stars. In mechanical engineering, it is combustion. In environmental sciences, we are concerned with mixing and dispersion in the atmosphere. Oceanography deals with mixing and dispersion in oceans. Chemical engineers are concerned with mixing in chemical reactors. Physiologists look at mixing in blood vessels. Bioengineers are interested in mixing and aeration in bioreactors. Geologists deal with mixing in the mantle of the earth. All these diverse mixing phenomena occur on diverse time and length scales, differing by several orders of magnitude. However, these disciplines rarely benefit from each other, and discovery and rediscovery of concepts and ideas is common place.

There are many instances, where one is trying to gain understanding of a common problem.

Mind Reader

Consider the issue of a human mind itself.

As was pointed out by P.N. Johnson Laird, since the second world war, scientists from different disciplines have turned to the study of the human mind. Computer scientists have tried to emulate its capacity for visual perception. Linguists have struggled with the puzzle of how children acquire language. Ethnologists have sought the innate roots of social behavior. Neuro-physiologists have begun to relate the function of nerve cells to complex perceptual and motor processes. Neurologists and neuropsychologists have used the pattern of competence and incompetence of the brain-damaged patients to elucidate the normal workings of the brain. Anthropologists have examined the conceptual structure of cultural practices to advance hypotheses about the basic principles of the mind.

These days one meets engineers who work on speech perception, biologists who investigate the mental representation of spatial relations and physicists who want to understand consciousness. And, of course, psychologists continue to study perception, memory, thought and action. However, I have not seen a meeting of these computer scientists, linguists, neurophysiologists, anthropologists, engineers, and so on! Understanding of mind cannot be made possible without meeting of minds of all of them.

As mentioned earlier, we need to fuse borders between several disciplines, including those in natural sciences and social sciences. For this, we need to change our culture. We need to ensure that our mind moves through diverse disciplines in a borderless way. The ability to correlate and link the non-obvious can lead to major breakthroughs.

Management Chemistry

Can you believe me, if I were to say that the supramolecular chemistry, which won the Nobel Prize in 1987, can be used to develop modern management structures? But this is precisely what is being done.

Consider the issue of self-organization in molecular systems by using molecular recognition. The organization of molecules finally determines the structure, the properties and the functions. But is this not what we want in creating modern management structures to derive a specific end objective, or an organizational goal, or a function? Innovative efforts have been made recently to create flexible management structures by using the concepts of self-organization in chemical and biological systems. It is called a van der Waals model of Management. It is indeed fascinating that the chemistry of the non-covalent band, or supermolecular chemistry, is being used to create modern management systems. This is a splendid example of borderless thinking. We need more of it.

An innovator is defined as one, who does not know that it cannot be done. Invariably, individuals who are unfamiliar with the discipline are also the ones who do not know that things cannot be done. Probably it is these individuals who will be able to give us conceptual breakthroughs through their unconventional thinking. Should we not, therefore, give away the habits of protecting our turf? Should we not organize unconventional fora, where only club members belonging to a single discipline do not meet but those in seemingly unrelated disciplines meet?

We, in India need to seriously address several issues that hinder the creation of borderless minds and borderless thinking. They include our rigid academic curricula, our process of learning by rote, our rigid examination system based on a single correct answer, hierarchical structures in management, etc. Our systems promote inhibition and imitation rather than innovation.

It is only in an environment, which fosters innovation that borderless minds can be formed and borderless thinking can flourish. Finally, we must recognize that innovation is not a unidimensional process. It is comparable to the intermeshing gears of a clock. The challenge before us is to make this intermeshing happen. It is only breaking up those walls and opening up those windows of mind will bring that fresh wind that will build the "Innovative India" of our dreams.

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