

## CORPORATE R&D IN THE UNITED STATES

Praveen Chaudhari

The desire for information is innate in us, as is the desire to obtain information instantly and easily. We are moving toward a world in which these desires will be increasingly realized. What impact will this have on corporate R&D strategy in the United States?

Two interdependent technologies make information widespread and accessible: computers and communications. One stores, processes and displays the information, while the second brings it to us. Both technologies have dramatically improved not only in cost but also in performance. It is a well-advertised fact that the cost per bit of information has declined by orders of magnitude over the last few decades. Perhaps less well known is that the cost of communication has similarly decreased. For example, the annual cost of a circuit in a transatlantic communication system has fallen by approximately an order of magnitude each decade over the last four decades. In terms of performance, computational speed—as measured by the number of operations per second—has improved by five orders of magnitude, and the bandwidth of communication systems, with the introduction of fiber optic cables, has shown a similar change. We can expect a continuation of this technological progress, driven by our desire for information directly comprehensible to our senses.

Since 1968 **Praveen Chaudhari** has worked at the IBM T. J. Watson Research Center in Yorktown Heights, New York, and was Vice President for Science there from 1981 to 1990.

For several decades following World War II, laboratories in the US were the premier source of research underlying the new technologies. American scientists and technologists largely determined the rate of release and the dissemination of this information. They carried out the research while the rest of the world “searched” for that information. This is no longer true.

Knowledge of comparable breadth and depth is now available worldwide, and by many indicators, including research funding and the quality of research and engineering journals, this trend will accelerate, as information technology helps make information more pervasive. Information about critical technologies and about critical needs within a given technology is already widely known and will become common knowledge in the future. Therefore the notion of “captive” knowledge, whether at a research laboratory or within a country, will become obsolete.

A technology product requires not just an isolated element of information but rather a collection of information that is frequently diverse. Generally, a part of this collective knowledge is widely available, a part is perhaps locally available and a still smaller part one must generate. Setting aside important factors such as organizational and financial skills of the company, the generation of new knowledge usually determines the rate of progress. In industries such as computers, communications, biotechnology and environment, what has changed and continues to change are the following:

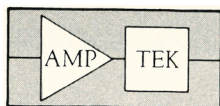
- ▷ Numerous laboratories around the world now conduct research.
- ▷ Different laboratories generate dif-

ferent elements of this new knowledge depending upon expertise, chance and emphasis.

▷ Since none of these elements alone may be crucial to an enterprise, they are published and hence accessible to those seeking them.

One cannot overestimate the significance of this changing environment, in which knowledge is easily available. If much of the information that a company requires is widely available—in research publications or product announcements—the company may believe it no longer needs to carry out proprietary research to the extent or of the type it did before. This implies that large corporate laboratories in the more established industries are likely to downsize unless they take on new responsibilities—for example, working more closely with customers—or obtain government funding. Both research laboratories and universities must think through the nature and manner of these new responsibilities rather carefully for them to be cost-effective. I mention universities for it is there that researchers develop their professional value systems. If researchers are to interact with marketing groups or with customers, which I anticipate will be the norm in the future, then a conscious effort has to be made, particularly in the engineering schools, to go beyond just teaching development and manufacturing.

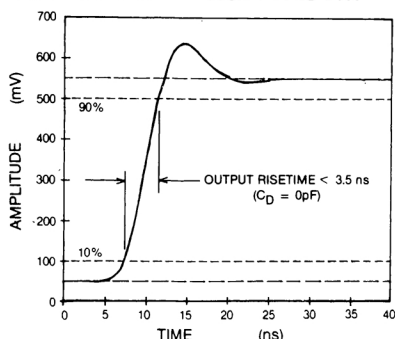
In parallel to the changes at large corporate laboratories will be the growth of new R&D efforts at smaller corporations. This is a direct consequence of our increasingly technology-dominated society, in which smaller firms require their own R&D to be competitive. Hence the overall



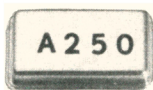
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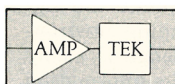
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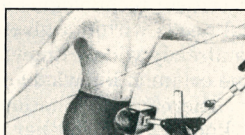
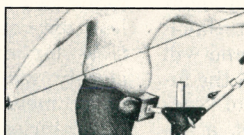
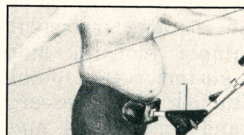
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R&D effort in US industry may increase, contrary to current opinion. If we believe that smaller R&D organizations will be more profuse, then both the legislative and executive branches of the Federal and state governments must respond appropriately, if they are to help with this evolution.

The organization, reward system and most importantly the attitude of R&D personnel in corporate research laboratories in the US has to change from just research to both research and search. This search may occur within the US or in other parts of the world where expertise resides, and it will require researchers to be willing to embrace solutions other than their own to problems on which they may have already invested their time. Alternatively, it may require an increasing number of them to spend more time on search and acquisition than on research and development.

As the focus shifts from just R&D to R&D and its strong relationship to the marketplace, an unfortunate byproduct can be a de-emphasis on basic (long-term, curiosity-driven, undirected) research and, to a lesser extent, exploratory technology. It is often presented as a truism that as researchers reach for customers, basic research must decline. I have never understood the intellectual basis of this cause and effect relationship, but I can perhaps rationalize it on a psychological or financial basis. From a practical standpoint, it does not matter what its basis is because the truism seems to hold. Why spend money on basic research or peripheral exploratory technology if the information is available elsewhere? This attitude is somewhat offset by the need for in-house expertise to ascertain what information to seek and, equally important, how valuable it is. These points notwithstanding, I expect basic research and exploratory technology in the US to become more and more the domain of universities. This will require increased funding for university-based research and stronger ties between university and industrial laboratories. Both the university and industrial communities will feel increasing pressure to work in concert.

Interestingly, this shift will accelerate the process of change I described above, for the results of university-based research are the most widely disseminated and most easily accessible.

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*The views expressed here are those of the author and not of IBM.*