Bridging the Science-Technology Gap

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Does anyone really doubt that the United States leads the world in the *science* of advanced materials? We support an unparalleled array of world-class universities, national laboratories, and private research centers.

Yet, when I ask corporate managers about their research programs, they complain they don't see a strong market pull for their new, innovative products. My company, Technical Insights, provides intelligence services on technologies ranging from advanced materials and manufacturing to biotechnology and sensors. Across the board, we hear executives despair about new product development.

Somehow, we fail to consistently translate good science into commercially useful technology. Why? And, specifically, what has limited industrial use of advanced materials?

Certainly, new materials are hard to make and use economically. Yet the Japanese have produced ceramic and metal-matrix composite auto engine components for years. They were the first to commercialize diamond coatings (for surgical knives and stereo speakers), and are now prototyping superconducting microelectronics.

I think a large part of the problem is that scientists, not just materials scientists, have been content to remain sequestered in their laboratories. There, they "do" science and turn the result over to engineers and marketers.

If they want to see their inventions move into the mainstream of economic life, scientists will have to expand their job definition. They are going to have to communicate their discoveries to the people who can use them. Now is the time.

Many organizations—from the Congressional Office of Technology Assessment (OTA) and National Research Council (NRC) to technology driven manufacturers—recognize that new materials are an enabling technology. They will help manufacturers make products lighter, hotter, stronger, stiffer, faster, more reliable, and more durable. New materials open the door to better products.

What are American Companies Doing?

Many American companies have started to listen. **They have brought scientists out of the lab and into the corporate mainstream.** Marketers and researchers routinely exchange information. They may work in closer proximity. Allied-Signal even has a "science fair" to bring together the diverse research and marketing groups that fall under its corporate aegis.

Corporations have also begun to rethink the rules that govern introduction of new technology, especially production and manufacturing technologies. In the past, corporate controllers often rejected new technologies that didn't offer a quick payback. They had no way to measure the cost of quality, the loss of production flexibility, or loss of competitiveness by not keeping up with technology.

But when corporations began to lose business to more technologically competent competitors, they began to rethink the accounting rules. Now, for the first time since the 1950s, the top management of many leading companies will more willingly pay for new technology, without knowing the magnitude of the positive return on their investment.

Finally, and most important, corporate research leaders are trying to inoculate themselves against the "Not-Invented-Here" syndrome, and are reaching out to embrace new technologies. TRW, for example, has "hunter-gatherers" who identify and license technology developed by government, university, and corporate labs. Several DuPont managers do the same. In fact, the company has built a leading position in high-temperature materials by licensing metal and ceramic-matrix composites technologies from Lanxide and France's SEP.

True, most corporate R&D managers believe their job is to create science, not find it elsewhere. But when a research leader like DuPont, with a $1.2 billion R&D budget, says you should be suspicious if all your technology comes from your own labs, others will start to listen.

Corporate openness to technological innovation will benefit small companies and university researchers. But scientists are going to have to do a better job of communicating the good news about materials.

What Should Scientists Do?

First, scientists—not just materials scientists—cannot remain isolated from potential users of their inventions. Scientists don't need marketing people to act as intermediaries between them and materials users. They need to talk to potential users themselves and find out what's needed.

Users are often a key source of innovation, especially in materials processing. Nine of every ten advances in pultrusion, for example, were developed by users rather than materials manufacturers, according to a ten-year study of innovation by MIT's Eric von Hippel (*The Sources of Innovation*, Oxford University Press, NY). The same was true for 67% of the breakthroughs in semiconductors and printed circuit boards, 43% of the discoveries in thermoplastic processing, and even 10% of the advances in engineering plastics. Innovator-to-innovator communications can only speed the flow of new ideas.

Second, materials scientists must also stop talking only to themselves. Most materials scientists will make it to at least one of the technical meetings held by MRS, SAMPE, ACerS, ASM, RC/CI, or SPI during the year. But how many go to the meetings held by their companies' customers? How many publish outside their technical journals?

While sharing research results with peers is important, scientists must learn to communicate the importance of their work to a larger, more diverse audience. They must learn to phrase their solutions in terms of their audience's problems.

Third, scientists should talk to the press. Reporters, even science reporters, are not materials scientists. They're generalists, and their writing is usually read by nonspecialists. They simplify and may not always get the details right. But they fill the key function of introducing your key ideas to people—users—who may not read your technical journals.

Fourth, materials researchers, especially those in industrial settings, must learn to look at the whole picture, not just the specifications for their part of the solution. They need to see the problems they will solve for the user and the competing technologies that might solve the same problem. Plastic composites researchers, for example, should be aware of other ways aircraft makers might improve fuel economy (the big push behind lightweight

composites), such as using aluminum-lithium alloys or switching to propfan (unducted fan) engines. Then they can focus their efforts on composite properties other systems don't provide, such as resistance to sonic degradation caused by propfan engines.

The Chief Technology Officer...

But all the communications skills in the world won't help if there's no way to funnel that information to the people who can use it. **So I'd like to suggest that corporations appoint a chief technology officer (CTO) with clear-cut authority and budgetary power over corporate technology.**

This man or woman would first define technologies crucial to corporate success and those that threaten its position in the marketplace, and develop a strategy to balance opportunities and risks. Second, the CTO must implement an internal R&D program to keep apace with the latest key technology, and monitor technological developments outside the firm.

Technology monitoring cannot consist of one person in an office. It must receive reasonable funding, at least 5% of the corporate R&D budget. It should have a twofold purpose. First, it should identify new opportunities, much the way DuPont solidified its position in composites by reaching out to Lanxide and SEP. And it should prevent the company from being blindsided by new developments the way, say, mechanical adding machine companies were made obsolete by the introduction of electronic calculators.

It's a different, more competitive world out there today, and research is no longer isolated from economics. I believe more and more corporations are looking for breakthroughs that will keep them competitive. Corporations whose lifeblood is science need to acknowledge the fact by creating a top-level position to ensure they stay on top of critical technologies.

There's also more good science being conducted worldwide than ever before. Materials scientists must learn to communicate what's important about their work in ways that cannot be ignored. America needs advanced materials. We cannot rely on industry to come to us. We must carry the news to them....

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