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Engineering Research Centers

An innovative program sponsored by the National Science Foundation (NSF) is having important consequences at a number of universities. The fostering of 18 Engineering Research Centers (ERCs) has led to better instruction of engineering students, enhanced interdisciplinary research leading toward practical applications, and beneficial interactions with and financial support by industry.

In 1985, concerns began to arise about declining U.S. industrial competitiveness. The ERC program was created to respond to this and to the fact that many opportunities in engineering research required an interdisciplinary approach. A 1990 NSF publication* described goals of the ERCs: "A primary objective of the program is to bring engineering and scientific disciplines together to address fundamental research issues crucial to the next generation of technological advances.... An equally important aim is to educate a new generation of engineering students in a cross-disciplinary team approach to problem-solving, increasing their ability to contribute productively to industry.... A major goal of the ERC Program is to facilitate the more efficient conversion of advances in fundamental research in universities into high-quality, competitive products and processes in industry."

Each of the 18 ERCs occupies a niche within six technological fields: manufacturing and design; materials processing for manufacturing; optoelectronics, microelectronics, and communications; bioprocessing and biomedical engineering; resource recovery and utilization; and infrastructure and environment. Major technologies that influence the nation's quality of life and economic strength are included in the ERC efforts.

The ERCs derive their funding support from diverse sources. The total contribution from NSF during 1991 of $45.6 million constituted 33% of the total. Industry supplied 30%, other federal agencies 20%, universities 11%, and states 6%. In addition to money, industry contributes equipment and often stations company personnel at the universities. The monetary support takes the form of membership fees. There are as many as three levels of membership entailing differing fees and privileges. The fees also vary among the ERCs. Some have top annual fees as high as $200,000. For others, the maximum is $100,000 or less. The lowest level ranges from $5,000 to $25,000 for small companies.

At present there are a total of 697 participating memberships held by 483 companies. Some of the major U.S. companies have multiple memberships. For examples, IBM participates and pays fees in ten centers. Eastman Kodak, GE, and AT&T are each members of nine centers. The total memberships continue to increase.

Industry engineers on campus teach classes in conjunction with faculty. They participate in research with faculty and students. They advise students on career choices as well as on research directions. They act to ensure effective transfer of information between the ERC and their company and vice versa.

One of the advantages enjoyed by participants in ERCs is their research support infrastructure. They enjoy unusually good research and computer equipment. Technicians and maintenance funds ensure the readiness of equipment to produce reliable measurements.

One of the latest ERCs to be activated involves the Universities of Minnesota and Wisconsin with the center located at Madison. Its special niche is plasma-aided manufacturing. In a partial vacuum, high electric fields give rise to an ionized plasma whose characteristics depend on pressure and gaseous content. The phenomena are complex. It is a goal of the center to gain a complete understanding of everything that takes place, from the initiation of an electric field in the plasma to an actual industrial application. Research at the center includes plasma etching or deposition, plasma synthesis of high-technology refractory materials, and plasma modification of materials. Already the hardness of many irregularly shaped metallic objects has been usefully improved by nitrogen bombardment. The total present and potential markets for applications of plasma-aided manufacturing have been estimated to be more than $100 billion.

The other ERCs have programs that also are relevant to industrial competitiveness. Progress that is being made by each of the ERCs is described in an NSF report† that will be released soon. An examination of the report shows that the $45.6 million devoted annually to the centers is being leveraged to produce highly significant effects.—PHILIP H. ABELSON

**The ERCs: A Partnership for Competitiveness* (National Science Foundation, Washington, DC, 1990). †*Highlights of ERC Technology Transfer* (Publ. 92-6, National Science Foundation, Washington, DC, 1992).