**The ERC Class of 1985**

**The Systems Research Center,** John S. Baras, Center Director, University of Maryland, joint with Harvard University. Professor Baras described the ERC in April 1985 as follows:

The theme of the Systems Research Center (SRC) is to promote basic research in the implications and applications of three types of technology (VLSI, CAE, and AI)[[1]](#footnote-1) involved in the engineering design of high-performance, complex automatic control, and communications systems. Systems engineering is defined as the discipline that combines automatic control systems and communication and signal processing systems with certain areas of computer engineering. The major research thrust of this discipline at present is the design and implementation of high-performance electronic systems for automatic control and communication.”[[2]](#footnote-2) The SRC will focus on the development of powerful and sophisticated software systems that will help and guide engineers in the design of automation and information-processing systems.[[3]](#footnote-3) The education program will focus on new systems courses and seminars at the University of Maryland and Harvard taught by faculty and visiting scientists from government and industrial laboratories. The center will include courses focused on retraining practicing engineers.[[4]](#footnote-4) Industrial collaboration will focus on collaboration with industry in the SRC’s research areas with firms and government agencies in the Washington, D.C. and the Boston areas, and around the country. They will join the center in a group known as Systems Research Affiliates (SRS) with a purpose to provide strong scientific and educational interaction and to support (financially) the Center’s activities. [[5]](#footnote-5)

**The Center for Intelligent Manufacturing** **Systems**, King-Sun Fu,[[6]](#footnote-6) Center Director, Purdue University. The Purdue team described the ERC in April 1985 as follows:

The Center is organized to support the long range cross-disciplinary effort in research and education needed to bring the next generation of automated design/manufacturing systems into side use in American industry. The major research questions were focused on “design, processing, and planning and control, which together cover all functions that transform concepts, requirement, raw materials, and resources into products.”[[7]](#footnote-7) These would be addressed through information engineering, requiring a completely integrated approach to the entire manufacturing system. The education program will focus on building a bridge to manufacturing from the disciplinary departments, augmenting the course materials with a systems perspective, and fostering a spirit of innovation to prepare student to live in a world of constant technical change. [[8]](#footnote-8) To encourage undergraduates to participate in research, a requirement of the ERC Program, the ERC decided to provide a summer research experience through the new Summer Undergraduate Research Interns (SURI) efforts at Purdue. At the graduate level Purdue is in the process of developing a Masters-level core program in manufacturing systems engineering under a program supported by the Westinghouse Foundation. Continuing education courses will be offered to engineers in manufacturing industries impacted by the research[[9]](#footnote-9) The industrial collaboration program rests on the ongoing CIDMAC (Computer Integration, Design, Manufacturing, and Automation Center), a precursor to the ERC at Purdue which will be expanded to include more members. Each member company will have representation on the Policy Advisory Committee and the Technical Advisory committee, representing not just their companies’ interests but also those of U.S. manufacturing industry as a whole. The program would be focused on guidance regarding research areas and technology transfer through direct involvement of members and broader dissemination to the industry at large. [[10]](#footnote-10)

**Center for Robotic Systems in Microelectrics.** Susan Hackwood, Center Director, University of California, Santa Barbara. Professor Hackwood described the ERC as follows:

The main goals are to create new technology in flexible automation for semiconductor device fabrication and to educate a new generation of engineers skilled in the implementation of robotic systems. The first subgoal is process investigation through robotic control of fabrication sequence automatically and reproducibly to obtain optimum output. The second subgoal is increasing yield, while maintaining quality and reliability. The research areas chosen are robotic systems for material transfer, robotic systems for process control, and robotic systems for assembly and packaging. The distinguishing feature of the UCSD program among other university robotics research program is its systems focus, defined “a collection of interacting robots and peripherals that together achieve a definite purpose.”[[11]](#footnote-11) It is the lack of this approach that is causing the U.S. to lag behind Japanese systems design and applications in industry. The research will be focused on the application first and more fundamental research will arise as the research and technology face barriers. The education program is focused on new courses in subjects relevant to robotic systems in microelectronics for both undergraduate and graduate students. Undergraduates will benefit from the research through a one-year, senior level curriculum for robotic systems specialization and the center will provide funds to pay undergraduates as technicians in implementation states of projects. The industrial interaction with industry joint industry/university projects, called “systems house” with company personnel assigned to work with the center where implementation takes place on location in industry. This placed the center in the role of the R&D labor for the firm. At start-up in its first year the center had 15 members.

**Center for Composites Manufacturing Science and Engineering.** R. Byron Pipes, Center Director[[12]](#footnote-12), University of Delaware and Rutgers University. Professor Pipes explained that this ERC grew out of the Center for Composites Manufacturing, established at Delaware in 1974 under the RANN Program to explore university/industry collaboration models. It became an Industry/University Cooperative Research Center (I/UCRC) in the ASRA days at NSF and was folded into the new ERC.

The goal of the ERC is to accelerate technological advancement in composites manufacture through the development of new knowledge and tis transfer to industry, especially focused on the primary barriers to the growth of this new high-technology industry. The five primary research programs make up the Center: (1) manufacture and Processing Sciences; (2) Mechanics, and Design Sciences; (3) Computation, Software and Information Transfer; (4) Materials Design; and (5) Materials Durability.[[13]](#footnote-13) The education program will start a program of undergraduate research assistants who will work in the ERCs labs in the summer, go on an internship to a member firm in their junior year, and conduct independent research under faculty supervision in their senior year. The primary goal will be the development of Ph.D. candidates to carry out research in labs in all sectors. The program will include continuing education for practicing engineers. Industrial collaboration will be focused through a joint University/Industry Research Program, known as “Applications of Composite Materials to Industrial Products, created under the I/UCRC. The ERC will operate this program through an Industrial Advisory Board.

**Engineering Center for Telecommunications Research.** Mischa Schwartz. Columbia University. Professor Schwartz explained that:

The focus of the ERC will be on integrated telecommunications networks of the future. The research thrusts are focused on developing new systems and concepts for these networks, which will handle, in an integrated fashion, data, voice, video, and other communications traffic. The second thrust will focus on VLSI circuits, microelectronics, and electrooptical devices needed to achieve the proposed degree of integration. They will implement a highly flexible network test bed call MAGNET, which is capable of supporting data, facsimile, voice, and video. MAGNET will be supported by an interactive multimedia environment with real-time voice and video as well as data and graphics. The education program will rest on the student projects, new courses and new curricula in telecommunications systems. Collaboration with the Law School, the Business School, and the School of Journalism should lead to new programs in telecommunications technology and policy. Industrial collaboration will involve the major telecommunications and electronics firms in the New York New Jersey area. This ERC too has its roots in an I/UCRC grant and members of that center will transition into members of the ERC. Members will set on an Industrial Advisory Board and provide guidance on the research program. There will be seminars, an industrial visitors program, and seminars run jointly by faculty and industrial engineers. [[14]](#footnote-14)

**Biotechnology Process Engineering Center**. Daniel I.C. Wang, Center Director, Massachusetts Institute of /Technology. Professor Wang introduced the ERC as follows:

The Biotechnology Process Engineering Center (BPEC) will be structured to capitalize on the monumental discoveries in the biological sciences that have enabled the new field of biotechnology. While these discoveries have moved ahead at a speedy pace, the necessary development of processing technology to realize the revolution inherent in biotechnology has not. Thus BPEC will focus on the barriers to the utilization of biotechnology – both technology and the people needed to lead the engineering aspects of this field. Because the field is rooted in biology but needs engineering to advance, the ERC will build a joint community from the Departments of Chemical Engineering, Biology, and Applied Biology, who will carry out joint research and team teach new courses. The research program is structured to address processing barriers that arise from the fact that many important human therapeutic products are proteins that require continued activity and stability during and after processing to be viable for manufacture of therapeutics. The four generic areas that the research program will address are:

* Genetics and molecular biology for protein synthesis, processing, and excretion in animal cells, and yeasts;
* Concepts of bioreactor design, scale-up, and operation;
* Downstream processing for product isolation and purification; and biochemical process systems engineering.

The education program does not strive to develop a new degree program but rather will infuse new interdisciplinary courses in ongoing degree programs in Chemical Engineering , Biology, and Applied Biology. There is also an MIT Interdepartmental Biotechnology Program that is in the planning stages. The undergraduate program will utilize the ongoing MIT Undergraduate Research Opportunities Program (UROP) to offer undergraduates the opportunity to perform interdisciplinary research in biotechnology. The graduate programs will continue apace and will be augmented by interdisciplinary mentoring for students. Formal industrial internships will be established. Industrial collaboration will reach out to established chemical engineering firms developing new biotechnology capability as well as start-up firms in the industry. The industrial members will serve on an advisory board to help the ERC address the pressing needs of industry in regards to education and research needed to strengthen our competitive position in this emerging industry. [[15]](#footnote-15)

1. VLSI = very large scale integrated circuits, CAE = computer-aided engineering, and AI = artificial intelligence. [↑](#footnote-ref-1)
2. Baras, John S. (1985). Systems Research Center. *The New Engineering Research Centers: Purposes, Goals, and Expectations*. Cross-Disciplinary Engineering Research Committee, summary of a symposium, April 29-30, 1985, National Research Council. Washington, D.C.: National Academy Press. p. 61. [↑](#footnote-ref-2)
3. Ibid. p. 62 [↑](#footnote-ref-3)
4. Ibid p. 70-71. [↑](#footnote-ref-4)
5. Ibid. p. 71-72. [↑](#footnote-ref-5)
6. Professor King-Sun Fu developed the proposal with Professor James J. Solberg and David C. Anderson. Tragically, he died during the center inauguration ceremonies on April 29, 1985, and Solberg assumed the Center Director role shortly thereafter. [↑](#footnote-ref-6)
7. Fu, King-Sun, Anderson, David C., Barash, Moshe M., Solberg, James J. (1986). Center for Intelligent Manufacturing Systems. In *The New Engineering Research Centers: Purposes, Goals, and Expectations.* Cross-Disciplinary Engineering Research Committee, National Research Council. Washington, DC: National Academy Press, p. 79. [↑](#footnote-ref-7)
8. Ibid. p. 82. [↑](#footnote-ref-8)
9. Ibid. p. 83 - 84. [↑](#footnote-ref-9)
10. Ibid. p. 85. [↑](#footnote-ref-10)
11. Hackwood, Susan (1986). Center for Robotic Systems in Microelectronics. In *The New Engineering Research Centers: Purposes, Goals, and Expectations*. Cross-Disciplinary Engineering Research Committee, National Research Council. Washington, DC: National Academy Press, p. 87. [↑](#footnote-ref-11)
12. Shortly after this presentation, Professor Pipes resigned as Center Director to assume the position of Dean of Engineering at the University of Delaware. [↑](#footnote-ref-12)
13. Pipes, R. Byron (1986). Center for Composites Manufacturing. In *The New Engineering Research Centers: Purposes, Goals, and Expectations*. Cross-Disciplinary Engineering Research Committee, National Research Council. Washington, DC: National Academy Press, p. 94. [↑](#footnote-ref-13)
14. Schwartz, Mischa (1986). Engineering Center for Telecommunications Research. In *The New Engineering Research Centers: Purposes, Goals, and Expectations*. Cross-Disciplinary Engineering Research Committee, National Research Council. Washington, DC: National Academy Press, pp. 100-106. [↑](#footnote-ref-14)
15. Wang, Daniel I.C. (1986). Biotechnology Process Engineering Center. In *The New Engineering Research Centers: Purposes, Goals, and Expectations*. Cross-Disciplinary Engineering Research Committee, National Research Council. Washington, DC: National Academy Press, pp. 107-120. [↑](#footnote-ref-15)