AC 2001-1017: TECH-4 Electronic Workforce Development

Andrew Hoff, University of South Florida

Marilyn Barger, Hillsborough Community College

Richard Gilbert,

TECH-4 Electronic Workforce Development

Marilyn Barger, Andrew Hoff, Richard Gilbert
University of South Florida

Introduction

An internationally competitive US electronics industry requires a well-prepared workforce. Many community colleges and universities along the central Florida "Interstate-4 Corridor" (Tampa-Orlando-Daytona) work with industry to offer programming in the engineering technology/electronics field. Rapidly evolving industry demands and increasingly limited resources have led to the establishment of an education/business alliance known as the Tech-4 High-Technology Industrial Education Consortium. Tech-4 is currently utilizing NSF-ATE funding and over $1 million in substantially cash value industry match to enhance individualized institutional efforts to design and deliver a collaborative, replicable Electronics Workforce Development System. This System will maximize learning for secondary and lower-division students through coordinated sharing of industry and educational resources.

NSF-TECH-4 Initiative

The galvanizing premise among the various industrial and academic partners within the "I-4 corridor" was the basic belief that the central section of Florida did not have the workforce in place to support the high tech boom projected within the next 10 years. As the fourth largest state and growing, there is virtual certainty that the counties connected to Interstate 4 will be ideal locations for high tech firms. What was found to be missing was a unified, technical educational support structure to meet the employment needs of such an industrial focus. The legislatively funded Florida High Tech Corridor Council, (Fl HTCC), began to address this issue in several ways. One of their principal action paths was the formation of the TECH-4 Educational Consortium.

After the expenditure of some organizational energy, the focus of TECH-4 Educational Consortium was on the creation of a technical educational structure that would be compatible with the existing community college and university system. This effort lead to a multiyear million dollar proposal with industry match to NSF's Advanced Technology Education Division, ATE. Grant partners are Brevard (Melbourne), Hillsborough (Tampa), Seminole (Sanford), and Valencia (Orlando) Community Colleges; along with the University of South Florida (Tampa) and the University of Central Florida (Orlando) and Cirent Semiconductor (Orlando). The awarded grant crossed the boundaries of three ATE areas (Curriculum and Instructional Materials; Teacher and Faculty Development; and Laboratory Development). Seven curriculum modules focusing on different aspects of the electronics industry will be located across the region to serve as collaborative resource centers. These modules and the institutions that will develop and house the curricula are: Fluids/Pneumatics (HCC/VCC): Cleanroom/Contamination Control

System (BCC); Hazardous Materials (HCC/BCC); Metrology (SCC); Radio Frequency/Vacuum Systems (HCC/VCC); Electromechanical/Automated Control Systems (VCC); and Photolithography (HCC). Instructional approaches are based on the latest trends in pedagogy and content. Articulated courses and activities will be developed or modified (using the MATEC NSF ATE Center curricula as a foundation) through extensive collaboration among education and industry representatives. Outcomes will include increased enrollment, retention, completion, and placement rates.

Thousands of students, including a significant number of special population students, will be encouraged to pursue higher education studies through enhanced coursework and career awareness focusing on engineering/engineering technology careers at large manufacturers and smaller support services companies. Community college graduates may elect to immediately enter employment and/or upper division study. Secondary/community college instructors will increase their understanding of instructional relevancy through professional development.

Typical Grant Activity

Overall grant activities were distributed among two universities and six community colleges. A representation of these activities is reflected by the efforts at Hillsborough Community College and the University of South Florida. Responsibilities and commitments for Hillsborough Community College and the University of South Florida with respect to this NSF grant fall into the 4 project categories that will be addressed separately:

1. Curriculum and Instructional Materials;
2. Teacher and Faculty Development; and
3. Laboratory Development
4. Industrial Partnerships

Curriculum and Instructional Materials

HCC chose to develop a new A.S. program to house the grant-related curriculum. Approximately 2,500 square feet of space on the Brandon Campus was allocated for offices, laboratories, classrooms and storage. During the fall semester of 1999, the course sequence for the 2-year program in Manufacturing Technology with a specialization in High Tech Industries was developed. The 2-year curriculum included development of 12 new technical courses at HCC. The course sequence and classes were developed after considerable review of various Manufacturing and Semiconductor Manufacturing Technology programs across the country; guidance from USF College of Engineering; as well as input from local industries. The proposed curriculum (including the 12 new technical courses) approved and the curriculum outline with its semester sequence is provided in Table 1. Highlights from this curriculum directly related to the NSF grant and Tech 4 are provided.

-Hazardous Materials

A 2-semester credit hour course, Process Safety and Hazardous Materials was designed as a component of the A.S. Manufacturing Technology Program at HCC. Three MATEC modules relating to Safety and Hazardous Materials were incorporated into the course. The interactive CD-ROM based courseware package by Marcon for Safety and Hazardous Materials was also selected. The complete curriculum materials for the Tech-

4 module are being developed from the Marcon courseware (resident on the LAN), MATEC modules, and other resource materials.

-Vacuum/RF

Four new courses in Manufacturing Technology curriculum at HCC will address vacuum science and vacuum technology: Vacuum Science, ETI 1840, (3 credit hours); Vacuum Science Laboratory, ETI 1840L, (1 credit hour); Vacuum Technology and Systems, ETI 1844, (3 credit hours); and Vacuum Technology Laboratory, ETI 1844L, (1 credit hour). Vacuum training systems for this hands-on laboratory experience were obtained with matching funds from the State of Florida.

In addition to curriculum development, the grant supports the development of a workable plan to share both the curriculum materials and the laboratory equipment. At the time of this paper, the first of the shared equipment has been ordered and the inter-institutional sharing agreement is being reviewed. This aspect of the grant will be discussed in the presentation.

Another aspect of the curriculum development aspect of the grant is the intermingling A.S. and A.A. courses and the articulation of the A.S. programs to the universities. Several articulation agreements have been signed for articulation of the Electronics Engineering Technology programs to the Engineering Technology Department of the University of Central Florida. Additionally, agreements for the Manufacturing Technology program at HCC to articulate to the same Engineering Technology Department will be in place by the end of spring semester 2001. Still on the agenda is an agreement for articulation of the HCC program to the Education Department at the University of South Florida. These articulation agreements have been expedited by the recent implementation of a statewide policy that establishes the Associate in Science (A.S.) degree in Florida as a transferable degree. All A.S. degree programs will now be allowed to develop articulation agreements with appropriate programs in state 4-year educational institutions. This new paradigm in higher education will allow for extensive intermingling of A.A. and A.S. courses. Traditional college transferable A.A. courses, especially languages, speech, mathematics, sciences, humanities, etc. will be used in A.S. programs to fulfill general education and basic core curricula requirements to ensure that these programs are transfer ready to 4-year B.A. and B.S. programs in the state. The new Manufacturing Technology program at HCC has transferable English. In conjunction with this effort, the state's 2-year institutions will be allowed to offer a new terminal degree, an Associate in Applied Science, or A.A.S. communications, humanities, basic science and mathematics courses in its curriculum.

Related to new structure of 2-year technical degrees in Florida, is the likelihood of ABET accreditation of the A.S. Technology Degrees. Exploring such accreditation is an objective of the Tech 4 grant. The new definition of the A.S. program in Florida now offers the opportunity for A.S Technology programs such accreditation. The curriculum content of the new technology programs can match a related ABET criteria. However, other ABET requirements for faculty and institutional resources will also have to be met if accreditation is deemed desirable.

Teacher and Faculty Development

The success of any workplace development curriculum is acutely dependent on the faculty representing the curriculum. For the community colleges within central Florida, the existing

faculty will require assistance as they build their comfort level with this new high tech based material. The Hillsborough Community College and the University of South Florida grant partners have supported a significant number of professional development programs for the faculty at the university, community college, and high school level.

For the high school teachers, profession development opportunities begin with introduction to and education about new high technologies. The Tech 4 consortium, under the leadership of Cirent Semiconductor has developed a 2-day workshop for high school teachers, called “Chip Camp” and a related 1-day workshop for high school counselors. Chip Camp has more than 400 participants since its debut in 1998. The informational workshop includes field trips, hands-on activities, presentations of various topics in science and technology related to high tech industries in central Florida as well as career opportunities and educational pathways.

External professional development opportunities are also vital. An external opportunity is a professional enhancement experience that is not conducted in a "local" environment. Faculty will "buy" new behavior patterns (i.e., teaching methods, topics, and materials) when they realize that there are many others throughout the country considering the same transformation. Professional society sponsored seminars and workshops conducted at a regional and national level are excellent ways to imprint a global impact on individual educators.

To this end, the grant partners have developed workshops on vacuum technology that are now being used at the national level. The American Vacuum Society, AVS, sponsors a two-day Science Educators Workshop at their annual international meeting that features technical materials developed for the workforce development vacuum related curriculum material. In addition, MATEC, Maricopa Advanced Technology Education Center, has agreed to host and facilitate “VacShop”, a workshop for High School Science Educators, at the ATESM 2001 Conference in Austin TX in August. The 2-day workshop will be taught by the NSF Tech-4 members from HCC and USF, and sponsored by local High Tech Industries in Austin. MATEC is a NSF supported Center of Excellence and has agreed to advertise the workshop in their conference program, make facility arrangements, and help identify sponsors for the program so that the cost to the teachers can be kept to a minimum.

Finally, the curriculum modules developed by the grant partners will be made available to high schools with related technical programs. The module contents will be adjusted to the appropriate delivery level. Parts of the curriculum have been packaged into professional training workshops for High School teachers that have been presented several times during the first year of the grant. The secondary teachers are then able to use the materials and handouts in their classrooms and work directly with educators at the universities and the communities.

To facilitate the various professional development activities for high school teachers a database of central Florida HS science teachers and the county level science coordinators has been developed for direct mailings. Contact with the science coordinators in Brevard, Hernando, Hillsborough, Manatee, Pinellas, Orange, Pasco, Polk, Sarasota, and Seminole counties has been established and is maintained by the Tech 4 office of USF.

Laboratory Development

The essential distinction between the workforce development curriculum being created and the classical ABET format engineering education familiar to most engineering educators is not, as most would suspect, the content of the courses. Granted, the mathematical vehicle used in the first two years of an engineering program has a lush calculus interior. Indeed, that level of mathematics is exactly what should be demanded of all B.S. engineering students. However, as more and more computer based components are embed within high tech manufacturing equipment and process procedures, fewer and fewer members of the high tech workforce will find any daily demand for specific calculus manipulation skills. What these employees will continue to need is a similar command of the mathematical skills encompassed in engineering based statistics and logic courses as well as the engineering science concepts fundamental to fluids, circuits, statistical process control, thermodynamics and computer engineering. Thus the essential difference between the curriculums is not really the engineering course content but the laboratory experience provided.

The characteristic distinction between the engineering curriculum and a high technology workforce development curriculum is the result of the philosophical focus of that laboratory experience. A laboratory activity for the high technology workforce student must provide a healthy dose of system assembly and trouble shooting. Although the engineering science concept does not take a back seat during the laboratory, the experience is not a hypothesis driven event to be confirmed by an expected model response.

Consider gas behavior in a vacuum system as an example. The technology workforce student is not trying to collect data to model and ultimately demonstrate Boyle's Law. Rather, the student is collecting pressure vs. time data to confirm an expected system pumping speed. Since pump down time and pressure data reflects system leaks, the data collection, plotting, and subsequent analysis efforts are to confirm proper assembly and operation of the vacuum system.

Industrial Partnerships

An additional distinction between the traditional engineering curriculum and high technology workforce curriculum is the way industrial partnerships are incorporated into the programs. Both programs use industrial partners as general program advisors, but the technology workforce program needs the industrial partners as specific resources. They are equipment sources and provide actual job skill requirements expected of program graduates. This tighter relationship is essential. The graduates of a workforce-based curriculum are to be specifically and immediately employed by the high tech company. The company expects these students to begin, after a brief orientation, to work on or with their processes. The student must have a comfort level with their equipment. This familiarity is light years different from a voc-tech training level. The equipment and instrumentation of today's high tech industries is expensive, complicated, computer controlled and integrated with other process equipment that is expected to stay on line.

The grant academic partners recognize the importance of this embryonic relationship and have developed several partnerships. Locally, Cirent Semiconductors, Siemens, and Uniroyal Optoelectronics are integral partners of the TECH-4 Consortium and strong supporters of the developing high technology workforce curriculum in central Florida. These partners have contributed in all the required areas for a successful program. In additional to matching funds

for the grant, the partners have provided equipment for the local educational programs. They are also sharing important technical information that allows the educational programs to develop programs that have a more specific local focus. Finally, they are providing a variety of internship programs that are available for both faculty and students.

Summary

The Tech-4 Electronic Workforce Development System is a multi prong approach to solving the problem of recruiting and training a highly skilled work force for Florida's existing high technology industries and new industries that the state is actively recruiting. The lack of qualified high tech workers to support these industries has become critical across the country. With emphases on curriculum and instruction development, faculty development, and student recruitment the Tech 4 Grant effort hopes to ease this critical shortage in central Florida and provide a working model for other regions throughout the country.

MARILYN BARGER is an Associate in Research in the College of Engineering at the University of South Florida and a Professor of Advanced Manufacturing Technology at Hillsborough Community College, both is Tampa Florida. She is actively developing programs and curricula for Advanced Manufacturing Technology as well as multimedia educational materials for a NSF Advance Educational Technology initiative in Florida.

RICHARD GILBERT is a professor of Chemical Engineering at the University of South Florida in Tampa Florida. He is actively developing multimedia educational modules in context of a NSF technology initiative within the state of Florida. In addition, he has helped developed multimedia technical educational materials for Lucent Technologies Inc.

ANDREW HOFF has worked in microelectronics manufacturing for the past twenty years. He received the Ph.D. in Electrical Engineering from The Pennsylvania State University in 1988. Since 1988 he has worked at USF in Tampa, Florida in the Center for Microelectronics Research and is presently an Associate Professor of EE and Director of the College Metrology Laboratory. His research interests include the characterization and control of process related defects and contamination, plasma processing of materials, and process induced charging and associated damage in IC manufacturing.