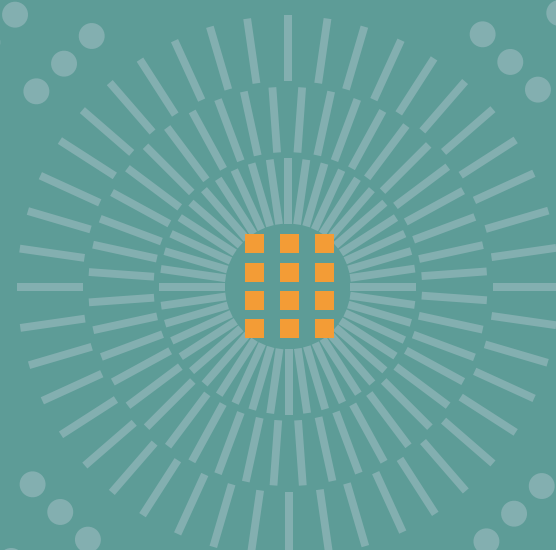


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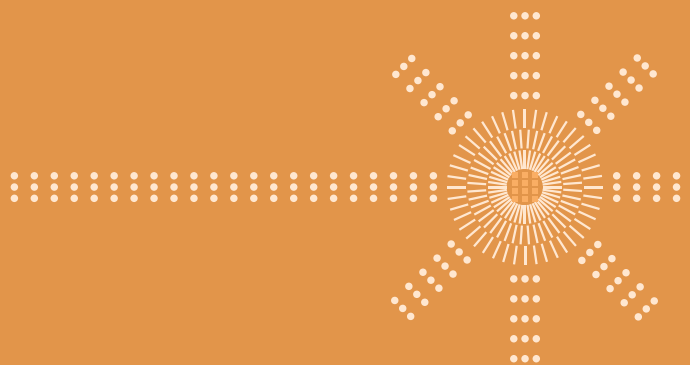
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INTRODUCTION

Innovative community college educators, with the support of Advanced Technological Education (ATE) grants from the National Science Foundation (NSF), are leading efforts to resolve the complex challenges of educating and training technicians in the United States. Their strategies vary by region and technical field, but all aim to increase the number of skilled technicians in advanced technology fields and to improve the productivity of American workers. The ATE program seeks to accomplish these goals by improving the technical skills and the general science, technology, engineering, and mathematics (STEM) preparation of technicians and the educators who prepare them. Given the intensity of global market competition, it is imperative that American technicians possess the high quality skills that power the nation's economy.

"Business and industry are demanding increased productivity per employee; multi-skilled employees who can change as the jobs change, and employees with core academic and workplace skills that come to work ready but adaptable and flexible. Companies tell us that they need employees they can send to training for a week every six months, not (for) six months every six months. Thus we have to prepare technicians with the core skills and knowledge that will allow them to learn and adapt," Elizabeth J. Teles said at a March 2004 gathering of community college presidents and their senior administrators whose institutions have ATE centers. Teles and Gerhard L. Salinger are NSF's co-lead program officers for ATE.

NSF awarded more than 600 grants for ATE projects and centers between 1993 and 2004. *Project grants* focus on specific aspects of technician education, and provide \$25,000 to \$300,000 per year for two to three years. The larger *center grants* fall into three categories: ATE Centers of Excellence with comprehensive national missions; ATE Regional Centers

INTRODUCTION

that focus on regional industry needs; and ATE Resource Centers that serve as clearinghouses of exemplary instructional materials, best practices, and professional development. Center grants may reach as high as \$5 million over four years. At the beginning of 2005, the ATE program had 249 active grants in 41 states, the District of Columbia, and Puerto Rico.¹

As the chief providers of technician education in the United States, community colleges have received the largest number of ATE grants. Community college administrators and faculty members who manage ATE programs, by design, lead team efforts that involve industry, business, government, and other education sectors. This comprehensive approach encourages information sharing and collaborative activities that cross academic disciplines and geographic boundaries. Among the most dynamic technical educators in the nation are the principal investigators and directors of the 31 ATE centers. These women and men are adept troubleshooters who work closely with local employers in their technical fields and with national companies or regional employers on industry-wide issues.

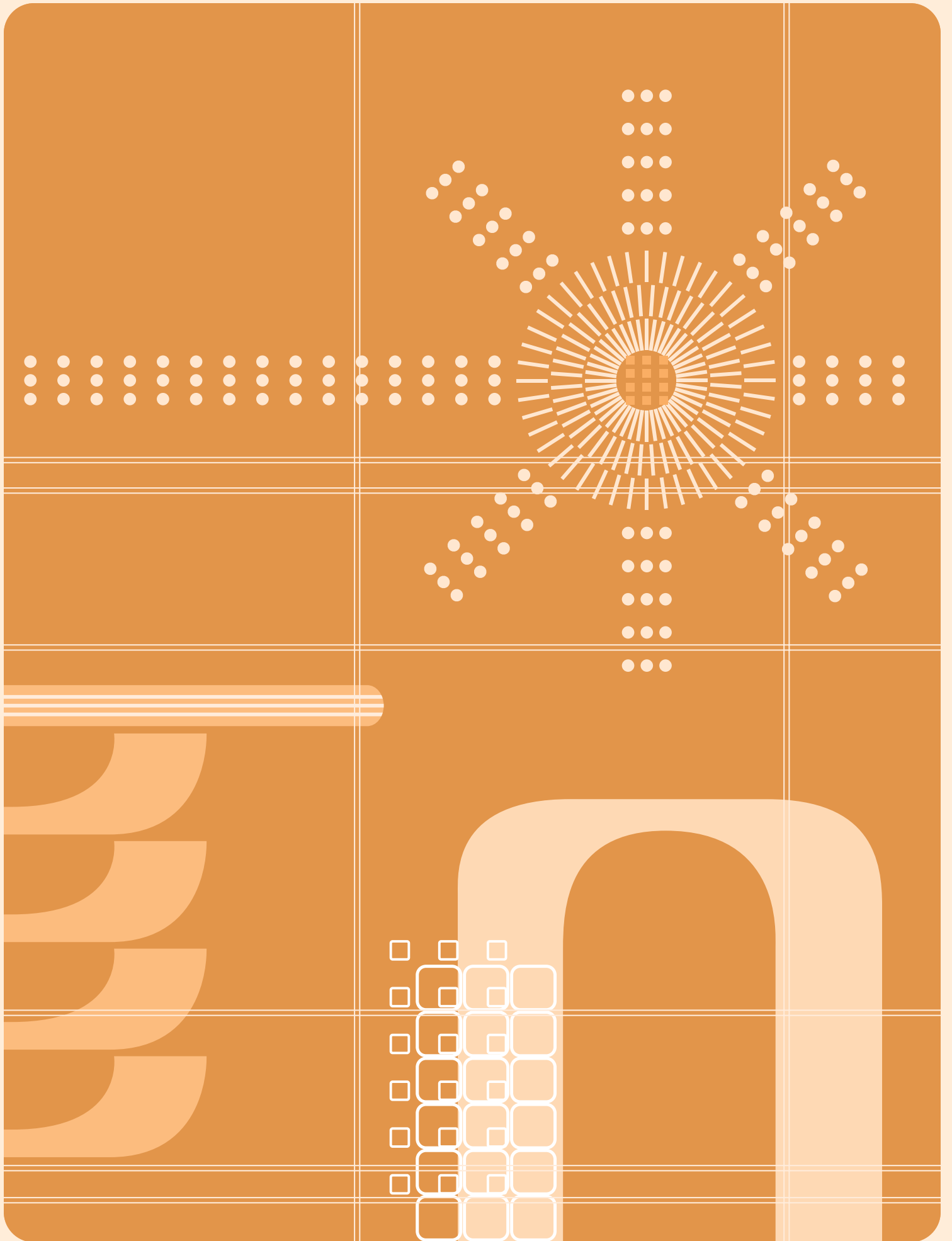
As a result of discussions at the March 2004 meeting of center principal investigators, their college presidents, and other senior administrators, the ten information technology (IT)-focused centers and the eight manufacturing-focused centers are pursuing joint activities. Several of the IT centers collaborated on a three-day Synergy conference in August 2004 in Nashville, Tenn., where 250 educators received help in developing plans to upgrade information technology programs on their campuses. Meanwhile, the manufacturing centers began a partnership with the Manufacturing Institute, the research and training arm of the National Association of Manufacturers (NAM), the largest industrial trade association in the United States. Together the ATE centers and the Manufacturing Institute hope to increase awareness of one another's needs and services.

¹ See National Science Foundation, Web site: <http://www.nsf.gov>.

The expansion of the centers' innovative activities has been cited by Arlen R. Gullickson, director of the Evaluation Center at Western Michigan University in Kalamazoo, Mich., and leader of the team of evaluators who have examined ATE's progress for NSF over several years. Gullickson describes the outstanding principal investigators as "solid entrepreneurs," and notes the centers' many curriculum products, their extensive industry and education partnerships, and their model articulation agreements as accomplishments.

NSF would like educators and employers to build on ATE's successes and leverage them for even greater benefits to maximize the taxpayer investment in the program and help U.S. employers remain competitive.

In this publication, ATE center leaders share with community college administrators, faculty, and other stakeholders what they have learned while carrying out their ATE grants. Although their experiences could fill volumes, each was asked to focus on a single activity. The various approaches they use, even when they encounter similar challenges, illustrate the efficacy of more than one solution. Together they provide promising strategies and tactics for developing faculty skills, cultivating partnerships, implementing new curricula, recruiting students, preparing for change, utilizing advisors, managing organizations, and nurturing leaders.



Faculty Development

Helping faculty members keep up with the rapid pace of technological changes in their fields is a constant challenge for community colleges nationwide. At the same time, economic pressure is increasing community college reliance on adjunct faculty members who possess technical expertise but may lack pedagogical background or teaching experience. The ATE program addresses both these needs. In fact, faculty development comprises the single largest category of activities pursued by ATE projects and centers.

ATE-funded programs “are training literally tens of thousands of faculty,” says Carl E. Hanssen, the ATE project manager at Western Michigan University’s Evaluation Center. Fifteen thousand educators, including community college faculty and secondary school teachers, received instruction through ATE programs in 2003 alone. In its analysis of business and industry perspectives of the ATE program, the Evaluation Center reports that successful community college-industry collaborations often hinge on the employer’s perception of an instructor’s skill in using new technologies.²

iTEC’s Professional Development Accommodates Faculty Needs

When it comes to faculty development “there is no one size fits all,” says Bob Williams, executive director and principal investigator for the Information Technology Education Center (iTEC) located at Daytona Beach Community College in Daytona Beach, Fla.

iTEC prepares Florida community college faculty to teach information technology (IT) with a “converged curriculum” that blends industry certifications and competency-based credit programs. It was created to address the challenge that instructors face in keeping up with the steady stream of innovations in IT programs and earning industry certifications while they are teaching.

iTEC’s staff is mindful that student employers are the ultimate customers for the center’s professional development services. Williams explains that

² See The Evaluation Center, Web site: <http://www.wmich.edu/evalctr/ate>.

TIPS FOR PROVIDING FACULTY DEVELOPMENT

- Provide corporate-quality professional instruction for IT faculty.
- Schedule courses for faculty member convenience.
- Design training facilities to accommodate all-day workshops.
- Incorporate information about how to teach new skills.
- Create networking opportunities for faculty to share best practices.
- Provide resources for faculty to use as they teach the new materials.
- Provide lab exercises and other instructional materials for faculty to use in their classrooms.

employers are the customers because “students have to have the credential to get hired, and teachers have to have the credential in order to prepare students.”

The corporate training design of iTEC’s facility allows faculty to work comfortably during eight-hour instructional sessions in the state-of-the-art IT lab. The course schedule also accommodates various faculty needs. Some courses are offered for a week during the semester, some are offered during semester breaks, and others are offered on successive weekends.

KITCenter Keeps Faculty Coming to Workshops

Positive word-of-mouth and emails that blanket faculty with information keep the Kentucky Information Technology Center’s (KITCenter) workshops filled with community college faculty and high school teachers from various disciplines, according to Lillie R.F. Crowley, one of the center’s co-principal investigators.

Approximately 2,000 people have attended 400 KITCenter faculty workshops since 2001. The KITCenter was created in part to help the Kentucky Community and Technical College System (KCTCS) access the professional development that the two-year college system’s leaders deemed essential to achieving a critical mass of IT-savvy educators.

The center’s multi-faceted delivery system includes instruction from a virtual center, mobile centers, KCTCS campuses, and a dedicated facility in Louisville. It offers AACCC/Microsoft Working Connections and Cisco Academy programs as well as workshops developed by the center’s staff.

Crowley thinks that good hospitality such as ample food, door prizes, and convenient locations create a welcoming atmosphere that sustains faculty interest and prompts them to encourage their colleagues to attend. “We’ve not had trouble recruiting,” she says.

The KITCenter initially focused on giving faculty basic IT skills. Now the center’s workshops focus on upgrading skills and teaching newer and more sophisticated programs. In his 2004 report, KITCenter Evaluator James Houglund wrote that the participation by instructors

and college personnel at the workshops “is invaluable because of their enhanced ability to support [other] instructors at their institutions. Follow up communication between workshop instructors and their students strongly suggest that at least 80 percent of the instructors enrolled in workshops are using the material in their instruction.”

AgrowKnowledge Increases Likelihood that Workshop Lessons Get Into Classrooms

Showing instructors how to use new technologies in ways that increase math and science knowledge is the goal of workshops offered by AgrowKnowledge, the National Center for Agriscience and Technology located at Kirkwood Community College in Cedar Rapids, Iowa. Just how to accomplish this has evolved over several years, says Terry Brase, principal investigator of AgrowKnowledge.

The center, with faculty partners from 16 colleges, taps instructors with expertise in particular technologies to lead workshops in locations that are convenient for participants. To increase the likelihood that new technologies will be used later in classrooms, AgrowKnowledge uses existing, high quality curriculum that faculty can readily access and keeps lectures to a minimum.

“The most successful workshops that we’ve held are the ones that are completely hands-on. They give them [participants] some content, but the majority of the workshop is a chance for them to use the technology, use some type of curriculum materials as they would be using them in the classroom, and then [develop] some type of action plan by which they tell us how they are going to integrate that into their home schools,” Brase says.

AgrowKnowledge prefers that educators attend workshops with their colleagues from the math, science, or agriculture departments of their community college or its feeder high school. “We specifically ask them to come as a team because, one, it helps the integration. If they have a team member there they can work together and it is more likely to be institutionalized or integrated into their programs. And, two, it provides a support to find some way of having somebody there close

TIPS FOR ATTRACTING FACULTY TO WORKSHOPS

- Offer workshops in different parts of the state, including cities and other locations that may attract people from rural colleges who like to get away.
- Provide incentives such as tote bags, snacks, or inexpensive door prizes to workshop participants.
- Provide lunch for workshop participants at the instruction site to minimize early departures.
- Save money by using dormitories for lodging rather than hotels for multi-day workshops.
- Schedule workshops for high school faculty on their professional development days rather than on Saturdays.
- Use email lists to circulate workshop information to faculty.

TIPS FOR TRANSFERRING WORKSHOP TECHNOLOGIES TO CLASSROOM PRACTICES

- Bring in expert instructors to lead workshops at convenient locations.
- Encourage faculty to attend as teams that include community college and high school faculty from different, but related disciplines.
- Conduct pre- and post-tests to determine participant understanding of a concept.
- Make workshops hands-on.
- Use the best curriculum materials available from commercial and other sources.
- Require participants to plan how they will integrate workshop information in their courses.
- Follow up with participants six to 12 months afterward about their implementation plans.

that they can call and ask, 'Now, how did we do that?'" Brase says.

AgrowKnowledge conducts pre- and post-testing to identify a participant's understanding of various concepts. It also surveys participants several months following the workshops for further feedback.

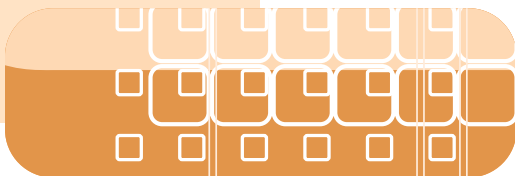
Acquiring Teamwork Skills Is Important First Step for Multi-Discipline Teams

To develop multi-functional technicians, the New Jersey Center for Advanced Technological Education (NJCATE) based at Middlesex County College in Edison, N.J., decided that faculty from multiple disciplines needed to develop a curriculum together and implement it as a team.

Restructuring classrooms into studios, as the center did, to accommodate combined lectures and laboratories was easy compared with the dynamics of restructuring technician instruction. Working as a multi-discipline team requires a level of cooperation and interaction not typically found on campuses. For a multi-discipline team to be successful everyone has "got to be on board," says Jack Waintraub, principal investigator of NJCATE.

The first thing the center did with the math, science, engineering, and communications faculty members who participated at Middlesex County College was to teach them, and the university professors and high school instructors who joined the team, how to work together.

The team was then led through professional development enhancement activities so they could create a "competency-based curriculum with just-in-time delivery." All the team members did research on the knowledge and skills that technicians should have. Though it took more time, it was important for the non-technical faculty to be involved in conversations with industry people. "Suddenly we had a common language among all the members of the curriculum team. And a new understanding among the members of the team of what it is that will be required of their discipline to educate this technician," Waintraub explains.



By the time the team settled on the competencies they wanted students to learn, everyone on the team understood the role of technicians. “It took two years to create the model and the curriculum, but when we were done with it we were confident that we had something that’s different, that’s out of the box so to speak,” Waintraub says of the projects-based instructional modules the team developed.

Externships Reinvigorate Faculty Skills in New Technologies

The Regional Center for Next Generation Manufacturing (RCNGM) at the Connecticut College of Technology in New Britain, Conn., uses externships for faculty members to learn about new manufacturing technologies like lasers, fuel cells, and biotechnology. With this “applied knowledge,” they are revamping the state’s secondary and post-secondary technical curriculum to add the skills that high tech employers need.

“A lot of our technical faculty have been out of industry for awhile,” says Karen Wosczyzna-Birch, principal investigator of RCNGM. The externships give faculty members two weeks in an industry setting for two consecutive summers.

The externships have invigorated the 45 community college and technical high school faculty members who participated during a pilot study and the first two years of an ATE project grant, which Connecticut’s College of Technology received before its ATE center grant in 2004.

Industry personnel have also gained new insights about higher education and faculty activities from the long conversations that are possible during the externships. Mentoring relationships have started between industry personnel and faculty. A biotechnology company even donated equipment to the college where its faculty extern teaches.

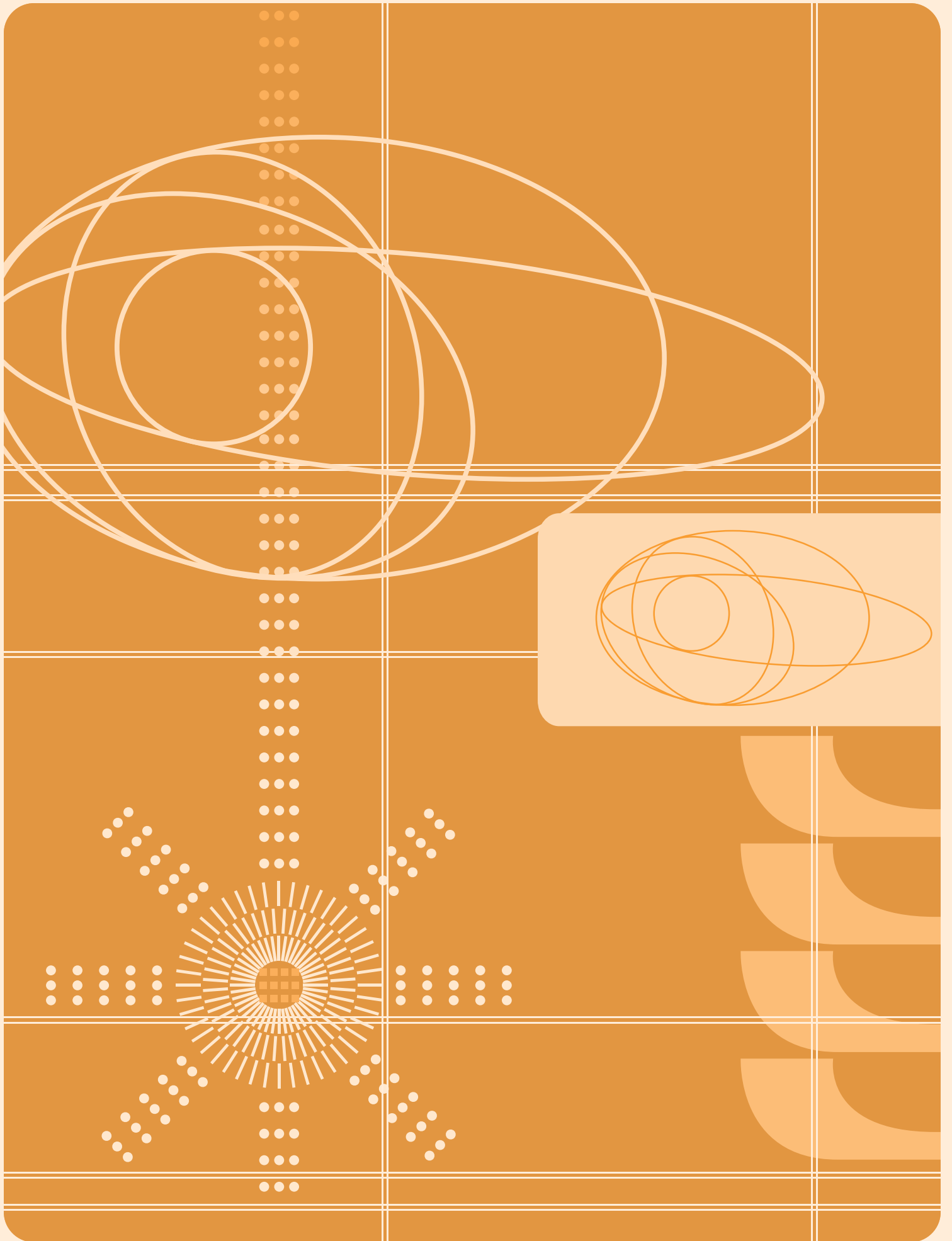
“It was a real win-win for both sides,” Wosczyzna-Birch says. Faculty members get the new skills to improve their instruction; employers get better prepared technicians.

TIPS FOR STARTING MULTI-DISCIPLINE TEACHING TEAMS FOR TECHNICIANS

- Provide plenty of release time for people to work together on curriculum.
- Coach faculty on teamwork skills.
- Provide professional development to boost faculty understanding of the role of other disciplines in technician preparation.
- Dispatch team members for face-to-face meetings with employers where they can see technicians at work.
- Make sure all team members understand what employers expect technicians to do.
- Jointly establish student outcomes for curriculum in all subjects.

TIPS FOR CREATING FACULTY EXTERNSHIPS

- Request that faculty rank their top three externship interests.
- Find industry placements to match faculty interests.
- Ask a respected business or industry organization leader to make contacts with industry for externship placements.
- Provide faculty stipends, payable upon completion of the externship and other requirements.
- Require participants to develop a curriculum addition or revision based on their externship experience.
- Make using the new curriculum and reporting results a requisite for externship faculty.
- Post the new curriculum on a Web site for others to use.



Partnerships

Every community college wants partners from business, industry, government, and other educational institutions. Theoretically, dividing work among more people lessens the burden. In reality, working with partners is a complicated endeavor that requires attention to other interests and the care and nurture of relationships. In places where formal legal partnerships between public institutions and the private sector are restricted, collaborative activities may take the form of informal alliances. In this publication, all mutually beneficial activities between employers and educational institutions are referred to as partnerships.

NSF requires that partnerships be in place before an ATE grant is awarded. The strength and scope of ATE center partnerships contribute significantly to their individual and collective success. As the Evaluation Center at Western Michigan University reports, “The ATE program does appear substantially stronger than non-ATE programs in producing fruitful collaborative relationships.”³

NCME Builds Strategic Partnerships

“Find the need and endeavor to meet it,” is not just a catch phrase at Sinclair Community College in Dayton, Ohio. It is a guiding principle for the college’s many partnerships with four-year institutions, secondary schools, other community colleges, as well as business and industry.

Sinclair looks for partners that have the skills it lacks, and then offers to provide something from its strengths. “We look for a partner that has strength in an area that we do not. So if we know we need someone with a great curriculum development history and skills, then we look for a partner who can provide that for



³ See The Evaluation Center, Web site: <http://www.wmich.edu/evalctr/ate>.

TIPS FOR BUILDING STRATEGIC PARTNERSHIPS

- Adopt a flexible attitude.
- Look for a partner with strength in an area in which your institution is weak.
- Offer assistance to the partner from your college's strengths.
- Define clearly the advantages of collaboration, such as access to cutting-edge curricula and materials.
- Delineate the investments, monetary, and in-kind contributions that partners will make.
- Set timeframes with closure dates, such as two years with an option to renew for two more years.
- Develop "alliances" as alternatives for colleges with legal limitations on partnerships.
- When necessary, make partners sub-awardees of a grant to pay for their work.

us," explains Monica Pfarr, director of the National Center for Manufacturing Education (NCME) at Sinclair.

"It's especially effective if you have some grant funding and you can provide something financially for them," she says. According to Pfarr the overture to a prospective community college partner goes something like, "'Here are the strengths that we have.' or 'How much would it cost? Would you like to be a subcontractor on our grant?'"

However, Pfarr explains that the partnership overture does not always involve financial remuneration. Sinclair personnel have mentored colleges, helped write grants, and reorganized engineering technology departments in exchange for a college's assistance on projects. "For us there's always that something else we can provide for them in return. So that becomes a win-win situation for both of us," she says.

Pfarr advises community college leaders to consider what expertise they have to offer when they seek partnerships with business and industry too. "We have gone in and said, 'In exchange for helping us we'll send our [faculty] consultants and we'll teach your employees about lean manufacturing techniques, and help implement more efficient processes so you can increase your bottom line.'"

ATEEC and MIT Point Out Criterion 2 Opportunities

The National Science Foundation's (NSF) Criterion 2 gives community colleges an exceptional opportunity to collaborate with university researchers, according to Ellen Kabat Lensch.

Kabat Lensch is the principal investigator of the Advanced Technology Environmental Education Center (ATEEC) in the Eastern Iowa Community College District in Bettendorf, Iowa. Since 2001, ATEEC has had a successful partnership with the Massachusetts Institute of Technology's Laboratory for Energy and the Environment (MIT/LFEE) in Cambridge, Mass.

Criterion 2 is the part of NSF's grant application that asks researchers to explain the broad social impact of their proposals. Since it was added in 2002, NSF reviewers have considered not just the intellectual merit of proposals but how the research will be used, how it will be made known to educators and other citizens, and how it will be integrated in classroom instruction. "We feel that community colleges are the excellent conduit for that [integration of research and education] to take place," Kabat Lensch says.

Amanda Graham, an education program coordinator who is part of the MIT/LFEE team, encourages community college educators to highlight how their understanding of classroom and workplace applications can help researchers shape their inquiry questions and meet the requirements of Criterion 2. "The more researchers can see the benefits of this kind of collaboration to them, in terms of helping them to refine their questions, to have an audience that is informed by current developments in the workplace," she says, "the more likely they are to participate."

The ATEEC-MIT/LFEE partnership, which has been supported by NSF with ATE grants, has produced a publication on critical environmental issues, multimedia modules that use MIT environmental research for community college and high school courses, and a report on the lessons learned from their ongoing collaboration.

"One of the most exciting things was for some of our faculty to intermix with MIT faculty, and for them to find out they cared about the same things, to hear what they are working on and the things they are developing," Kabat Lensch says.

Despite the challenges of working a thousand miles apart in different academic settings, no one in the partnership wavered from the goal of immersing environmental technician education with current research. Kabat Lensch explains, "We wanted to make sure it was good science getting into the hands of people."

TIPS FOR WORKING WITH UNIVERSITY RESEARCHERS

- **Share the same primary goal for the project, and make a detailed plan.**
- **Obtain high-level commitments from both institutions for the collaboration.**
- **Allow extra time to understand each other's views and to build trust.**
- **Budget for multiple face-to-face meetings; do not rely solely on email and phone.**
- **Write summaries of decisions immediately after meetings and phone conversations, and share these summaries to minimize misunderstandings.**



TIPS FOR WORKING WITH INDUSTRY

- Develop collaborative leadership to identify goals and to solve problems.
- Use existing industry associations to connect with employers.
- Pick key partners among industry associations carefully and well in advance of launching activities.
- Place key partners on a steering committee that serves as a catalyst for activities by various stakeholders.
- Invite association leaders to provide input on letters of introduction to employers and to issue press releases about the partnership.
- Write a brief feature story about the initiative that highlights the association's support of education and submit it for inclusion in the association's annual report.
- Investigate options for exhibiting at industry trade shows.
- Consider offering discounts on the initiative's products or services to association members.

Working with Industry Associations Helps TIME Center Reach Businesses

Early on, the planners of the Technology and Innovation in Manufacturing Education (TIME) Center at the Community College of Baltimore County in Catonsville, Md., decided to seek partnerships with several existing industry associations rather than individual employers.

"We don't want to pick you off one by one. We want to go to your industry association and say here is what we need from you," TIME Center Principal Investigator and Director Dennis Faber says of the center's indirect overture to employers. Working through the associations gave the center a way into more manufacturing companies than it could have contacted effectively on its own and added credibility to its activities.

"In addition, the steering committee that we put together has some of the key decision makers from the various stakeholder associations or agencies that deal with manufacturing," Faber says.

Consequently, the TIME Center has become a catalyst for collaborations among industry associations, employers, and government agencies that previously did not work well together. Faber explains, "We've created a forum where some of those obstacles to cooperation can be processed and dealt with in a positive way."

To get started, center personnel did not try to figure out why people "were not playing well together," he says. They simply brought everyone together for a meeting where they laid out the opportunity to improve manufacturing that would come from obtaining an ATE grant, and said they would write the grant application if everyone agreed to cooperate.

After one year of operation, the center's strategy is paying dividends that are evident in enrollment growth, new partnerships, and new excitement about manufacturing in Maryland. The state is the focus of the center's development of regional skills standards, faculty enhancement activities, marketing to improve the image of manufacturing, and Internet dissemination of career pathways for manufacturing technicians. The center has been helped by the new governor's vocal support of manufacturing and a statewide commission manufacturing report.

Nevertheless, Jim Rogers, TIME Center assistant director, says the center's identification of shared goals and emphasis on collective problem solving makes an important difference in outcomes. "When you put a team together you have a common goal. When you have a common passion for solving [a problem], it will get solved."

(npt)² Offers Compelling Scholarship-Internship-Jobs Model

By combining corporate scholarships with internships and jobs, the National Network for Pulp and Paper Technology Training Center (npt)² at Alabama Southern Community College in Monroeville, Ala., recruits students and engages companies in the education of those students.

"It's a real significant workforce model for the whole country, but particularly for rural America where you have to 'home grow' your own (technicians)," says Randy Parker, principal investigator and director of (npt)². During 2005, the center plans to increase the number of scholarship students in the program from 30 to 50, and the number of corporate sponsors from six to 10.

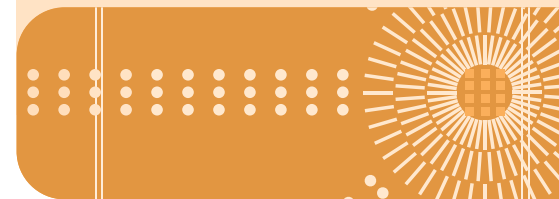
Students enrolling in the two-year Pulp and Paper Technician and Operator program must apply for the \$3,400 per year scholarships that cover tuition, books, fees, and supplies. The sponsoring companies have representatives on the scholarship selection committees. "They are involved from the get-go," Parker says, adding that the companies also provide input on the curriculum. "It's not just a one-shot deal."

The students work for six to 10 weeks in the summer as paid interns at the companies that sponsor their scholarships. During the internships, the college's division director is in touch with human resources personnel or site supervisors of the companies.

Though there is no guarantee of employment, most students are hired upon graduation by the companies that sponsored their scholarships or at another company in the (npt)² partnership. Their starting wages are typically \$30,000 per year in an area where the median household income is \$29,000.

TIPS FOR ESTABLISHING A SCHOLARSHIP-INTERNSHIP-JOBS PROGRAM

- **Make sure graduate technicians are highly qualified.**
- **Involve industry in curriculum development.**
- **Recruit key company employees for advisory panels and scholarship committees.**
- **Facilitate contact between employers and students.**
- **Follow up with employers regarding work performance of interns and graduates.**
- **Use this feedback to improve the program.**



“It’s a major commitment from the local companies,” Parker says, explaining that corporations are willing to make the investment because the process technician graduates’ skills equal those of operators with 10 years of experience. “They are getting a very high quality product.”

Nanofabrication Center Builds Cooperation Across Higher Education Sectors

Pennsylvania’s Nanofabrication Manufacturing Technology (NMT) Partnership is the first successful collaboration that includes every sector of public higher education in the commonwealth. In truth, it was the first ever attempted. Prior to the formation of the NMT Partnership in the late 1990s, Pennsylvania, like many states, did not enjoy much cooperation and had little communication between sectors or even between institutions.

“It’s a good marriage. Everybody brings something that’s needed,” says Paul M. Hallacher. He is the research program development director at Pennsylvania State University in University Park, Pa., and director of the ATE regional center.

Initially, there was “a lot of suspicion to overcome” when Stephen J. Fonash suggested that the flagship university develop a technician curriculum with community colleges. Fonash, a tenured professor, leads Pennsylvania State’s Nanofabrication Manufacturing Facility and is a national nanotechnology leader. “He has the authority to go out and find money and do what he wants,” Hallacher says.

Given this experience, Hallacher explains that it is critical for community colleges to have a powerful faculty member or administrator as an ally when they seek partnerships at research universities. Community college leaders should come with compelling reasons for the research institution to get involved. If possible, they should identify in advance how their institutions can help universities demonstrate the benefit of research activities.

Universities, like community colleges, are always looking for money. “The glue that holds an alliance together is money,”

Hallacher says, adding that whenever possible a partnership should split funds equally.

However, Hallacher notes that institutional financial interests are not the sole motivation for the NMT Partnership and the center's activities. As an example of their collaboration, he points to the unanimous decision of all 14 NMT partner community colleges to redirect \$600,000 in state money, which they usually share, to the four-year universities for lab kits. The universities, which make up the Pennsylvania State System of Higher Education, are in the process of creating nanotech labs where students can execute experiments that do not require clean rooms. "It was not a hard sell," Hallacher says of his pitch to shift the funds, because of the trust developed during six years of working together. All of the NMT partners agree that the next step in achieving their goal to expand nanofabrication education in Pennsylvania is to open the university labs and put the kits in the hands of the students in those labs.

Colleges Need Not Fear Big Institutional Partners

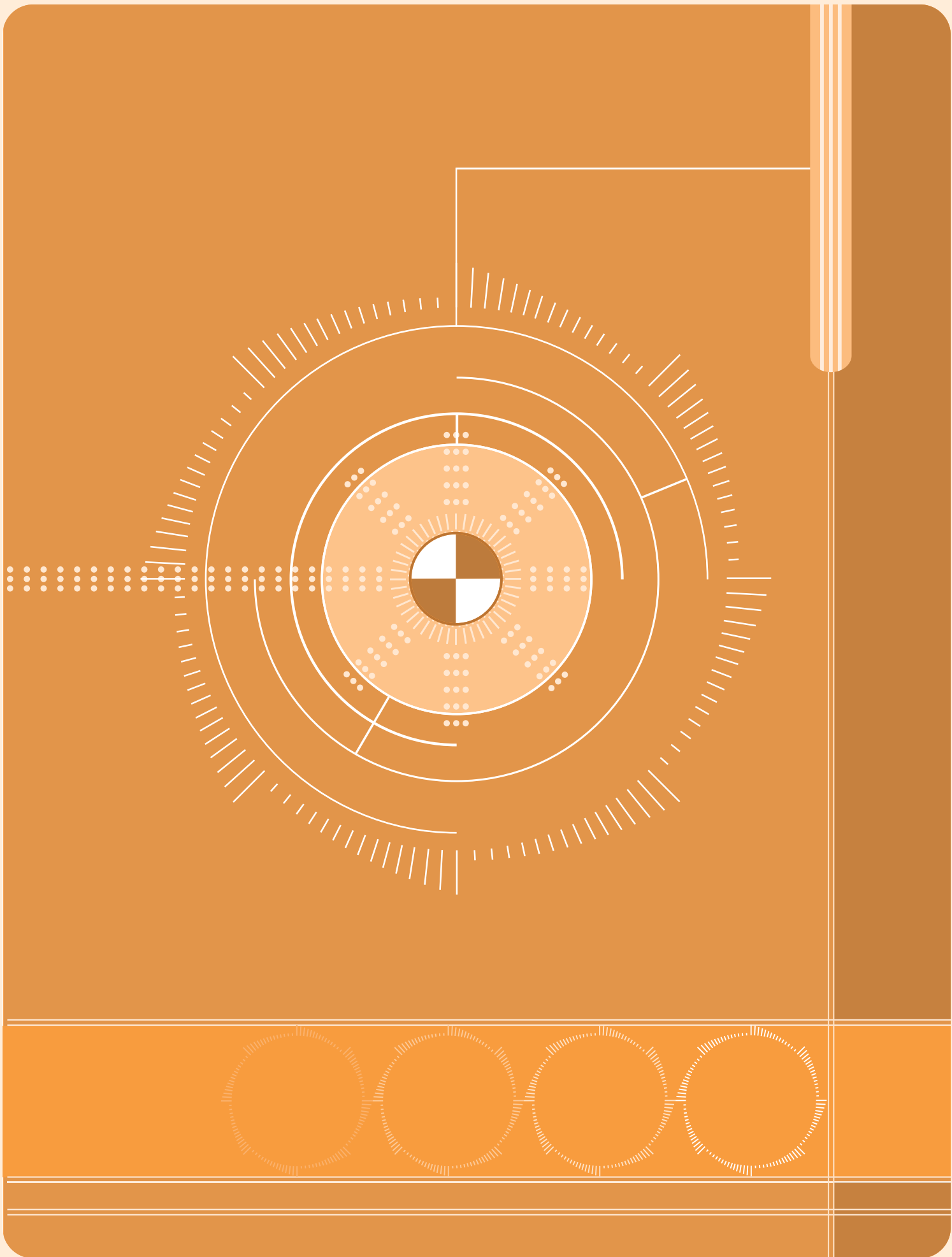
Ann Beheler, principal investigator of the Regional Convergence Technology Center (CTC) at Collin County Community College in Frisco, Texas, encourages suburban or rural colleges to collaborate with larger metropolitan community colleges. "Don't be intimidated by a bigger district. Large districts welcome the opportunity to collaborate, and they do not necessarily have to drive the effort," she says.

CTC evolved from two previous ATE grants in which the younger, suburban Collin County district partnered with the older, massive college districts in metropolitan Dallas and Tarrant counties. "With a strong enough idea, you can be a leading force with partners of any size. You may think this is a risk, but the bigger risk is the missed opportunity if you don't expand your reach throughout the region."

She and her co-principal investigators from Dallas and Tarrant work together as a team. "It's professionally stimulating and satisfying, and I think we are getting quite a bit done in a very short time period," she says.

TIPS FOR WORKING WITH MULTIPLE OR LARGE INSTITUTIONS

- Define and focus upon a single, paramount goal.
- Identify how partners will contribute.
- Set clear expectations for participation from all partners.
- Establish boundaries and treat all partners with respect.
- Create a governance structure that works.
- Communicate directly with partners at group meetings and at campus visits.
- Disburse funds equally whenever possible.



Curriculum

Developing instructional materials for technology programs and keeping them up-to-date is a large challenge facing the nation's community colleges. Curriculum materials must be amended often to keep up with the addition of new equipment and changing processes in high tech workplaces, and changes often vary from region to region within the same field. The high cost of developing curriculum materials coupled with the relatively small audience for such materials also limits commercial publishing interest in new textbooks for technicians. As for individual colleges publishing their own texts, the cost in human and material resources is prohibitive.

Several ATE centers are addressing the national need for current, high quality technical education materials by placing interactive lessons and experiments on the Internet. This format saves money on paper and ink, and allows for frequent modifications of the content to match changes within the industry.

NCTT Uses Innovative Curriculum Delivery

The National Center for Telecommunication Technologies (NCTT) at Springfield Technical Community College in Springfield, Mass., has launched two Web-based innovations to disseminate its industry-driven curriculum materials.

These efforts build on the solid, but more traditionally delivered curricula that NCTT's leaders have written in textbooks, have taught at workshops, and have relayed in face-to-face consultations with community college educators around the country.

In 2004, NCTT launched two Web-based initiatives to make up-to-date curriculum materials available to telecommunications technicians, educators, and employers. The first is its Digital Library, which offers free curriculum materials and uses the open source information exchange of the Linux operating system as its model. The second is NCTT's online certification assessment tool, known as TECHwize Solutions, which is fee-based.

The center and its eight regional partners broadly define network infrastructure technicians as anyone who installs, manages, and maintains network mediums, the interconnecting hardware, the software that manages the flow of traffic, and the end devices through which traffic is initiated and received.

When the center began in 1997, it focused on the traditional telecommunication service provider's need for technicians. As NCTT Principal Investigator Gordon Snyder explains, the center now addresses how various industries use technicians to maintain internal and external networks.

The Digital Library's open source curricula allow technicians and educators to tap instructional materials from various sources at no cost. Users can download materials on specific topics or for entire courses. The open nature of the Digital Library allows users to obtain current educational information, which NCTT checks for accuracy. Recently, market forces have led to a convergence of telecommunications technologies and information technology that is reflected in the curriculum materials available from NCTT.

TECHwize addresses the need for individuals and employers to identify skill and knowledge areas that need improvement. The assessment questions are randomly chosen from a database of 600 items written by field experts who utilized validated skill standards. When



users make mistakes on the assessment, they are given links to study guides. Snyder expects employers to use TECHwize to identify areas for retraining. The strategic alliance that created TECHwize blends the content knowledge of NCTT's personnel with the expertise in skill standards testing and statistics of the Global Skills Exchange, a company that grew out of the National Skill Standards Board.

NDT Web Site Instructs Students and Incumbent Workers

One million Internet visitors have used the Nondestructive Testing Resource (NDT) Center's Web site since its launch in March 2002. The NDT Center, a university-industry research cooperative, is located at Iowa State University in Ames, Iowa. Its Web site usage climbs every month. In October 2004, the site had 84,700 hits of which 54,000 were from unique visitors.

The Web site was created in collaboration with community college faculty who teach non-destructive testing techniques. They told center staffers they needed good science and technology-rich instructional materials that could keep up with industry trends. "We definitely want to do computer-based [materials] because we thought things were changing so rapidly, we wanted to be able to update," Brian Larson, a researcher and project manager at the NDT Center, explains.

From the email addresses of visitors and the Web site's feedback center, staffers have concluded that a significant number of users are veteran NDT technicians who access the Web site to refresh their skills and learn about high tech advances. "The whole idea of continuous learning is pretty solid in this technology sector," Larson explains. Prior to the resource center Web site, educational materials for nondestructive testing fell at two extremes of the spectrum: they were either very basic manuals or advanced research

TIPS FOR PUTTING CURRICULA ON THE INTERNET

- Check curriculum materials for accuracy.
- Tap into content knowledge of industry partners.
- Assign one well-organized, knowledgeable person responsible for keeping the Web site and Internet materials current.
- Display prominently the minimum and desired hardware and browser requirements with clear definitions of required plug-ins.
- Tie a simple set of questions to access, such as college identification, to help track use and provide impact data.
- Create a "Faculty Only" area and populate it with teaching tools.
- Provide clear, concise instructions that guide users through the course.
- Offer practice questions and exercises frequently.
- Provide a PDF-formatted workbook or notes that give students a take away activity book.

reports. "There wasn't anything in the middle. We clearly had a niche to fill," Larson says.

The researchers worked with graphic design and engineering students to make the Web site lessons interactive and the animation engaging. On average, visitors make 18 clicks while at the NDT Web site. According to Larson, this is indicative of people using the applets and other interactive tasks built into the Web site's lessons.

When the Web site was up and running, Larson and others who contributed to its content wrote about it for professional journals and made presentations about it at industry and educator conferences. The center also publicized the Web site with paid advertisements in key NDT publications.

MATEC Ventures Toward Sustainability

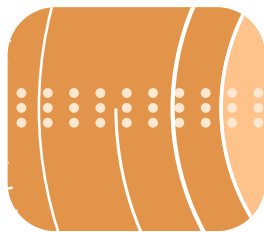
The Maricopa Advanced Technological Education Center (MATEC) at Maricopa Community College in Tempe, Ariz., continues its entrepreneurial ways with an online education provider and its own membership organization.

In 2004, six MATEC courses were launched on SemiZone, an online resource for semi-conductor industry education, which is affiliated with the Stanford University Center for Professional Development in Palo Alto, Calif. The agreement with SemiZone pays MATEC a royalty for each person who takes one of MATEC's courses.

Previously MATEC sold most of its curriculum materials directly to educators at a discounted price and to industry through its own Web site. MATEC will continue to offer these materials through its Web site, but hopes that by converting and revising the materials for

individuals that it will reach a vast, untapped market of veteran semi-conductor technicians.

"We've tried to make our stuff as interactive as we can. We have learning games in there. We



have video clips. We have everything to increase interactivity rather than just a page-turner Web site,” says Michael Lesiecki, principal investigator of MATEC.

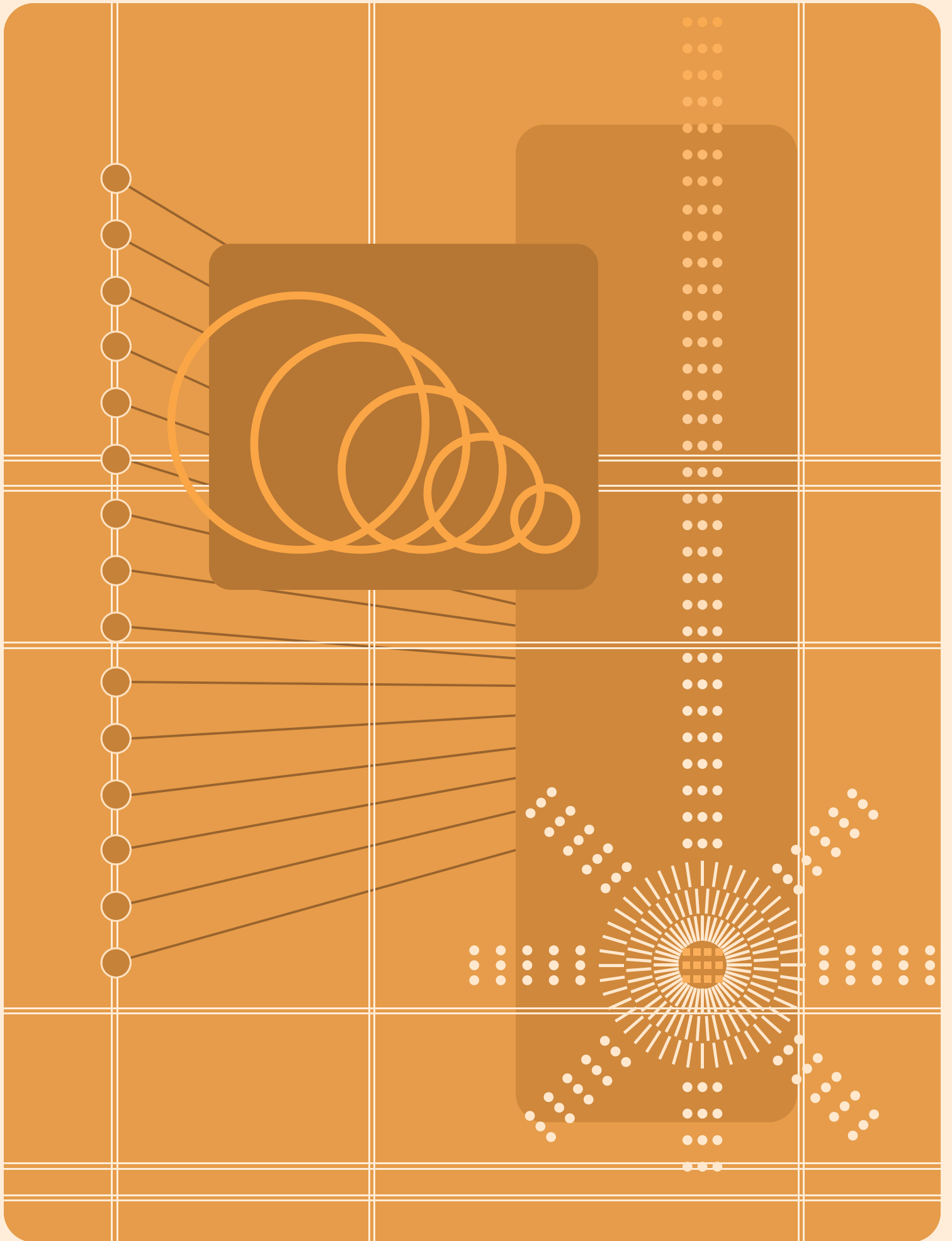
MATEC has also developed a membership organization as a vehicle for disseminating innovative curriculum and other products it developed with industry and its education partners. MATEC’s Academic Membership Program generated \$100,000 in 2004, about 10 percent of the center’s annual budget.

Lesiecki thinks that the community colleges and high schools that participate in the membership program “are getting the leveraged results of a larger effort.” When he makes his case with potential members, Lesiecki explains that no individual school with only its own resources could develop what MATEC offers from its partnership with industry and other colleges. “Even if they had the time and the money, they probably would not have the faculty to do it,” he says. Some companies have purchased memberships for colleges and high schools, and Lesiecki plans to increase memberships by taking representatives of community colleges that wish to participate in the program along with him for meetings with employers.



TIPS FOR CREATING AN EFFECTIVE EDUCATIONAL WEB SITE

- **Identify the needs a Web site will address.**
- **Have a clear vision of how the Web site will achieve those goals.**
- **Invest in the graphic design of the Web site, as well as text content.**
- **Organize the Web site for easy navigation by users.**
- **Use a secure Web site for collaborators to view drafts of Web pages and suggest revisions.**
- **Publicize the Web site through academic journal articles, paid advertisements, and conference presentations.**



Change

Preparing for the future rarely tops an administrative agenda when keeping up with technological changes and dealing with financial constraints at community colleges are everyday imperatives. Without vision and goals, however, people in any setting can become beset by the challenges that crop up each day. Given the diverse needs of students, employees, and the community, planning for long-term goals is a priority for community college administrators and faculty.

The principal investigators of ATE centers are adept at multi-tasking and balancing immediate needs with long-range goals. In addition to directing the daily operations of their centers, they are expected to know what is going on in their technical fields and accurately gauge where that field is moving, nationally and locally. Well-tuned perceptiveness, flexibility, and stamina characterize their efforts as change agents.

SCME Principal Investigator Moonlights at National Laboratory

Microsystems, also known as Micro Electro Mechanical Systems (MEMS), are so new that the activities of the Southwest Center for Microsystems Education (SCME) at Albuquerque TVI Community College (TVI) in Albuquerque, N.M., have preceded statewide economic development initiatives in this field.

Riding the leading edge of an emerging technology wave is exhilarating for SCME's Principal Investigator Matthias Pleil. It is also a bit scary, Pleil explains. With so many things happening in the field and so many emerging uses for MEMS, there is a lot of uncertainty. However, decisions at SCME about how best to prepare technicians and establish skill standards cannot wait while the marketplace sorts itself out.

The center's primary partner, the Sandia National Laboratories in New Mexico helps in two big ways. The first is that Sandia keeps Pleil in the information loop by employing him part-time. Pleil works Fridays in a characterization laboratory at Sandia with two other scientists. He teaches at TVI Monday through Thursday.

TIPS FOR KEEPING UP ON NEW TECHNOLOGIES

- Obtain a summer or part-time position at a research laboratory.
- Use laboratory workplace opportunities to talk positively about community college programs.
- Borrow an industry or government executive, or participate in an exchange program.
- Establish a collaborative relationship with a research university and its students.
- Place students in internships with leading-edge employers.
- Recruit key industry, business, government, and university laboratory representatives for advisory boards.

In addition to the steady supply of MEMS educational materials and experiences at the national lab, Pleil uses his weekly workday there to talk up the Microsystems technician program, find student internship opportunities, and recruit guest speakers and SCME advisers. “I try to sell our program,” Pleil says.

The second way that Sandia is assisting NCME is by lending one of its experienced managers to help get the center started. Al West, who has been Sandia’s director of environment, safety, and health in New Mexico, will serve as SCME’s executive director for two years. The national laboratory wants the center to succeed and is lending West to assist in that effort. “There are big savings for a lab that can hire students who know MEMS,” West explains.

CSSIA Survey Results Shape Curriculum

To create a model information security curriculum, the advisors and partners of the Center of Systems Security and Information Assurance (CSSIA) located at Moraine Valley Community College in Palos Hills, Ill., agreed they needed to ask Great Lakes employers what skills they want in information security technicians.

The Research and Planning Office at Moraine Valley Community College developed the survey instrument with significant input from the center’s seven partner community colleges.

“It’s not something we created overnight,” says Erich Spengler, CSSIA’s principal investigator. Survey questions were piloted through advisory board members from the colleges who were subsequently enlisted to help distribute the survey in five states.

Though there were no big surprises among the survey responses, Spengler notes that they quantified information security job growth in the region and confirmed the community college role in the information assurance field. Most importantly the survey influenced the center’s curriculum and activities. “It gave us a roadmap for the center,” he says.

The National Security Agency announced in fall 2004 that the Moraine Valley Information Assurance program that serves as the basis of the center’s curriculum “maps” to its standards and those of the U.S. Department of Defense. This designation was previously granted only to

university programs, and is akin to a federal stamp of approval for an information security education program and its graduates.

For community colleges that adopt the CSSIA curriculum, attaining the mapping designation from the NSA should be a simpler process. “It builds credibility for the community college programs that we haven’t had before,” Spengler says. “We feel this is a huge bonus.”

CREATE Responds to Funding Cuts with Hybrid

When financial cuts hit public higher education, the California Regional Consortium for Engineering Advances in Technological Education (CREATE) headquartered at College of the Canyons in Santa Clarita, Calif., was unwilling to let its Industrial Technology bachelor’s degree program become a casualty.

“I didn’t want to let this die because we still had the need for those bachelor’s degrees,” says Kathleen Alfano, principal investigator of CREATE. Her team from seven community colleges had worked for several years with colleagues at the Fresno State University in Fresno, Calif., to establish articulation agreements for the ABET-accredited program.

Faced with the reality that neither the university nor the community colleges had funds to sustain the program as envisioned, the team came up with a hybrid that combines distance learning and in-person instruction. Most of the classroom instruction was converted to a Web-based format.

Associate degree graduates who want to continue in industrial technology now take 90 percent of their courses online. In traffic-jammed California, the students have to commute to Fresno State for only seven Saturdays of classroom instruction during the two years it takes to complete the hybrid baccalaureate degree. In person and virtual meetings help keep students connected with their peers and faculty members.

How CAPT Gets Things Done

Joanna Kile, principal investigator for the Center for the Advancement of Process Technology (CAPT), has a system for identifying and responding to the concerns of her center partners.

CAPT, which is located at the College of the Mainland in Texas City, Texas, has an annual Critical Issues and Best Practices Conference.

TIPS FOR SURVEYING WORKFORCE NEEDS

- Enlist college or university institutional researchers to create the survey instrument.
- Include industries and industry associations in the survey design process and distribution plans.
- Pilot survey questions with advisory board members and colleagues at partner institutions.
- Partner with other community colleges and industry organizations to distribute surveys regionally.
- Analyze results and employ them when planning activities.
- Offer guided workshops at colleges on how to use and implement survey results.
- Seek local sponsors, such as utility companies, that wish to play a role in community economic development and give them high visibility.

TIPS FOR DEVELOPING HYBRID DEGREE PROGRAMS

- Ensure that community college courses meet accreditation standards.
- Align community college courses with university curriculum.
- Develop interactive Web-based instruction.
- Provide opportunities for students to connect with classmates and instructors.
- Work with student services personnel to ensure equitable services for online students.

TIPS FOR ADDRESSING CHANGE AMONG PARTNERS

- Allow for time to hear requests from partners.
- Listen carefully to various alternatives for addressing the needs identified by partners.
- Pick the best solution and move forward.
- Encourage volunteers to focus on the task.
- Respond with an activity or product in a timely manner.
- Check with partners to see if the activity or product meets their needs.
- Refine the activity or product based on feedback.

Each year, Kile leads a discussion with the 150 people who represent CAPT's education, industry, and government partners. The discussion topic is simple: what would the partners like the center to do in addition to the activities already on CAPT's agenda?

To ensure that everyone gets a say, participants type their responses on a computer system, which projects them on to a large screen for all to see. At the 2003 meeting, improving local advisory committees and student recruitment were the most frequently listed needs.

"So we went out and found what others thought. We had no definition of best practice, but we had others give us what they thought were their best practices," Kile says. CAPT staffers compiled these best practices for the center's Web site and included how-to guidelines with all the "nuts and bolts" to accomplish particular tasks.

At the 2004 conference, the partners were asked to comment on the how-to guides. Several colleges also agreed to evaluate the materials with employers, students, and other stakeholders. Their suggestions will be used to revise the online materials.

Mike Gragg of Dow Chemical serves on the center's national visiting committee. He says that the attentive way that CAPT staffers listen and quickly respond to partner needs is the key reason Dow has invested resources in the center. He cited the development of the online guides as an example of Kile's understanding that a timely solution that helps 85 percent of the people is better than a perfect product that takes three to five years of research. "We in industry are perfectly happy with something at an 85 percent. Implement it, and then work the bugs out as you move forward—Bam, Bam, Bam—because you have to move. You have to move forward," he says.

CITE Is a Catalyst for Change

With the creation of two high school information technology (IT) Academies and plans for a third, the Center for Information Technology Education (CITE) at Nashville State Community College in Nashville, Tenn., has become a catalyst for change in three Tennessee cities.

An IT Academy is a career-oriented, school-within-a-school that provides secondary students with the academic and technical skills they need to gain employment upon graduation or to succeed in college.

The IT academies that CITE helped start in Nashville and Oak Ridge and the one that it is planning in Spring Hill, Tenn., will eventually be a source of well-qualified students for community colleges. However, the creation of a student pipeline is not the sole motivating factor behind these initiatives—community needs are the primary impetus.

“It all happened because of community interest and involvement, more than just [us] thinking it would be a neat thing to do,” explains David McNeel, director of CITE. The IT Academies offer three tracks—applications, hardware, and Web design—in ways that respond to community needs.

Since it opened in fall 2003, the Stratford IT Academy in inner city Nashville has helped turn around a failing high school. CITE became involved at the request of the school principal, but the metropolitan school system, the city government, and the business community all invested in the new curriculum, new IT equipment, internships, co-ops, and school-to-work initiatives that are part of the academy concept. Aside from serving as a convener, CITE provided faculty development for teachers.

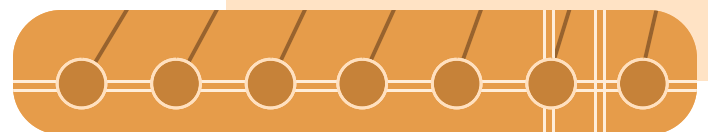
In Oak Ridge, the large number of retirements among technicians at the government’s nuclear weapons facility is a concern. The Chamber of Commerce, Roane State Community College, and the local school district are partnering with CITE on the Orbit Academy that opened in fall 2004 to help meet the need to train future technicians.

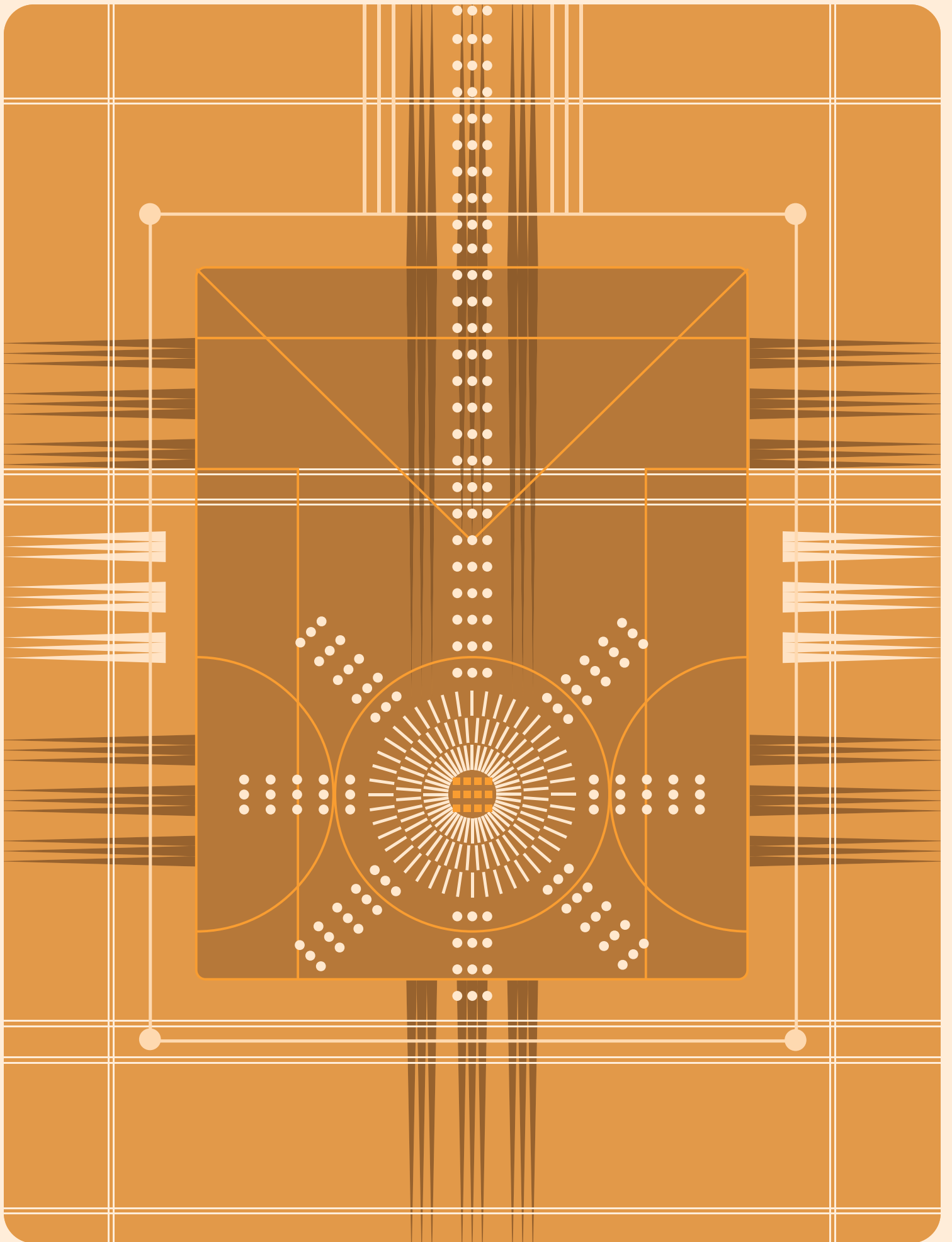
Community leaders in Spring Hill hope that when the IT Academy opens there in fall 2005, it will cultivate the critical thinking skills in students that auto manufacturers and other high tech industries seek in employees.

Serving as a change agent takes “hours and hours, and days and days of relationship building, confidence building,” McNeel says, adding the outcome is well worth the extra effort. “A community-based project elevates a school’s reputation and opens the eyes of the community to new opportunities,” he explains.

TIPS FOR BECOMING A CATALYST FOR CHANGE

- Respond to a community need with a solid, innovative plan.
- Work with a key, visionary leader or leaders with strong community connections.
- Be open minded and bold.
- Devote time to relationship building.
- Cultivate a broad base of support for the goal.
- Gauge the limits of flexibility among key stakeholders.
- Know the physical facilities of the institutions involved.
- Understand the political landscape, and choose battles carefully.
- Point to evidence of success when lobbying.





Student Recruitment

Community colleges are the largest, most accessible sector of higher education, and community college technician education programs offer people excellent opportunities for advancement. According to the U.S.

Department of Labor, 19 of the 30 occupations expected to grow most quickly by 2012 will require associate degrees or further education.⁴

All 31 ATE centers are committed to developing the next generation of technicians and to devoting resources to student recruitment. Several centers have begun to use career pathways to address the gap between an incoming student's academic skills and technical course prerequisites. These pathways smooth student entry into technical education by boosting their academic foundations and giving them structured experiences in high tech workplaces.

BATEC Recruits at College Fair

The Boston Area Advanced Technological Education Connections (BATEC), an ATE regional center in information technology (IT) based at the University of Massachusetts Boston, recognizes the importance of a strong approach to student recruitment. BATEC focuses the majority of its student recruitment efforts on minority teenagers who attend public schools in the Boston metropolitan area.

Even when dealing with several hundred students at a time, BATEC employs multiple tactics to connect with students as individuals, explains Deborah Boisvert, BATEC principal investigator and director. For instance, for its High Tech College Fair at Roxbury Community College in April 2004, BATEC staffers arranged the booths, workshops, and the feedback forms to increase the interest of 600 high school juniors in IT, and to maximize their contact with college personnel.

The center's early outreach initiative brings eighth graders to the three metropolitan community college campuses for tours that include visits to college laboratories and meetings with faculty. Jabril Salaam, BATEC's higher education outreach consultant notes that the "eighth grade is an ideal time to begin impressing on these kids that college is a possibility."

⁴ In *Monthly Labor Review* (February 2004), U.S. Department of Labor, available at www.stats.bls.gov/emp/emptab3.htm.

TIPS FOR RECRUITING HIGH SCHOOL STUDENTS

- **Begin outreach early with middle school students.**
- **Develop multiple approaches to reach students.**
- **Use current college students to promote programs.**
- **Offer prizes or scholarships to students who attend college fairs.**
- **Invite parents to recruiting events, and offer a raffle prize to students who bring parents.**
- **Collect information from students about their parents or guardians, and reach out to these adults in follow-up materials.**
- **Seek a highly visible industry co-sponsor for college fairs.**
- **Provide partners with the templates necessary to conduct their own student recruitment fairs.**

Students who attended the fair as part of a regular school day had to get their “passports” stamped by staffers from at least two different colleges. Financial aid officers and admission personnel from various colleges worked with small groups of students during mini-workshops where financial aid forms and application processes were explained. At other workshops, current college students talked about their classes and campus activities.

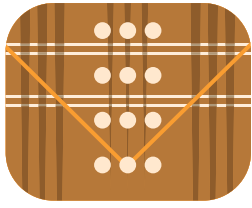
All of the students who attended the fair were given a free pass to the Museum of Science, and those who completed feedback forms had a chance to win one of two donated digital cameras. “We got great feedback. Students wrote a lot, thinking perhaps it would increase their chances [to win],” Boisvert says.

In 2005, BATEC plans to have current IT students from Bunker Hill, Roxbury, and Middlesex community colleges make structured follow-up phone calls to everyone who attends the fair. “The voice of a current student carries more weight than any of us,” says Salaam. He also has IT students join him at high schools for personalized outreach with students who have expressed an interest in IT.

BATEC, which coordinates internships for high school and college students, plans to add employers to its college fairs “so students can actually make the connection between school, work, and a career,” Salaam adds.

Non-Credit Courses Are Fertile Territory for Recruiting Technicians

The City College of San Francisco (CCSF) in San Francisco, Calif., has 30,000 people enrolled in non-credit classes. However, it was not until Frances Lee, CCSF’s former vice chancellor of instruction suggested recruiting non-credit students for biotechnology classes that Elaine Johnson or anyone else considered it. Johnson, the principal investigator of the National Advanced Technological Education Center of Excellence in Biotechnology (Bio-Link) located at CCSF, spent a good bit of the 1990s making presentations to high school students and CCSF credit students without much success. Most of the students she recruited for



the associate degree program continued into baccalaureate programs, which left Bay Area companies short of qualified biotech technicians.

The recruitment initiative among non-credit students, particularly among English as a Second Language students, has been “incredibly successful,” Johnson says. Not only are the adult students highly motivated to become technicians, their presence is enriching the biotech program and energizing the faculty.

Bio-Link’s recruitment initiative is based on more than just a good pitch. It centers around two remedial education programs—the Bridge to Biotech and the On-Ramp to the Bridge—that were developed to prepare non-credit students from Mission Bay, a Latino neighborhood, and Bay View Hunter’s Point, a district where many African Americans live.

Students must take entry assessments and agree to take the whole package of classes. If their reading ability is at less than an eighth grade level, they must first go through the On-Ramp to Biotech, an eight-week reading and work skills program that includes a paid internship at a government, university, or commercial laboratory.

The Bridge to Biotech consists of three linked semester classes. The students take a non-credit math course that focuses on biotechnology concepts, and a non-credit English course that teaches the language skills used in biotechnology. A one-credit biotechnology laboratory course is taught by an industry professional. When the Bridge students complete the classes, they are ready to enter CCSF’s biotechnology certificate program or bio-manufacturing degree program.

In fall 2004, the Bayer Company hired five students for full-time jobs that paid \$21 per hour. These students were among the first cohort of Bridge students and were working toward their associate degrees at the time they were hired.

The program has other enviable statistics. The On-Ramp program had a 99 percent retention rate. Thirty-nine of the 44 students who completed the On-Ramp program before October 2004 enrolled in the Bridge to Biotech.

TIPS FOR RECRUITING STUDENTS FOR TECHNICAL FIELDS

- **Recruit from non-credit classes including English as a Second Language.**
- **Create student cohorts or learning communities, including for remedial courses.**
- **Structure remedial math and science instruction around skill-based and industry-driven curriculum for technicians.**
- **Hire industry personnel to teach industry-related courses.**
- **Include workplace visits in the curriculum.**
- **Place students in paid internships.**
- **Draw on the expertise of social service agencies to instruct students in workplace skills.**
- **Use program completers as volunteer mentors for new students and as program recruiters.**



In the first four semesters that it was offered, the Bridge program had an 85 percent retention rate with 150 students. Ninety percent of the completers enrolled in the biotechnology certificate program.

The National Science Foundation recognized the programs' accomplishments with minority students—63 percent of the students are African Americans and 37 percent are Latinos or Asians—by awarding Bio-Link two other grants to continue the Bridge and On-Ramp programs and to help other colleges replicate them.

MATE Competitions Give Glimpse of Marine Technology Careers

The Marine Advanced Technology Education Center (MATE) located at Monterey Peninsula College in Monterey, Calif., uses Remotely Operated Vehicle (ROV) competitions to increase student awareness of careers in marine technology.

The idea for the underwater vehicle competitions came from the Marine Technology Society, which wanted to increase its presence in education through student participation in its scholarship programs, explains Deidre Sullivan, MATE's co-principal investigator and curriculum and industry manager. More than 1,000 high school and college students have participated in the regional and national competitions since they began in 2000.

Sullivan points to the direct involvement of engineers and other marine professionals with the student teams as one of the most successful aspects of the ROV competitions. "Students are learning the basics from teachers, but industry people are taking them to a different level with a mission in mind," she says.

"At the competition, working professionals who represent industry, government, research, and the military volunteer as judges and technical assistants, which provides the students with three-plus days of interaction with these individuals," explains Jill Zande, MATE outreach director and competition coordinator.

Students are also evaluated on how well they troubleshoot problems and work together during the competition. "When you deal with things underwater, you have failure all the time," Sullivan says. Because of the friendly nature of the competitions, Sullivan comments, it is not uncommon for teams that have already finished to give parts from their ROVs to teams that have leaks or other mechanical problems.

However, the competitions are more than just fun extracurricular activities. They give students experience performing technical tasks, which their coaches overtly connect to the occupational guidelines and educational competencies MATE has developed. The center's instructional materials, workshops, and internships are also tied to the basic, intermediate, and advanced competencies identified in the skill standards that MATE features on its new Web site OceanCareers.com. "Everything we do fits into this shape and form," Sullivan says.

ChemTechLinks Offers Customizable Marketing Materials

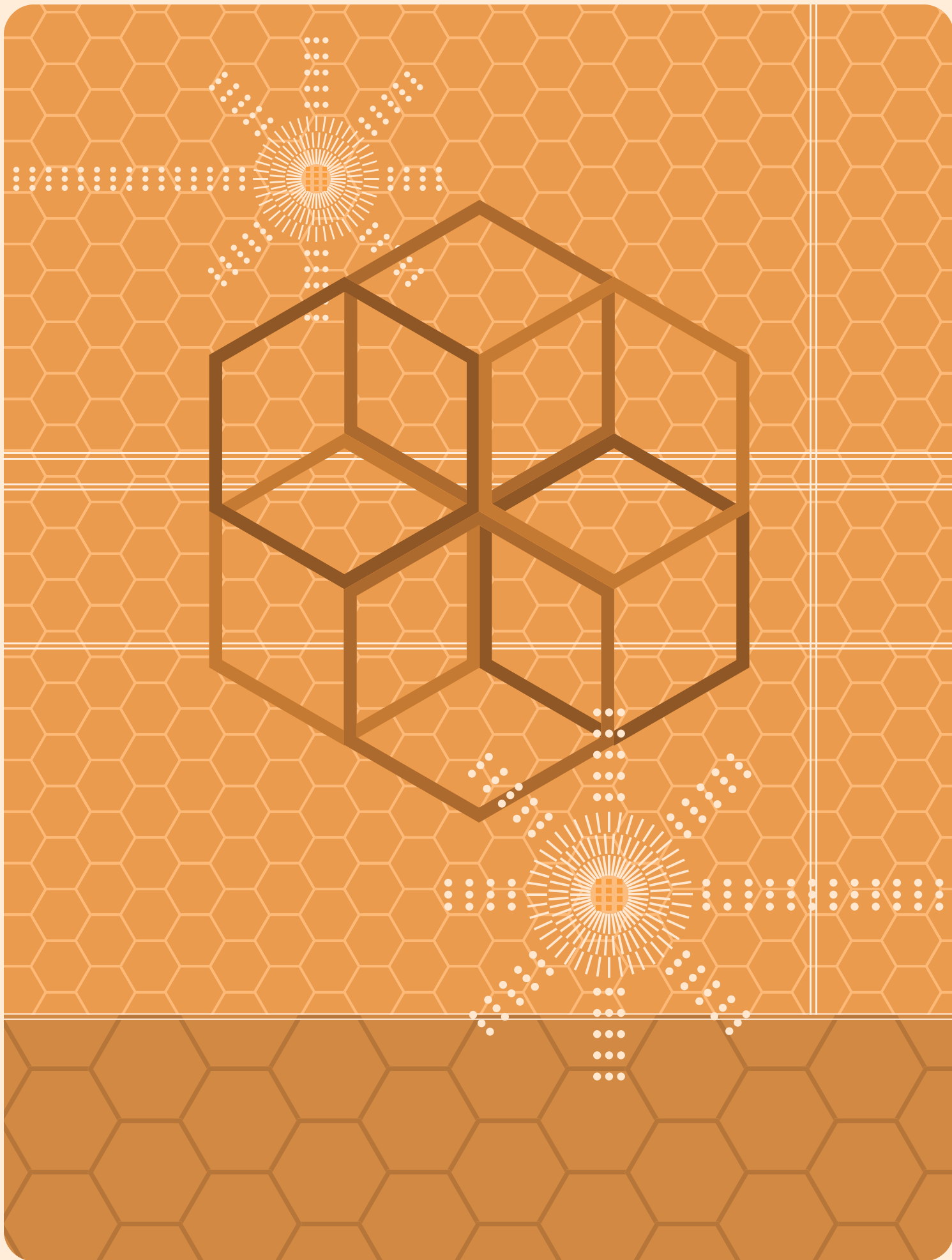
ChemTechLinks, the National Resource Center for Chemistry-Based Technology Education managed through the American Chemical Society in Washington, D.C., offers customizable marketing materials that colleges can download at no cost from its Web site www.ChemTechLinks.org.

The Web site features separate career packages that can be used to recruit students into laboratory technician and process technician programs. These packages include two types of tri-fold brochures that have six panels for information. One of the panels is left blank for colleges to insert information about their programs. The Web site includes instructions on how to access the brochures and amend them in ways that match their professional design.

The career packages also include videos, career briefs, talking points, and a PowerPoint presentation that can also be customized. "These are very useful tools for high school faculty and community college faculty to explain what people in these careers do," says Sam Stevenson, principal investigator of ChemTechLinks.

TIPS FOR CREATING AND COORDINATING STUDENT COMPETITIONS

- Create a competition that builds student learning within a fun activity.
- Use existing channels to connect with schools.
- Enlist professional or trade association members to serve as coaches.
- Emphasize the learning process involved in the preparation for the competition.
- Include complementary activities like tours of local facilities or campus visits.
- Encourage a collegial atmosphere during the competition.
- Connect student work on competitions with career pathways.



Advisors and Evaluators

Being innovative can be lonely. Transforming a good idea into reality can be so daunting that each year countless promising ideas stall and eventually fade because individuals lack the professional support to pursue testing. While the National Science Foundation (NSF) prizes the unique ideas at the core of each ATE grant, it encourages information sharing, mentoring, and other collaborative activities so that none of those who participate in the Advanced Technological Education (ATE) program are left to go it alone.

Built within the ATE program are mechanisms that advise grant recipients as they experiment with new strategies and make decisions about ways to improve technical education. To begin with, the ATE program solicitation expects proposals to include “partnerships between academic institutions and employers.” NSF program officers encourage the leaders of ATE projects and centers to supplement the informal feedback from their partners with formal advisory committees. Principal investigators then use these committees to test ideas and check plans. In addition, independent evaluators check all ATE grants, identifying strengths that can be built upon and weaknesses that should be addressed.

Active and Engaged Advisors Are Critical to Success

Having active, engaged advisors is critical whether one is running an ATE center or a local community college program, according to John Lowdon, interim executive director of the National Workforce Center for Emerging Technologies (NWCET) located at Bellevue Community College in Bellevue, Wash.

NSF requires every ATE center and large project to have a national visiting committee (NVC), which is a group of outside experts. These experts advise staff members, assess a program’s progress, and make annual reports to NSF. NVC members may also disseminate information about the center or project, and otherwise champion its efforts.

“Having the right representation on those committees is really key to center success because they can provide links to industry, government, and other education entities. And they can provide terrific advice. If you have a passive visiting committee I think you are missing a lot. You need an active, engaged committee,” Lowdon says.

Lowdon suggests that whenever community colleges assemble a group of advisers that they include representatives from business or industry, government, and education. Finding individuals with interests that complement those of the educational entity and the interests of the other advisors is more important than getting token representation from a big employer, Lowdon explains. Getting the right people on any advisory group makes a difference, Lowdon adds, “It’s not so much the name of the company. It’s the fit and the needs of the organization and how they might be able to complement one another.”

TIPS FOR WORKING WITH ADVISORY COMMITTEES

- Identify the project’s needs.
- Recruit advisors from business, industry, government, and education that best meet those needs; include women and minorities.
- Choose advisors who have the time and are committed to serve.
- Keep committee members informed and involved in facets of the program.
- Establish renewable terms for advisory boards, (e.g. three years).
- Follow committee suggestions.
- Be alert for potential conflicts of interest.
- Formally recognize and publicize the committee and its contributions.

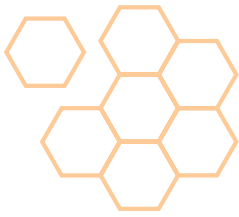
High Performance Computing Center Takes Advice

The leader of the National Center for High Performance Computing Technologies (NCHPCT), which is based out of the University of Hawaii at Maui considers the center’s industry and academic advisors an enormous asset.

NCHPCT Principal Investigator Robert R. Borchers points out that the center’s national visiting committee (NVC) is helping the co-principal investigators at four community colleges figure out how to build a cohesive program. Each of the partner institutions, in a different region of the country, has advisory boards as well. Borchers and the co-principal investigators also receive input from the center’s National Technology and Certification Advisory Board about the skill standards they are developing for high performance computer technicians.

High performance computing is an emerging field that uses clusters of personal computers to accomplish complicated tasks previously processed by supercomputers. To date most of the content of the partner institutions’ educational programs have been based on regional industry opportunities.

Borchers, who is the chief technology officer of the Maui High Performance Computing Center in Hawaii, previously chaired the center’s NVC. He wants advisors to participate at meetings, contribute to reports, and otherwise engage in activities that help the center. Bill Youngblood,



current NVC chairman and former director of the North Carolina Supercomputing Center, even accompanied the co-principal investigators for a meeting with the center's NSF program officer.

"It is great having that type of resource," says Dennis G. Vaillancort, NCHPT principal director at Maui Community College.

FL-ATE Uses Evaluator Input Every Step of the Way

The standard practice of reporting to an external evaluator annually, as most foundations require of their grant recipients, just did not work for Marilyn Barger, the principal investigator of the Florida Advanced Technology Education Center (FL-ATE) at Hillsborough Community in Tampa, Fla.

When she participated in other grants, Barger said she dreaded writing the year-end reports. When she would finally sit down to write, she tried to "wow" the evaluator with accomplishments and minimize missteps. Months later when the evaluator responded with a summary of findings and suggestions, she and the other people working on the project had already moved on to different challenges within the same project. "There wasn't much feedback and it all happened too late in the project to go back and make a difference," Barger explains.

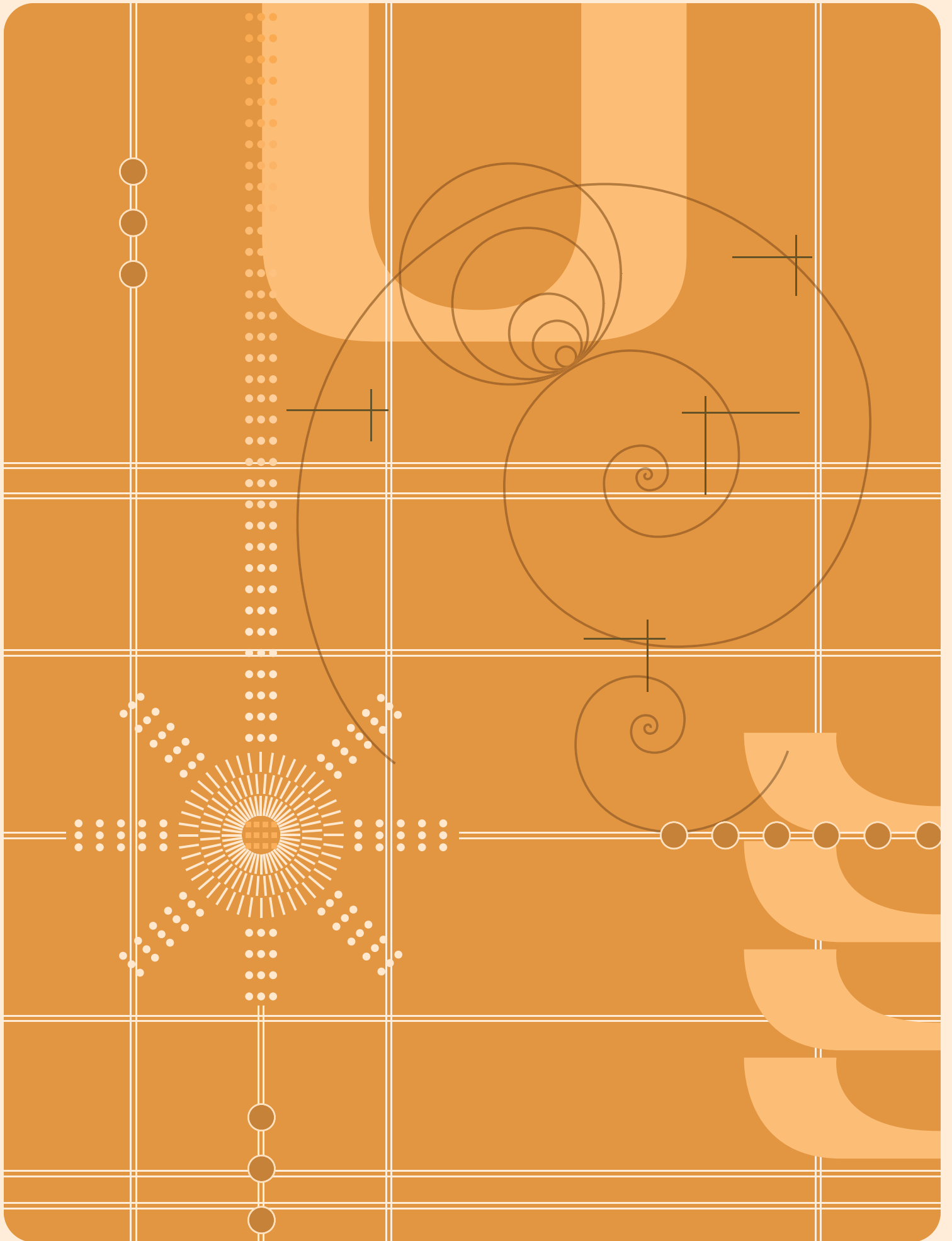
When she and a planning team of 15 people sought funding for an ATE regional center for manufacturing in Florida, they made having an evaluator with experience using the Baldrige National Quality Program a priority. The Baldrige criterion, used by business and other enterprises since 1988, considers leadership, strategic planning, customers, statistical analysis, employees, process management, and results.

The team agreed that the evaluator should be involved in developing the plans, protocols, and instruments for their center's evaluation up front. "We're looking for integral help along the way," Barger says. By using email and frequent phone conversations plus quarterly meetings with the evaluator at Hillsborough Community College, Barger says that FL-ATE's leaders hope to "find what's good and make it work better" as they proceed with their plans to improve manufacturing education.

"We're looking to do something that will help us focus on the long-term, the sustainability," she says.

TIPS FOR WORKING WITH AN EVALUATOR

- Involve a knowledgeable, independent evaluator from the beginning and throughout the project.
- Focus the evaluator's attention on devising true measures of student impact in addition to gauging progress toward the project's goals.
- Involve industry and education partners in the development of evaluation metrics at the project's conception.
- Use the evaluator's input as the project proceeds.
- Modify goals based on feedback the evaluator receives from various stakeholders.
- Document reasons for changing goals.



Organization

Each year community colleges educate nearly half of the undergraduates in the United States. Nationwide, community colleges enroll more than 11 million students.⁵ Just the arranging of several thousand student schedules, and those of the faculty and staff who serve them, is an enormous organizational undertaking. Creating optimal learning environments and effectively managing the components of community colleges require the talents of numerous people.

Though ATE centers generally have fewer than 10 employees, they have multiple partners spread throughout the nation. Each ATE center has its own way of handling its constituents and organizing itself. Despite the unique characteristics of center management structures, the experiences of ATE principal investigators yield helpful lessons for other community college educators.

SpaceTEC Uses Formal Agreements to Reach Goals

The National Aerospace Technical Education Center, SpaceTEC, located at Brevard Community College in Cocoa, Fla., created a degree program and completed other projects in three years by using formal contracts with its 12 community college partners.

Al Kohler, SpaceTEC's principal investigator, says that the structure established by making its college partners sub-awardees of the center's NSF grant was an important strategy. Their shared goal of helping the aerospace industry remain globally competitive is so complicated and the partner institutions are so widely dispersed that everyone involved agreed to make their activities as business-like as possible.

Representatives of the partner colleges, including several that previously worked together on the Community Colleges for Innovative Technology Transfer (CCITT) consortium, brainstormed about what they hoped to accomplish through SpaceTEC. The CCITT colleges, which formed their national consortium in 1994,

⁵ American Association of Community Colleges, 2004, http://www.aacc.nche.edu/Content/NavigationMenu/AboutCommunityColleges/Fast_Facts1/Fast_Facts.htm.

TIPS FOR GENERATING EFFECTIVE CONTRACTS WITH OTHER COLLEGES

- Define goals.
- Identify products.
- Establish timelines for delivery of products.
- Incorporate goals, timelines, and product delivery into written contracts.
- Have college chief executive officers sign the contracts.
- Pay according to the work completed.
- Confer regularly.
- Share monthly reports with all partners.

have worked together on aerospace technician education issues and are all affiliated with NASA centers or U.S. Department of Defense facilities. From that brainstorming session in 2001, the SpaceTEC partners created a matrix of goals, deliverables, and timetables.

The partners then bid among themselves to determine which institution would produce each curriculum, publication, or other product; when they would be completed; and how much of the grant each partner would receive for its work. The statements of agreement required participation in monthly phone conferences and submission of monthly written progress reports, which were shared with all of the partners.

This process eliminated a lot of squabbles and established a sense of teamwork. “We just got off to a really good start,” Kohler comments. He also required that the chief executive officer of each college sign the college contract that lists the specific details of what each college would do for SpaceTEC. “When you work at the CEO level, you have a formal commitment from the college that they’re going to do that job,” Kohler explains.

Kohler thinks all community colleges can benefit from using business contracts, even for small scale partnerships among themselves. “If you are able to define the work in ways that you are able to write down goals, deliverables, timeframes, and the costs, what that forces you to do is to see to the end of the project right at the beginning of the project. If there are disagreements, they come out early and you resolve them. They don’t grow into bombs and blow up the organization.”

NCSR Finds Out How Its Materials Are Used and Responds

Tracking how curriculum materials are used, particularly when they are free, is challenging. The Northwest Center of Sustainable Resources (NCSR) located at Chemeketa Community College in Salem, Ore., initially distributed its environmental science courses to mass audiences. From booths at big educational conferences, staffers gave away the curricula for entire courses and passed out pamphlets advertising the Web site where all the center’s materials could be downloaded at no cost.

Unfortunately, NCSR’s staff never knew for sure whether anyone who received those materials used their lessons. Almost no one who downloaded the material from the Web site bothered to complete the



center's electronic survey, and it was not feasible to track down all the folks who picked up the materials at conferences.

The best feedback the center received was from the educators who attended its summer institutes where participants learned hands-on science activities using the center's curriculum, according to Wynn Cudmore, principal investigator of the center.

The institutes are structured for different target audiences—high school teachers, community college faculty, college and university environmental science faculty—and became a rich source of information about what worked and what did not. From the evaluations of their summer institutes, Cudmore learned that high school teachers like more complete packages of instructional materials, including lesson plans. Experienced faculty from community colleges and four-year institutions typically will download materials or use parts of courses to enhance their existing curricula.

The center now focuses on developing laboratories and field-teaching modules on environmental topics rather than entire courses. "In the future we hope to adapt our Web site to search by modular unit or topic," Cudmore says.

The center has refined its marketing as well. Instead of targeting mixed-discipline conferences and those attended by administrators, it uses national databases to mail promotional materials to high school life science teachers and natural resource college instructors. Upon request, it mails hard copies of its course materials with a note that points out the materials are free and that recipients are simply asked to respond to a survey. Surveys are sent four months later; those who reply get a t-shirt. Online users receive surveys in the mail, too. Overall, survey response has increased 33 percent. The center has also found that 67 percent of those who reply are using the materials, and another 25 percent plan to use them.

Top-Down Support and Infrastructure Essential for Oklahoma Center

Obtaining the support of leaders and maximizing the state's existing educational systems is critical to success, according to Sujeet Sheno, principal investigator of the Oklahoma Center for Information Assurance and Forensics Education based at the University of Tulsa in Tulsa, Okla.

TIPS FOR OBTAINING AND USING FEEDBACK

- Provide guidelines for developing use and implementation plans.
- Ask users to complete use and implementation plans prior to their receipt of the materials, especially free materials.
- Send feedback surveys after people have had time to read and use the materials.
- Give a nominal thank-you gift (e.g. t-shirt) to those who return evaluations.
- Conduct focus groups to consider questions generated by survey results.
- Modify the program based on survey and focus group responses.



The Oklahoma center received an ATE grant in September 2004, but Shenoi and his University of Tulsa colleagues have been laying the groundwork for this cyber security initiative with Oklahoma's 54 CareerTech Centers and 14 community colleges for several years. Their efforts began shortly after the terrorist attacks of September 11, 2001, when Shenoi was one of three private citizens asked to serve on Oklahoma's homeland security task force.

While serving on Oklahoma's homeland security task force, Shenoi concluded that it was imperative for every law enforcement officer to understand the digital component of crimes. He also gained new appreciation for Oklahoma's educational system and the capabilities of the CareerTech Learning Network, the state's online training system. He decided the needs of law enforcement and business could best be met by utilizing all these sectors simultaneously.

"We saw that the only way industry could be secured is if community colleges and CareerTech centers had programs. "Tom Ridge says all the time that 85 percent of America's electronic infrastructure is in private hands. Where does the private sector go to learn that stuff? Not the University of Tulsa, not to Carnegie-Mellon University, not to MIT. They go to community colleges and they go to CareerTech centers," Shenoi says.

Shenoi obtained National Security Agency funding to prepare 15 community college and CareerTech instructors to offer the information assurance and forensics classes; the instructors began teaching law enforcement and industry cyber security personnel in 2003. All of the instructors are working toward master's degrees in computer science. Some are using mobile labs "to reach out to rural communities that do not typically have access to the latest technology," explains Sheryl Hale, head of the CareerTech system.

Hale and Shenoi plan to host instructor workshops for educators from six bordering states. They hope educating digital forensics technicians will eventually be a source of economic development for Oklahoma. Given the sensitive nature of material covered in the center's courses, Shenoi said the ATE regional center proposal would not have been possible without the support of the state's political and education leaders. "We don't do things unless we have that infrastructure," Shenoi explains.

TIPS FOR DEVELOPING SUCCESSFUL PROPOSALS

- Identify a critical community need.
- Recruit a partner or partners willing to work collaboratively.
- Base the proposal on a collective vision and the needs of the partnership.
- Do homework prior to writing to ensure that all partner issues are addressed and that all proposed activities fit within this context.
- Ensure that proposal meets a funding agency's interests and culture.
- Explain the partnership's goals clearly in the first two paragraphs.
- Follow proposal guidelines including matching headings in the proposal to the guidelines, so the reviewer does not need to hunt for information.

SC ATE Reorganization of Delivery Accompanies Content Revisions

Elaine Craft advocates fundamental organizational changes to improve technical education. These changes include arranging classrooms to mimic workplaces and coordinating instruction among a team of teachers who deliver just-in-time learning. “You cannot fix just one element and hope to make a substantial difference,” says Craft, the principal investigator of the South Carolina Advanced Technological Education Center of Excellence (SC ATE), a national resource center for engineering technology education located at Florence-Darlington Technical College in Florence, S.C.

SC ATE’s Engineering Technology (ET) Core Curriculum inserts real world problems in lessons and incorporates multiple disciplines to solve technology problems. It requires that instructors work in teams that coordinate their lessons so that every student assignment has a communications, math, and science component. Instructors work alone with groups of students. They move among the classrooms, which resemble workplaces and students stay together as cohorts, and move through core courses together.

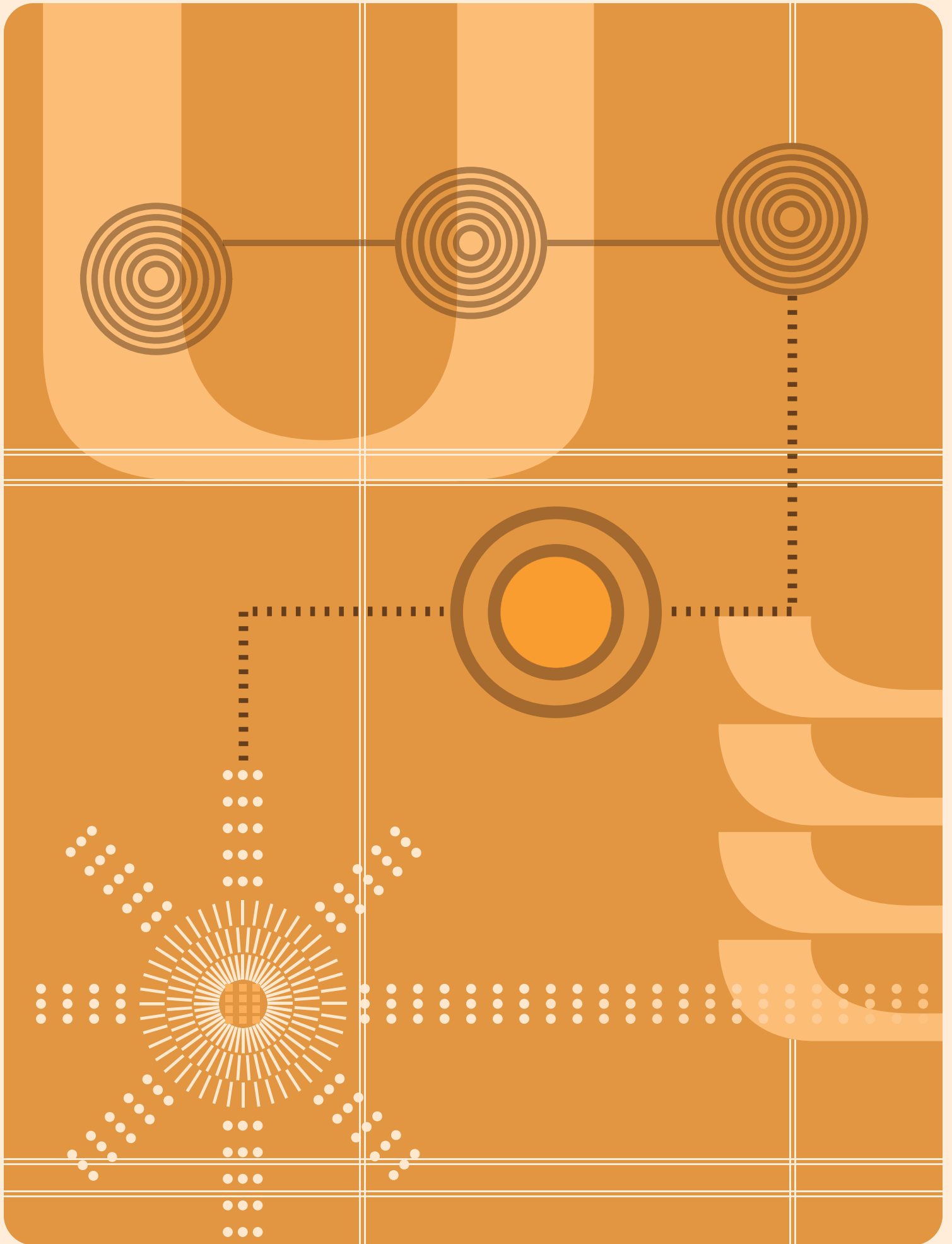
“So it’s like you come to work, you’ve got your work station, you’ve got your [student] team, you’ve got your project you are working on and then your English teacher comes in and does a workshop on whatever the English lesson is today. Then the math teacher comes in and does a workshop. Just like in industry if you are working on a new project, and you needed some kind of new software for that project, then you would take the key people that needed to know that skill and they would either go for training or bring training in-house. You learn your new skill. Then apply it and move on to the next thing,” Craft explains.

Colleges and high schools that have implemented the ET Core Curriculum with appropriate administrative support have had improvements in student learning, retention, and job placement. Even students who typically resist complex math and science are more engaged when the content and delivery are well coordinated, Craft says, adding, “It answers the question ‘Why am I learning this?’ everyday.”

TIPS FOR IMPROVING TECHNICAL EDUCATION INSTRUCTION

- **Create faculty teams that model effective teamwork by coordinating student learning and evaluating student performance.**
- **Schedule students in cohorts that take core technical education courses together.**
- **Teach new math and science concepts as students need them to complete multi-disciplinary assignments, regardless of traditional sequencing.**
- **Assign instructional team member offices near one another, rather than in traditional, discipline specific areas.**
- **Arrange classrooms to resemble workplaces.**
- **Get administrative support to ensure that scheduling and support services support the curriculum reorganization.**





Leadership

Community colleges throughout the nation are seeking ways to cultivate new community college leaders to replace the presidents, administrators, and senior faculty expected to retire during the next decade. The American Association of Community Colleges anticipates that 700 new community presidents or campus heads will be needed by 2007. The number of new leaders for upper academic positions is estimated at 1,800 while approximately 30,000 new faculty members will be needed to fill vacancies left by retirements and created by enrollment growth.⁶

ATE centers are cultivating leadership among diverse faculty members by engaging them to develop administrative skills, and broaden their professional networks with employers and educators in other sectors.

MCIT's Grant Sparks Faculty Leadership

The Midwest Center for Information Technology's (MCIT) ATE grant fosters leadership. MCIT, which is fiscally managed through the Applied Information Management (AIM) Institute in Omaha, Neb., relies on faculty site coordinators at 10 Midwest community colleges. These site coordinators are released from 25 percent of their teaching responsibilities, to carry out the day-to-day tasks involved in MCIT's efforts to enhance information technology (IT) programs.

Initially MCIT was just another IT activity, but as the center's programs have evolved the site coordinators have become champions of the MCIT program and it has become a priority for their colleges. "I think this has really helped to create those faculty leaders at each college," says John H. Jeanetta, MCIT's director and co-principal investigator. He is also vice president of the AIM Institute.

Faculty members have grown in different ways. One faculty coordinator has been promoted to chairwoman of the math and science division on the strength of the administrative skills she developed with mentoring from MCIT's personnel. Another woman has become more confident and uses her MCIT contacts as

⁶ In *The Critical Impact of Impending Retirements on Community College Leadership*, Community College Press, 2001.

TIPS TO ENCOURAGE FACULTY LEADERSHIP

- Encourage faculty initiatives.
- Pay faculty for extra responsibilities.
- Budget for periodic face-to-face meetings.
- Provide opportunities for faculty development.
- Advise faculty of conferences and how to become presenters.
- Provide training in grant management, including tracking in-kind contributions.

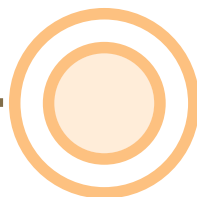
information resources for her explorations of new technologies. Another coordinator became more outgoing and initiated IT summits for employers.

When the center began, Jeanetta expected the coordinators to meet only annually. However, when threaded email discussions failed to attract input and coordinators asked for more face-to-face meetings, he reallocated funds for quarterly meetings that have become leadership building activities.

With the 10 partner colleges spread over 270,000 square miles, rotating the quarterly meetings divides the aggravation of traveling and gives the coordinators an acute awareness of campus operations. It also provides new organizational and management experiences for the site coordinators.

“They’ve developed skills because of the meetings themselves. They’ve each been responsible for housing the meeting, and planning it, and having the guests there and everything, and the meal planning. So, they have claimed ownership and leadership at their own school as a result of that,” says Dennis Kirlin, MCIT’s principal investigator and the dean of Business and Information Technology at Iowa Western Community College in Council Bluffs, Iowa.

The grant’s financial support of faculty development has also energized other faculty members to attend conferences and to write grants to support their ideas for new initiatives. “We have got a lot of community college faculty who have grown to the point that they are now making presentations at national conferences,” Kirlin says.



SUMMARY

The centers funded by the Advanced Technological Education (ATE) program use multi-faceted approaches in their efforts to improve technician education in the United States. Their collaborative work with employers and educators is improving the quality of science, math, and technology instruction in secondary schools and in community colleges; the readiness of students for courses in cutting-edge technologies; and the skills of new and incumbent technicians.

As NSF's program solicitation states, "The nation's economic prosperity hinges on the fields served by ATE." These fields include cyber security and forensics, biotechnology, nanotechnology, chemical technology, agriculture technology, civil and construction technology, computer and information technology, electronics, environmental technology, geographic information systems, manufacturing and engineering technology, marine technology, multimedia technology, and transportation technology.

The strategies and tactics offered here are just a small sampling of the important, creative work ATE centers do. To gain a fuller understanding of the numerous, dynamic initiatives each center is pursuing see the *ATE Centers IMPACT* brochure at www.aacc.nche.edu/atecenterimpact or the centers' Web sites listed at the end of this publication. A complete list of the 600 ATE grants awarded since 1993 is available at www.nsf.gov. Additional information about the ATE program can be found at www.aacc.nche.edu/ateprogram.

APPENDIX

ATECENTERS

Biotechnology and Agricultural Technology

- The National Advanced Technological Education
Center of Excellence in Biotechnology (Bio-Link) www.bio-link.org
- The National Center for Agriscience and
Technology Education (AgrowKnowledge) www.agrowknowledge.org

Chemical and Process Technology

- Center for the Advancement of Process Technology
(CAPT) www.capttech.org
- National Network for Pulp and Paper Technology
Training (npt)² www.npt2.net
- The National Resource Center for Chemistry-Based
Technology Education and Information (ChemTechLinks) www.ChemTechLinks.org

Engineering Technology

- The California Regional Consortium for Engineering
Advances in Technological Education (CREATE) www.create-california.org
- New Jersey Center for Advanced Technological
Education (NJCATE) www.njcate.org
- The Nondestructive Testing Resource Center (NDT) www.ndt-ed.org
- South Carolina Advanced Technological
Education Center of Excellence (SC ATE) www.scate.org
- National Aerospace Technical Education Center
(SpaceTEC) www.spacetec.org

Environmental Technology

- Advanced Technology Environmental Education
Center (ATEEC) www.ateec.org
- Marine Advanced Technology Education Center (MATE) www.marinetech.org
- Northwest Center for Sustainable Resources (NCSR) www.ncsr.org

Information Technology

Boston Area Advanced Technological Education Connections (BATEC)	www.batec.org
Center for Information Security (CIS)	www.cis.utulsa.edu
Center for Information Technology Education (CITE)	www.cite-tn.org
Center for Systems Security and Information Assurance (CSSIA).	www.cssia.org
Convergence Technology Center (CTC).	www.high-technology-center.org
Information Technology Education Center in Florida (iTEC)	www.itecfl.org
Kentucky Information Technology Center (KITCenter)	www.kitcenter.org
Midwest Center for Information Technology (MCIT)	www.midwestcenterforit.org
National Center of Excellence for High Performance Computing Technology (NCEHPCT)	www.highperformancecomputing.org
National Center for Telecommunications Technology (NCTT).	www.nctt.org
National Workforce Center for Emerging Technologies (NWCET).	www.nwcet.org

Manufacturing Technology and Nanotechnology

Florida Advanced Technology Education Center (FL-ATE)	www.fl-ate.org
Maricopa Advanced Technology Education Center (MATEC)	www.matec.org
National Center for Manufacturing Education (NCME)	www.ncmeresource.org
Regional Center for Nanofabrication Manufacturing Education	www.cneu.psu.edu
Regional Center for Next Generation Manufacturing (RCNGM).	www.commnet.edu
Southwest Center for Microsystems Education (SCME)	www.scme-nm.org
The Technology and Innovation in Manufacturing Education Center (TIME).	www.time-center.org

APPENDIX

Additional Resources

AMERICAN ASSOCIATION OF
COMMUNITY COLLEGES www.aacc.nche.edu

ATE Center Information www.aacc.nche.edu/atecenterimpact

ATE Program Information www.aacc.nche.edu/ateprogram

NATIONAL SCIENCE FOUNDATION www.nsf.gov

ATE Program Information [www.nsf.gov/funding/pgm_summ.jsp?
pims_id=5464&org=DUE&from=home](http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5464&org=DUE&from=home)

THE EVALUATION CENTER,
WESTERN MICHIGAN UNIVERSITY www.wmich.edu/evalctr

ATE Program Evaluation www.wmich.edu/evalctr/ate

ATE Evaluation Project Products www.wmich.edu/evalctr/ate/evalproducts.htm



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