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The NCME: Reaching Out

For more than a decade, the National Center for Manufacturing Education (NCME) has served in a wide range of capacities to enhance manufacturing technology education throughout the United States. As a nationally recognized resource for educators, the NCME continues to provide a variety of products and services intended not only to improve classroom activities and faculty effectiveness, but also to serve the manufacturing industry—the backbone of the American economy—by recruiting and educating the highly skilled advanced manufacturing workforce for the 21st century. The current primary service of the NCME is the operation of the Manufacturing Education Resource Center (MERC Online), a searchable electronic database of exemplary materials for manufacturing educators.

In 2008, the NCME acquired the National Engineering Technology Education Clearinghouse (NETEC), a well-established sister database similar to MERC Online, but with a constituency that includes educators in virtually all engineering technology fields (other than manufacturing). The NCME remains committed to its depth of focus in manufacturing, but the acquisition of NETEC has brought about an expanded scope, and the NCME now serves a much broader audience of educators in existing (mechanical, civil, electronics, aerospace, quality, etc.) and emerging (nano, bio, green, etc.) engineering technology fields. The merger of MERC Online and NETEC puts the NCME in position to be a facilitator of cross-disciplinary endeavors at all levels. Sheppard, et.al. in *Educating Engineers: Designing for the Future of the Field*, indicates that the new model for engineering education should move student thinking to engineering thinking, reflective judgment, and analytic problem solving:

> "…The ideal learning trajectory is a spiral, with all components revisited at increasing levels of sophistication and interconnection. In this networked model, the traditional analysis, laboratory, and design components would be deeply interrelated: engineering knowledge remains central but is configured to include both technical and contextual knowledge; competencies of practice, laboratory, and design experiences are integrated into the whole, as are professionalism and ethics."[1]

In addition, the merger of the two centers has provided the NCME the opportunity to expand not only its scope, but also its mission. During its inception, the overarching goal of the NCME was to provide curriculum materials and faculty development opportunities for manufacturing educators. The two-year program in manufacturing engineering technology developed with the initial National Science Foundation (NSF) funding continues to be implemented in a variety of institutions, including community colleges, universities, and high schools. The workshops providing training in activity-based learning continue to be well received. However, in its current iteration, the NCME recognizes the critical issue of STEM (Science, Technology, Engineering, and Math) recruitment. Filling the worker shortage facing technology fields in the early 21st century is essential to our global competitiveness.

In reaching out to new audiences, the NCME is building on its well-established existing partnerships and initiatives, as well as making a concerted effort to engage new partners and to support and participate in other exciting projects both nationally and internationally. Crawley, et.al. in *Rethinking Engineering: The CDIO Approach*, have taken an international approach to engineering education reform and contend that "every graduating engineer should be able to Conceive-Design-Implement-Operate complex value-added engineering products, processes, and systems in a modern, team-based environment. More simply, we must educate engineers who can engineer."[2] The CDIO Initiative held their CDIO Region of the Americas meeting at the University of Colorado at Boulder in March, 2009, organized around the theme of "Involving Industry in Project-Based Learning". The theme highlights the need for better connection with industry. The NCME strategic approach for making these important connections is through appropriate professional societies.

Established partners with MERC Online include ASEE Manufacturing Division; the Society for Manufacturing Engineers (SME) Manufacturing and Education Research Community; the SME Education Foundation (SME-EF); and the Lean Education Academic Network (LEAN). In general, partner organizations with the NCME agree to a relationship in which:

- The NCME provides electronic clearinghouse services related to enhancing the number and variety of quality educational materials in the MERC Online and NETEC databases relevant to the partner organization's field.
- The NCME promotes the use of MERC Online and NETEC by the partner organization's members.
- The partner organization adopts the MERC Online and NETEC clearinghouses as their primary repository for educational materials relevant to their field and assists in promoting the use of the clearinghouses by their members.
- The partner organization's members are encouraged to submit for possible inclusion in the MERC Online and NETEC databases materials which they have personally developed.
- The partner organization's members are encouraged to suggest quality materials with which they are familiar for possible inclusion in the MERC Online and NETEC clearinghouses. They serve as "eyes and ears" for expanding the databases.
- Pertinent papers written by the partner organization's members for conferences, journals, etc. could be included in the MERC Online and NETEC databases with due consideration of copyright issues.
- The partner organization's members benefit from easy access to the variety and quality of educational materials focused in their field found in the MERC Online and NETEC databases.
- The partner organization's members may serve as reviewers of materials submitted to MERC Online and NETEC that are within their field.

The NCME is being proactive in its efforts to increase partnerships related to the NETEC audience, addressing a wide range of engineering technologies. One example of the NCME's overall commitment to both its longstanding manufacturing focus and its newly expanded scope is the composition of its Principal Investigators and its Advisory Board. The Principal Investigators are:

- Bart Aslin, Director, SME Education Foundation, MI
- Walt Buchanan, Department Head, Engineering Technology and Industrial Distribution, Texas A&M University, TX
- Jack Waintraub, Advisory Committee Chair, former executive director of NJCATE/NETEC, NJ

The membership of the Advisory Board also includes representatives from a wide variety of fields:

- Marilyn Barger, Executive Director, Florida Advanced Technological Education (FLATE) Center for Manufacturing Education, FL
- Doug Gorham, Director, IEEE Education Activities, DC
- Frank Hart, Dean, School of Engineering Technology & Computer Science, Bluefield State College, WV
- Henry Kraebber, Regenstrief Faculty Scholar, College of Technology, Purdue University, IN
- Michael Lesiecki, Executive Director, Maricopa Advanced Technology Education Center (MATEC), AZ
- Albert McHenry, Vice President and Executive Vice Provost, Arizona State University Polytechnic Campus, AZ
- Tom Perry, Director, ASME Education and Professional Development, NY
- Robert Sicora, Director (retired), former director of NJCATE/NETEC, NJ
- Mark Stratton, Community Relations Manager, Society of Manufacturing Engineers, MI

Additionally, the NCME's external evaluator, Karl Kapp from Bloomsburg University in Pennsylvania, participates regularly in the meetings of the Principal Investigators and Advisory Board, giving the center ongoing feedback for addressing the needs of all constituencies.

The NCME's diversity in its leadership ensures that simultaneous attention is paid to both MERC Online and NETEC's existing clientele, and efforts are directed at increasing awareness and usage of the clearinghouses across manufacturing and the entire spectrum of engineering technology fields. Since the merger, new partners include the Institute of Electrical and

Electronics Engineers (IEEE), the American Society of Mechanical Engineers (ASME), and the American Society of Civil Engineers (ASCE), and more are being sought. By the end of January, 2009, MERC Online had more than 1000 total users, well over 700 total resources, and 400 links. NETEC had more than 800 users and over 600 resources. While efforts persist in adding resources to MERC Online, bringing a greater number and variety of resources to the NETEC database is also a primary goal.

To provide even greater access and benefit to all users, whether from partner organizations or individual members of MERC Online and NETEC, the NCME's databases will eventually be a part of the NSF's ATE Central—a centralized database for all the NSF Advanced Technological Education (ATE) program resource centers. Other centers are located throughout the US and specialize in a variety of technology fields:

- Advanced Technology Environmental Education Center (ATEEC)
  Bettendorf, IA
- Bio-Link
  San Francisco, CA
- Marine Advanced Technology Center (MATE)
  Monterey, CA
- Maricopa Advanced Technology Education Center (MATEC) NetWorks
  Tempe, AZ
- Materials Technology Education (MatEd)
  Lynwood, WA
- National Center for Telecommunications Technologies (NCTT)
  Springfield, MA
- National Workforce Center for Emerging Technologies (NWCET)
  Bellevue, WA
- Northwest Center for Sustainable Resources (NCSR)
  Salem, OR

- South Carolina Advanced Technological Education (SCATE) Resource Center for Engineering Technology Education
  Florence, SC

When fully operational, the NSF's ATE Central online database will be a powerful tool for engineering technology educators, providing an effective way to stay current with the latest materials, best practices, recruiting strategies, etc.

In extending its efforts to lead, participate in, and support initiatives aimed at attracting students at the pre-college level into the STEM pipeline, the NCME is working with a number of national programs, including Project Lead the Way (PLTW); Engineering is Elementary (EiE); SME-EF's Gateway Academies and www.manufacturingiscool.com; and a new manufacturing career web portal, www.careerME.org, funded by the SME-EF.

Of particular interest to the manufacturing community, but certainly relevant to anyone concerned about enhancing recruitment for STEM education across the board, www.careerME.org is a website designed to appeal primarily to young people in grades 11–14, providing positive information about careers in advanced manufacturing. While the pilot effort focused on the southwest Ohio region, the NCME is seeking regional adopters nationally.

The goal of www.careerME.org is to create an affordable, replicable website to promote careers in advanced manufacturing. In addition to the student population being targeted, the site also seeks to engage parents, high school teachers, career counselors, and college faculty. The project's goal is to heighten awareness of advanced manufacturing careers, and www.careerME.org uses a variety of features in this endeavor:

- Provides content showing the exciting possibilities of advanced manufacturing careers as dynamic, action-oriented, lucrative, and appealing to technically savvy people
- Is interactive and gives contact information for follow-up to acquire additional information about educational opportunities, such as summer programs, internships, scholarships, etc.
- Has a home page with a national emphasis, showing positive information about the health of advanced manufacturing in the nation and links to examples of thriving manufacturers in each of the 50 states (page in progress)

- Lets users interface with local advanced manufacturing companies about their industry, products, and advanced manufacturing related careers

- Is adoptable or adaptable by other regions, allowing for customized content that leverages local resources

- Describes the high skill levels needed by those who enter the field of advanced manufacturing, such as bio-manufacturing, highly automated systems, global supply chains, and lean manufacturing, etc.

- Offers information or links about degree programs, cooperative education program resources, and programs at the high school and college level

- Collects website data and metrics about the users, site visits, links used, and more to track user activity

The www.careerME.org site will also serve as a conduit for regional and national endeavors, such as The SME-EF's collaboration with the Academy of Engineering (AOE) to expand the Gateway Academies. AOE is a partnership among the National Academy Foundation (NAF), the National Action Council for Minorities in Engineering (NACME), and PLTW, and focuses on recruiting students into engineering and engineering technology. They emphasize participation of women and minorities, as well as high school preparation in math and science to ensure success in postsecondary STEM programs.

This multi-collaborative approach in which the NCME leads, implements, and/or supports a variety of programs through their partnerships with professional societies not only leverages funding opportunities, but also serves to coordinate initiatives in order to maximize effectiveness.

The merger of MERC Online and NETEC also provides opportunities to address the "grand challenges" outlined by the National Academy of Engineering, particularly the challenge of advanced personalized learning (http://www.engineeringchallenges.org/cms/8996/9127.aspx). As a repository for exemplary and state-of-the-art educational resources; as a coordinator, facilitator, and supporter of programs and events nationwide; and as an active partner with a wide variety of professional societies, the NCME gives students, faculty, parents, and counselors a virtually limitless range of ways to engage interest in STEM careers.

As an additional service, and serving as a model for other engineering technology fields, the NCME has undertaken ongoing research and reporting of issues impacting postsecondary manufacturing education. The NCME has initiated and will maintain a database of information related to the following categories for manufacturing engineering technology:

- Existing two-year and four-year programs
- Best practices
- Enrollment trends
- Recruiting methods
- Accreditation
- Industry demands
- Professional society student chapters

While this information is available from a variety of sources, having access to a compilation at one site should prove to be an enormous benefit to faculty, administrators, and industry leaders.

As it continues in its second decade of service, the NCME is reaching out as a leader in facing the variety of challenges facing engineering technology educators. The NCME's success in the past has depended on its collaborations with organizations and individuals, and these collaborations have become more important as the center's scope and mission are expanded. As an active national advocate for STEM education, and with the efforts of all its partners, the NCME's goal is to address not only current issues, but also to be proactive in meeting the needs of engineering technology educators and students throughout the US.

[1] Sheppard S., Macatangay, K., Colby, A., and Sullivan, W. *Educating Engineers: Designing for the Future of the Field.* Jossey-Bass, 2008.
[2] Crawley, F., Malmqvist, J., Ostlund, S., and Brodeur, D. *Rethinking Engineering Education: The CDIO Approach*. Springer, 2007.