

National Resource Center For Manufacturing Education

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Abstract

Manufacturing educators face major problems in identifying and accessing timely, high-quality information that can assist them in providing up-to-date educational services that prepare technical professionals for employment in industry. This paper describes the unique services of the National Resource Center for Manufacturing Education that helps manufacturing educators overcome these difficulties. The Resource Center is sponsored in part by the Advanced Technological Education program of the National Science Foundation¹ and is an extension of the National Center for Manufacturing Education that has been in operation in Dayton, Ohio since 1995.

Need For a National Resource Center for Manufacturing Education

It is imperative for educators in manufacturing engineering technology or manufacturing engineering to maintain currency in their field and to implement novel pedagogies that have been proven to enhance student learning. The future growth of manufacturing enterprises depends heavily on the availability of highly skilled professionals, technicians, and production associates because of rapidly changing technology, ever increasing customer expectations, and fierce global competition.

Many resources exist to assist manufacturing educators in creating effective curricula, courses, and learning activities. However, it is difficult for educators to become knowledgeable about what is available, how to access it, and how to put it into action in their own programs. Many fine projects funded by the National Science Foundation, the Society of Manufacturing Engineers, and others have produced exemplary materials, but they have difficulty disseminating them to potential users around the country. Identifying commercially available equipment, software, and services can also be difficult.

To meet these needs, the National Center for Manufacturing Education (NCME) has established a resource center to identify, evaluate, collect, and disseminate exemplary materials in manufacturing education.

Overview of the National Resource Center for Manufacturing Education

The resource center for manufacturing education was initiated by the NCME in July 2003 with funding from the Advanced Technological Education program of the National Science Foundation, building on eight years of successful innovation in instructional materials development. The NCME is a part of the Advanced Integrated Manufacturing Center (AIM

Center) located in Dayton, Ohio and operated jointly by Sinclair Community College and the University of Dayton. The AIM Center offers numerous services to educators and manufacturing enterprises to improve instruction and to upgrade manufacturing systems.

Services Provided by the Resource Center

The resource center offers a variety of services to manufacturing educators, including:

- An extensive, Internet-based clearinghouse database of information pertinent to manufacturing education obtained from numerous sources such as NSF centers and projects, other academic institutions, industry, and vendors of equipment and software
- Database search capability
- Preparation of custom searches to provide electronic compilations of materials on a specific subject
- Consulting on implementing novel curriculum materials and pedagogies in manufacturing education
- Internet-based symposia on selected topics highlighting emerging technologies

Collaborators

The resource center is collaborating with the Society of Manufacturing Engineers (SME), the Manufacturing Division of the American Society for Engineering Education (ASEE), and the Computer Integrated Manufacturing in Higher Education Alliance (CIM/HE) to ensure that the materials are useful to a wide variety of educational program types in engineering technology and engineering. There is also a collaborative relationship with the New Jersey Center for Advanced Technological Education (NJCATE) that has established a separate resource center called the National Engineering Technology Education Clearinghouse (N-ETEC).

SME is the premier source for information in the manufacturing engineering field in the United States and internationally. It operates hundreds of conferences, exhibitions, seminars, and technical programs annually for practicing manufacturing professionals. It is also the leader in manufacturing education, promoting and coordinating national accreditation activities, recruitment of new students into the field, and encouraging curriculum development.

ASEE is the national society that promotes the improvement of education in the numerous disciplines of engineering and engineering technology. Its Manufacturing Division coordinates the manufacturing-related activities, representing educational programs at the associate, baccalaureate, and graduate levels in both engineering and engineering technology. The establishment of an Internet-based resource center for materials to support manufacturing education has been a goal of the Manufacturing Division and an agreement has been made for the NCME resource center to satisfy that need.

CIM/HE is a voluntary association of institutions of higher education and businesses who are dedicated to the improvement of manufacturing through the utilization of computer technology. Its vision is to be a network of educational and business resources created for the purpose of enhancing U.S. industrial competitiveness in the global marketplace. The NCME resource center is highly complementary to the mission of CIM/HE and endeavors to enhance the effectiveness of its members. In turn, CIM/HE members are involved in the development and operation of the resource center.

The National Engineering Technology Education Clearinghouse (N-ETEC), operated by NJCATE at Middlesex County Community College in Edison, NJ, is providing a resource center for a broad range of engineering technology disciplines. The NCME resource center provides the manufacturing education resources for N-ETEC through cooperative planning and Internet links.

Classifications of Manufacturing Education Materials

Instructional materials in the database will be classified making searches by key words possible. The primary classifications of materials included in the clearinghouse are:

1. Manufacturing processes
2. Materials technology
3. Automation systems
4. Quality management
5. Design for manufacturing
6. Production and inventory control
7. Manufacturing of electronic products
8. Manufacturing enterprise management
9. Manufacturing information systems
10. Technical mathematics (as they pertain to manufacturing)
11. Technical science (as they pertain to manufacturing)
12. Manufacturing curriculum development methodologies
13. Novel and effective pedagogies as applied to manufacturing education

In addition, the materials will be classified according to type and form such as instructional module, learning object, CD-ROM, video, PowerPoint slides, and so forth.

Process for Rating Items to Go Into the Clearinghouse

The NCME staff and subject matter experts are using four criteria to evaluate candidate materials submitted for inclusion in the database of the National Resource Center for Manufacturing Education clearinghouse.

Three categories of rating are being used:

A = Exemplary B = High Quality C = Not appropriate

All materials approved for inclusion in the clearinghouse database must be rated either A or B on all criteria. Materials receiving an A rating on three or more criteria will be designated to be ***Exemplary***. Others will be designated ***High Quality***.

The four criteria are listed below with brief explanations of the rating factors being used.

1 Relevance to Manufacturing Education

- A: The material is solidly within the scope of the technology of manufacturing.
- B: The material has applicability within a manufacturing education program as support subject matter. Examples: Mathematics, science, communication, teamwork.
- C: The material is not sufficiently relevant to manufacturing education.

2 *Technical Quality of the Material*

- A: The material is of excellent technical quality. The information is accurate. The depth of coverage is appropriate for the program level indicated.
- B: The material is of high quality and accurate. The depth may be appropriate for some programs when supplemented by additional material.
- C: The technical quality of the material is low and does not meet the standards of the Resource Center.

3 *Innovativeness of the Material*

- A: The material is highly innovative in terms of the subject matter and/or form.
- B: The material is of high quality but of a more traditional nature in content or form.
- C: The material is presented in an obsolete form or is not particularly novel.

4 *Ease of Use for Educators*

- A: Manufacturing educators can readily use the material to enhance their educational mission.
- B: Manufacturing educators can adapt the material to their educational programs with some adjustment to the material or to their own educational methodologies.
- C: The material would be inordinately difficult for manufacturing educators to implement.

An additional factor will indicate the *Quality of Instructional Design*. This will help the users of the clearinghouse to incorporate the materials in their classes. The instructional materials will be evaluated for completeness versus criteria, called the First Principles of Instruction², developed by David Merrill at Utah State University. Merrill reviewed exemplary instructional designs and determined that the following five design criteria were present in all those materials

1. Does the material present a *problem* from the real world?
2. Does the material *activate* relevant prior knowledge or experience?
3. Does the material *demonstrate* (show examples) of what is to be learned?
4. Does the learner have an opportunity to practice and *apply* their new knowledge or skill?
5. Does the material provide techniques that encourage and provide opportunities to *integrate* or transfer the new knowledge or skill?

The rubric will assess and report the completeness of the instructional materials when judged versus these five areas.

A geographically dispersed panel of subject matter experts works with the NCME to complete the evaluations of candidate materials. NCME staff members compile their evaluations. The panel members have been recruited through personal contacts and referrals from the Society of Manufacturing Engineers, the Manufacturing Division of ASEE, and CIM/HE.

Internet Based Symposia

The NCME Resource Center will be offering a series of six symposia on emerging manufacturing topics through June 30, 2006. Recognized experts in selected fields will lead the symposia and provide plenary presentations that give overviews of the state of the art and future potential for the technology being discussed. Interactions among the participants and with the symposium leader will be a part of each web seminar.

Conclusion

The Manufacturing Education Resource Center operated by the National Center for Manufacturing Education can significantly impact the improvement of education in the broad range of manufacturing technologies for the benefit of faculty, students, and industry professionals. See the web site: www.ncmeresource.org.

Endnotes

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² Merrill, David, First Principles of Instruction, www.id2.usu.edu/5Star/FirstPrinciples/sld001.htm
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