

**Enhancing the Resource Center Role of
the National Center for Manufacturing Education**

Sinclair Community College 
Dayton, Ohio

1. Results from Prior NSF Support

In 1995 the National Center of Excellence for Advanced Manufacturing Education was one of the first three national centers created by the National Science Foundation. In addition to an estimated \$1,069,000 in local support from the College, corporate sponsors and sales of products and services, the following NSF grants were awarded to Sinclair Community College.

| PROJECT TITLE | PROJECT DIRECTOR | FUNDING LEVEL | GRANT NUMBER | FUNDING CYCLE |
|---|-------------------------|----------------------|----------------------------|----------------------|
| National Center of Excellence for Advanced Manufacturing Education | David Harrison | \$5,000,000 | DUE 9454571 DUE 9714424 | 1/1/95 – 12/31/01 |
| Completing the Curriculum: Modular Manufacturing Education Model for Advanced Manufacturing Education | Monica Pfarr | \$1,800,000 | DUE 0071079 | 7/1/00 – 6/30/03 |

The three goals of the National Center of Excellence for Advanced Manufacturing Education have been to:

- Develop an integrated manufacturing curriculum that is interdisciplinary, competency-based, and occupationally verified.
- Implement a program in Dayton that will serve as a model partnership for manufacturing and technology education.
- Disseminate best practices in manufacturing education, providing implementation support and faculty enhancement opportunities to partner organizations.

The impact of the National Center of Excellence for Advanced Manufacturing Education has been substantial with 10,338 students directly using the products and services. Furthermore 3,510 individuals employed in business have been directly impacted. Specific outcomes include the following.

- A. Developed a Module Architecture[®].** This formalized, repeatable pedagogy and instructional design process creates hands-on, competency-based learning materials,

where skill-building activities are simultaneously coupled with fundamental theoretical knowledge throughout the educational experience.

- B. Developed a Model Manufacturing Engineering Technology Associate Degree Program.** A comprehensive, competency-based manufacturing engineering technology associate degree program was created based on Society of Manufacturing Engineering industry skills standards (SME, 1990, 1994, 1997, 1999).
- C. Developed Competency-Based Curriculum Modules.** National Center of Excellence for Advanced Manufacturing Education staff is continuing to collaborate with nearly 40 colleges, universities, industries, and high schools to develop, refine, and test modules. The following table summarizes the production status of the 62 modules:

| # MODULES | STATUS | PUBLICATION DATE |
|-----------|---------------------------------------|------------------|
| 31 | Complete: 28 for AAS, 3 for Tech Prep | 12/31/00 |
| 31 | In process | 12/31/03 |

- D. Implemented a Model Manufacturing Engineering Technology Associate Degree Program.** The Engineering and Industrial Technology Division at Sinclair Community College implemented the model manufacturing engineering technology associate degree program. The program was established in 1997 and currently 110 Sinclair students are majoring in manufacturing engineering technology. To date, over 4,073 Sinclair students have completed at least one course in which a module has been taught. In addition, as of 12/31/01, 148 students at the University of Dayton have completed at least one course in which a module has been taught and 13,652 students in colleges across the nation have benefited.
- E. Sponsored Three National Conferences.** The National Center staff conducted three national conferences. The 1998 conference focused on Best Practices in Manufacturing Education; the 1999 and 2000 conferences centered on developing effective partnerships among Tech Prep, community colleges, universities, and industry to implement effective models for manufacturing engineering technology programs.
- F. Provided Faculty Professional Development.** The staff developed several core workshops to provide structured professional development for 4,519 faculty members from colleges and secondary schools nationwide. The National Center of Excellence for Advanced Manufacturing Education hosted three Summer Institutes for module development in 1996, 1997 and 1998.
- G. Disseminated Results via Publications and Presentations.** The staff disseminated the project results and lessons learned through 28 articles in national publications and 23 presentations at national and regional conferences.
- H. Evolved into the National Center for Manufacturing Education.** The major effort has been the development and publication of the curriculum modules. As the production nears completion, greater effort is required for dissemination and outreach. Reflecting this broader scope, the name changed to the National Center for Manufacturing Education, a new logo was developed, a new web site created, and a business plan completed the summer of 2002.

2. Project Overview

The National Center for Manufacturing Education, with Sinclair Community College serving as fiscal agent, submits this proposal to the National Science Foundation to expand upon the Resource Center and Technical Assistance roles.

The National Center for Manufacturing Education Resource Center has three primary roles: Publications, Resource Center/ Clearinghouse, and Professional Development/Consulting. As indicated by the shading, this proposal will provide funding to expand upon the latter two roles.



The clearinghouse role includes developing the web site (www.mfg-ed.org) as a primary national clearinghouse for exemplary manufacturing education materials and information. Materials will be selected by a peer review process, categorized, and incorporated into a searchable database. The site will have links to other Internet sites, professional societies, college and university manufacturing education programs, and announcements.

The National Center for Manufacturing Education staff will continue to provide professional development/consulting in the areas of faculty professional development; adapting and adopting new manufacturing curricula and course materials; and starting and improving manufacturing technology programs. These supportive services will be provided on the Sinclair campus or on-site at campuses across the country.

The project partners include the University of Dayton, the Center on Education and Training for Employment (CETE) at the Ohio State University (which operates the ERIC Clearinghouse on Adult, Career, and Vocational Education), the Society of Manufacturing Engineers, the Computer Integrated Manufacturing in Higher Education (CIM/HE) consortium representing five community colleges and 18 universities in 12 states.

The broader impacts of the project are far ranging beyond Dayton and Sinclair Community College and include advanced discovery and understanding, enhanced infrastructure for research and education, and dissemination of technological understanding related to manufacturing.

Broader Impacts: Advanced Discovery and Understanding While Promoting Teaching, Training, and Learning

The resource center role will disseminate via the clearinghouse effective models and pedagogical approaches in technical science, technical mathematics, and manufacturing education. The peer reviewed instructional materials will focus on integrating research activities into classroom teaching of manufacturing at the undergraduate level. Faculty and corporate trainers will use the materials resulting in manufacturing curriculum enhancements and improved student and employee learning on their campuses.

Broader Impacts: Enhanced Infrastructure for Research and Education

This project involves collaboration between disciplines (technical mathematics, technical science, and manufacturing technology) and several types of institutions—including colleges, universities, industry, and professional associations. Together, these institutions will focus on improving manufacturing education within U.S. community colleges.

Broader Impacts: Broad Dissemination to Enhance Scientific/Technological Understanding

Finally the project will disseminate exemplary learning materials and provide technical assistance to community college faculty and administrators in two ways. First, information and

manufacturing instructional materials will be made available via a web-based clearinghouse.

Secondly, the Project Director, Co-Principal Investigators, and Senior Personnel will provide technical assistance and consulting and give at least four presentations per year on the products and services at local, regional, and national conferences of professional associations.

3. Goals and Objectives

This section of the proposal lists the goals and objectives and provides a market analysis demonstrating a need for the manufacturing-related NSF ATE Resource Center. The goal and objectives are:

Goal 1: *To be a clearinghouse of readily accessible resources for improving manufacturing education.*

Objective 1.1 Establish a process and the criteria for determining center-approved resources to be included in the database.

Objective 1.2 Classify center-approved resources to facilitate efficient access.

Objective 1.3 Develop and maintain a website as the primary means of user access.

Objective 1.4 Develop links to other organizations and entities that provide information or materials relevant to manufacturing education.

Objective 1.5 Develop and implement a clearinghouse dissemination strategy that includes the use of brochures, abstracts, how-to-find flyers, and conferences.

Objective 1.6 Obtain periodic feedback from existing and potential users as to the scope of materials and the features of the clearinghouse, for continuous improvement.

Goal 2: *To provide support services for stakeholders on the effective use of the Resource Center and the implementation of its products.*

Objective 2.1 Develop and offer services that provide professional development opportunities on manufacturing related subject topics.

Objective 2.2 Develop and offer services that provide assistance to institutions and their faculty that wish to start or improve manufacturing technology programs.

Objective 2.3 Assess the services related to manufacturing education on a periodic basis for the purpose of continuous improvement.

Market Analysis

The National Science Foundation is currently funding ATE projects due to a critical national need for skilled technicians in order to meet the technological, communication, and teamwork requirements of the modern, U.S. world-class manufacturing enterprise.

Manufacturers are valuable contributors to the U.S. economy and are highly productive. For example eight states (California, Texas, Ohio, Michigan, New York, Illinois, Pennsylvania, and North Carolina) account for nearly half of the nation's \$1.4 trillion in manufacturing output.

According to the Ohio Manufacturers Association, in 1998 each Ohio manufacturing employee produced \$78,432 in output—68% more than employees in other sectors of the economy.

Clearly manufacturers need a skilled workforce to maintain international competitiveness and high productivity.

The National Governors Association in its publication *A Governor's Guide to Creating a 21st-Century Workforce*, points out that the United States does not produce enough graduates in mathematics, science, and technology to meet the specialized workforce demands, nor does it produce enough students with even basic quantitative and scientific knowledge (National Governors Association, 2002). This skills gap is especially critical in states that have high concentrations of high tech manufacturers. Faculty at community colleges must meet the challenge of producing more, higher quality graduates to meet the workforce skills gap. The needs are great.

- **Need for best practices to support manufacturing associate degree programs.** Most colleges, universities, and industries do not have the resources to develop a cohesive, integrated curriculum that will produce high quality manufacturing technicians. A national clearinghouse of curriculum products and related services will improve associate-degree granting institutions and their ability to adapt and adopt field-tested, proven effective best practices based on national skill standards.
- **Need to produce a philosophical shift in the way science, math, and engineering technology education occurs.** Colleges and universities require technical assistance to shift from lecture-based, traditional teaching to activity-based facilitated learning. The

emphasis must be a deep knowledge of subject matter, inquiry-based, hands-on approaches to learning, focusing on the skills of observation, information gathering, sorting, classifying, predicting, and testing (National Commission on Mathematics and Science Teaching for the 21st Century, 2000).

- **Need to help colleges and universities address the projected growth in demand for engineering technicians.** According to the *Occupational Outlook Handbook Quarterly* (U.S. Department of Labor, 2002), 519,000 engineering technicians were employed in 2000. The Bureau of Labor Statistics projects a 10% - 20% growth (or 52,000 to 104,000 additional engineering technicians) through 2010. The need for an educated manufacturing workforce is as significant in Ohio with the nation's second largest concentration of manufacturers. The Labor Market Projections (Ohio Department of Job and Family Services, 2002) reports there are 9,960 engineering technicians with associate degrees in the labor force and a projected growth of 13.7% growth is expected through 2008.
- **Need to improve learning opportunities at colleges and universities to meet the global needs of manufacturers.** In a presentation to the Midwest Workforce 2020 Midwestern Legislative Conference, Richard Judy of the Hudson Institute summarized global workforce development imperatives (1999):
 - Our most competitive industries are high-tech manufacturing and services.
 - Manufacturing requires technicians with high-skills.
 - There is fierce competition for skilled, well-motivated, well-educated technicians.

The target market is national and will include educators in high schools, two- and four-year institutions, as well as industry trainers. The market segment is educators in the following fields:

- Manufacturing engineering
- Industrial engineering
- Mechanical engineering
- Quality engineering technology
- Technical science
- Manufacturing engineering technology
- Industrial engineering technology
- Mechanical engineering technology
- Industrial technology
- Technical mathematics

Manufacturing technology programs at the postsecondary level, which are included in numerous different departments, opt for voluntary accreditation through a peer-review process.

The two main accrediting agencies for technology education are the Accreditation Board for Engineering and Technology (ABET) and the National Association of Industrial Technology (NAIT). The following is a summary of the numbers of associate and baccalaureate programs nationally—all of which are target markets for this NSF ATE Resource Center.

| ACCREDITATION BOARD FOR ENGINEERING AND TECHNOLOGY | | NATIONAL ASSOCIATION OF INDUSTRIAL TECHNOLOGY | |
|--|-------------------|---|-------------------|
| Program Name | Number Accredited | Program Name | Number Accredited |
| Industrial Engineering | 99 | Design Technology | 2 |
| Industrial Engineering Tech. | 14 | Computer-aided Design Technology | 4 |
| Mechanical Engineering | 264 | Industrial Technology | 44 |
| Mechanical Engineering Tech. | 145 | Mechanical Technology | 2 |
| Manufacturing Engineering | 23 | Machine Tool Technology | 2 |
| Manufacturing Engineering Tech. | 48 | Manufacturing Technology | 12 |
| Quality Engineering Tech. | 3 | Quality Technology | 2 |
| TOTAL | 596 | TOTAL | 68 |

Assuming conservatively that there are at least three engineering or technology faculty members, three technical mathematics and science faculty members, and six high school teachers interested in technology at each of the 664 programs, there are nearly 8,000 potential customers for products and services. These faculty members will reach an estimated 200,000 students annually.

4. Project Plan

The National Center for Manufacturing Education and its national project partners will implement this NSF ATE Resource Center grant over four years. Activities are explained below by goal and objectives.

Goal 1: *To be a clearinghouse of readily accessible resources for improving manufacturing education.*

Objective #1.1: *Establish a process and the criteria to be used for determining center-approved resources to be included in the database.*

The National Center for Manufacturing Education in its resource center role will become a database repository where manufacturing educators come to acquire information about innovative educational materials. It is essential that the materials be of high quality and relevant to the manufacturing field. One primary source of materials will be the work products of

existing and future centers and projects sponsored by the National Science Foundation under the Advanced Technological Education program. Other materials and Internet links to other sources will also be featured in the resource center. Therefore, a process will be established to identify potential exemplary materials and to judge their quality and relevance to the field of manufacturing education.

Instructional materials in the database repository will be classified making searches by key words possible. The primary classifications of materials to be sought for inclusion in the resource center 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.

The Internet will be the primary means of disseminating the materials housed in the resource center. In addition to the instructional materials listed above, the website will include:

- Links to other Internet sites that offer exemplary and pertinent manufacturing-related information and instructional materials such as suppliers of materials and equipment for manufacturing enterprises that can be used in educational settings.
- Links to professional societies related to manufacturing such as the Society of Manufacturing Engineers, American Society for Engineering Education, Accreditation Board for Engineering and Technology, National Association of Industrial Technology, Institute of Industrial Engineers, American Society of Mechanical Engineers, American Production and Inventory Control Society, American Society for Quality, Numerical Control Society, and Fluid Power Society.
- Links to colleges and universities offering manufacturing educational programs.
- Announcements of events and educational programs related to manufacturing.

Subject matter experts from other colleges and from industry will provide expert opinions about materials in the database. Each educational resource will be peer reviewed by experts to provide third-party validation of quality. Criteria for evaluating prospective materials for inclusion in the resource center database will be established early in the project by Center staff supplemented by a team of selected, recognized subject matter experts recruited from other sites. A similar process is used by the Multimedia Educational Resource for Learning and Online Teaching (MERLOT), which is an international cooperative for high quality online resources to improve learning and teaching within higher education (Schell and Burns, 2002). Operated by the University of California Center for Distributed Learning with partial funding from NSF, MERLOT has links to online learning materials developed and peer-reviewed by other faculty. It is a repository of on-line learning resources with a variety of user interfaces, graphical looks, and pedagogical approaches.

Types of selection criteria to be used are based on broad themes developed by the Center on Education and Training for Employment at the Ohio State University (Thompson, 2002):

1. Program quality.
2. Educational significance.
3. Evidence of effectiveness and success.
4. Replicability or usefulness to others.
5. Relevance to manufacturing technology education.
6. Technical quality.
7. Potential to influence improvement and systemic change in manufacturing technology education.

One of the primary functions of the resource center will be to showcase the products developed by other ATE-sponsored projects and centers. Therefore, such products would be accepted after the application of the criteria for quality and relevance to manufacturing education.

The Center on Education and Training for Employment (CETE), which operates the ERIC Clearinghouse on Adult, Career, and Vocational Education, will provide the project with invaluable experience in creating and maintaining a national resource center for educators. Staff and senior personnel of the National Center for Manufacturing Education will make the final judgments about whether or not particular materials are to be included in the resource center database.

Benchmarking will be an important ongoing activity of the clearinghouse. During the planning for this proposal, staff members have researched several clearinghouse sites including: the ERIC Clearinghouse, The Society for Manufacturing Engineers, the Distance Learning Clearinghouse of the University of Wisconsin—Extension, Bio-Link (an NSF National Center), the Eisenhower National Clearinghouse, and MERLOT. As a result of this effort, staff then contacted the Center on Education and Training for Employment at the Ohio State University, which agreed to become a partner on this project.

| DELIVERABLES FROM OBJECTIVE 1.1 | |
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| <ul style="list-style-type: none">• A detailed set of criteria for selecting appropriate exemplary materials for inclusion in the resource center database• A group of highly qualified subject matter experts who are available to establish the criteria and evaluate prospective materials for the database• A process for evaluating prospective materials to be included in the database | |

Objective #1.2: Classify Center-approved resources to facilitate efficient access.

The resource center/clearinghouse will classify into user-friendly categories for easy access, the exemplary and best-practice materials that are accepted. National Center for Manufacturing Education staff will create appropriate categories and then determine which categories are appropriate for a given resource. Potential classifications may include:

| | |
|---|--|
| <ul style="list-style-type: none">• Subject specific categories and sub-categories• Curriculum materials• Reference materials | <ul style="list-style-type: none">• Equipment and tools• Learning activities• Websites |
|---|--|

Materials will also be cross-referenced by academic levels. Staff will classify, index, and abstract all materials.

| DELIVERABLES FROM OBJECTIVE 1.2 |
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| <ul style="list-style-type: none">• A user-friendly index for efficient research and use of clearinghouse materials• Abstracts describing individual materials |
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Objective 1.3: *Develop and maintain a website as the primary means of user access.*

The primary means of accessing the materials housed in the resource center/clearinghouse will be the website, www.mfg-ed.org. This website will be established with researchable capability, links to other referenced websites, ample technical platform and design for expansion, and ready access to human technical assistance. In addition to the clearinghouse of materials, the website will include:

- User's guide to the clearinghouse.
- A videotape introduction.
- Links to other websites that offer exemplary and pertinent information and materials, such as manufacturers and suppliers of equipment and materials for educational settings.
- Links to professional societies related to manufacturing.
- Links to accreditation boards and resources.
- Links to colleges and universities offering manufacturing educational programs.
- Links to other entities that provide information or materials relevant to manufacturing education.
- Announcements of events and educational programs related to manufacturing education.
- Opportunity for individuals to submit materials and/or links to be reviewed for inclusion in the site.

The website will be created and maintained by the project web developer. The Center will also employ an expert, knowledgeable in manufacturing technology and qualified to provide assistance in center products and services. This expert will be available as a resource to users of the website through electronic mail as well as a toll free telephone number.

| DELIVERABLES FROM OBJECTIVE 1.3 |
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| <ul style="list-style-type: none">• A functional website containing the information, resources and features described above• A clearinghouse with manufacturing educational materials• A toll-free phone number for technical assistance inquiries• A user's guide to the clearinghouse |
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Objective 1.4: Develop a list of links to other organizations and entities that provide information or materials relevant to manufacturing education.

In addition to the main database of exemplary materials, the website (www.mfg-ed.org) will also feature links to other organizations and entities that provide information, materials, services or equipment relevant to manufacturing education. Such links would not be subjected to the review and evaluation by subject matter experts, but would instead be identified and selected by staff on the merits of each link's potential usefulness for manufacturing educators. The website would include brief summaries (1-3 sentences) for each of the links. The resource center would also request that each link provide a reciprocal link back to www.mfg-ed.org. Example links might include (but are not limited to):

Discipline-specific professional societies such as:

- Society of Manufacturing Engineers (SME)
- American Society for Quality (ASQ)
- Institute of Industrial Engineers (IIE)

Education-related societies and organizations

- Accreditation Board for Engineering and Technology (ABET)
- National Association of Industrial Technology (NAIT)
- American Society for Engineering Education (ASEE)
- National Science Foundation (NSF)
- CIM in Higher Education (CIM/HE)
- League for Innovation

Manufacturing industry organizations

- National Association of Manufacturers (NAM)
- National Coalition for Advanced Manufacturing (NACFAM)
- Automotive Industry Action Group (AIAG)

Other colleges and universities

- Manufacturing and related programs

Equipment suppliers

- Manufacturing laboratory apparatus
- Manufacturing suppliers

| DELIVERABLES FROM OBJECTIVE 1.4 |
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| <ul style="list-style-type: none">• At least 200 appropriate links that provide information or materials relevant to manufacturing education• Brief summaries for each link |

Objective 1.5: Develop and implement a clearinghouse dissemination strategy that includes the use of brochures, abstracts, how-to-find flyers, and conferences.

The staff of the National Center for Manufacturing Education will disseminate the products through a variety of strategies. Both print and non-print materials will be created and disseminated. In addition staff will attend conferences of appropriate professional societies to promote the products and services. The following table summarizes the dissemination approaches.

| STRATEGY | DESCRIPTION |
|--------------------|---|
| How-to-Find flyers | Flyers that provide instructions on how to find and use the web site. Distribute 500 flyers per year over the four-year grant. |
| Brochure | Three-fold brochure that describes the purpose and expected benefits for the potential user of the resource center. Distribute 500 per year over the four-year grant. |
| Abstracts | Abstracts provide summaries, one half to one page in length, for specific resource center topics, materials or keywords. Similar in content to ERIC summary documents, abstracts will be generated and distributed for specific topics based on stakeholder interest. |
| CD-ROMs | CD-ROM that includes instructions for access to the resource center web site and selected topic summary resource abstracts. At least ten-resource summary CD-ROMs will be produced. |
| Workshops | One-hour workshops to assist users in locating appropriate topics for their use—two per year in years two, three and four. |
| Presentations | Presentations at appropriate conferences on the uses of the clearinghouse. |

Based on this dissemination plan, the National Center for Manufacturing Education will reach a large national audience of manufacturing educators who will be consumers of products and services. The methods of distribution will be addressed in section 7. Dissemination Plan.

| DELIVERABLES FROM OBJECTIVE 1.5 |
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| <ul style="list-style-type: none"> • A variety of dissemination products (print and non-print) • Workshops and presentations at appropriate conferences |

Objective 1.6: *Obtain periodic feedback from existing and potential users as to the scope of materials and the features of the clearinghouse for continuous improvement.*

Center staff will obtain periodic feedback from both existing and potential users of the clearinghouse in an effort to continuously improve the information and services offered. Tools used to collect this information will include on-line surveys and user groups. Information collected may include:

- Subject areas to be covered by the clearinghouse
- Usefulness of materials
- Ease of locating desired information
- Cost of resources available
- Grade level of resources in clearinghouse
- Suggestions for additional materials and services

Staff will evaluate recommendations from these users and incorporate them, where appropriate, in order to continuously improve the clearinghouse.

| DELIVERABLES FROM OBJECTIVE 1.6 |
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| <ul style="list-style-type: none">• List of both existing and potential users of the clearinghouse• An on-line survey to collect feedback on the materials and features of the clearinghouse• Compilation of data and evaluation report of the survey responses• Additions, enhancements, and recommendations from the on-line survey implemented to improve the clearinghouse• User groups to obtain feedback on the materials and features of the clearinghouse• Compilation of data and evaluation report of the user group feedback• Additions, enhancements, and recommendations from the user groups implemented to improve the clearinghouse |

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| <p>Goal 2: <i>To provide support services for stakeholders on the effective use of the Resource Center and the implementation of its products.</i></p> |
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Objective 2.1 *Develop and offer services that provide professional development opportunities on manufacturing related subject topics.*

This objective builds on the Clearinghouse objectives by extending the availability of information and resources to include educator professional development services. These services include virtual conferences and discussion forums that provide the participants (educators, trainers, and students) with the opportunity to ask questions and participate with manufacturing

subject matter experts. The virtual conferences will be held on specific topic areas with follow up discussion through the web discussion forums. Twelve virtual conferences are planned over the second, third and fourth years.

The professional development opportunities are based on best practices offered by the ERIC Clearinghouse operated by the Center on Education and Training for Employment at the Ohio State University, MERLOT operated by University of California Center for Distributed Learning, and the Society of Manufacturing Engineers.

Other services include CD-ROMs that support the topics presented in the virtual conferences. Other CD-ROMs will be developed that provide a collection of subject specific resources that have been developed and are available. At least fifteen CD-ROMs will be produced throughout the grant.

| DELIVERABLES FROM OBJECTIVE 2.1 |
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| <ul style="list-style-type: none">• Virtual conferences and web-based discussion forums• CD-ROM media |

Objective 2.2: *Develop and offer services that provide assistance to institutions and their faculty members that wish to start or improve manufacturing technology programs.*

Improving education in manufacturing technology has been an integral part of the mission of the National Center for Manufacturing Education since its inception in 1995. Innovative educational materials based on a novel, activity-based pedagogical approach entitled the Module Architecture[©] have been developed and disseminated to many educators across the country. One of the means of dissemination has been through providing specialized consulting services on the implementation of the Module Architecture[©] and the use of modular approaches in curriculum development.

With the advent of the significant amount of additional resources to be acquired for the clearinghouse, the consulting services will adopt an enhanced and broadened mission. The

database of resources will be organized and classified in useful ways so that users can search for materials on a specific subject that meets their needs. The Resource Center staff will be available to assist in completing searches. Specialized bibliographic listings of subsets of the resource center materials will be developed and made available to users electronically, on CD-ROMs, or in printed form.

Center staff will be available to mentor faculty members in community colleges, universities, and secondary schools in the adoption or adaptation of materials from the database and the implementation of pedagogical techniques appropriate to the subject matter. Having the larger set of materials from other ATE centers and projects, other sources, and the materials developed by the National Center for Manufacturing Education itself should make this service attractive to a broader set of potential clients.

Workshops, conference presentations, and other techniques will be employed to acquaint the manufacturing education community of the availability of these services.

| DELIVERABLES FROM OBJECTIVE 2.2 |
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| <ul style="list-style-type: none">• Specialized searches of materials in the database• Consulting services to faculty members on implementing a variety of methods to improve manufacturing technology education• Workshops, conference presentations, and other techniques to promulgate the availability of consulting services |

Objective 2.3: *Assess the services related to manufacturing education on a periodic basis for the purpose of continuous improvement.*

Center staff will assess the services provided to customers in an effort to continuously improve the educational offerings. Tools used to collect this information will include evaluations sent to customers at the conclusion of a deliverable. Information may include:

- Sufficient coverage of subject content
- Effectiveness of facilitation and time management
- Plans to implement newly acquired knowledge
- Suggestions for additional services

Center staff will evaluate recommendations from these customers and incorporate them, where appropriate, in order to continuously improve the center's service offerings. Staff will proactively contact potential customers to understand additional needs beyond the scope of existing services to develop, provide, and continuously improve the offerings of the center.

| DELIVERABLES FROM OBJECTIVE 2.3 |
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| <ul style="list-style-type: none">• Identified list of both existing and potential customers of the resource center• An evaluation form to collect feedback on the services provided by the resource center• Compilation and evaluation of the evaluation responses• Additions, enhancements and recommendations from the evaluation implemented to improve the service offerings of the center• Communication with potential customers of the resource center• Compilation and evaluation of the potential customer feedback• Additions, enhancements and recommendations from potential customers implemented to improve the resource center service offerings |

Project Timeline

This Resource Center grant will be implemented according to the following timeline.

5. Experience and Roles of Senior Personnel

The Project Senior Personnel, National Visiting Committee, Project Evaluators, and Project Partners not only have the necessary credentials to lead this effort, but they also have extensive knowledge and experience with the National Center for Manufacturing Education.

Senior Personnel

The following table summarizes the expertise of the Project Director, Principal Investigators, and other key Senior Personnel.

| Individual | Organization | Role in Project |
|---|---|------------------------|
| Monica Pfarr, Director | National Center for Manufacturing Education, Sinclair Community College | Project Director |
| Robert Wolff, Professor of Manufacturing Engineering Technology | University of Dayton | Principal Investigator |
| Henry Kraebber, Professor of Mechanical Engineering Technology, President, CIM/Higher Education | Purdue University (West Lafayette, IN) | Principal Investigator |
| James Houdeshell, Professor of Quality Engineering Technology | Sinclair Community College | Principal Investigator |
| Shepherd Anderson, Associate Professor of Industrial Engineering Technology | Sinclair Community College | Senior Personnel |
| Robert Mott, Professor Emeritus | University of Dayton | Senior Personnel |
| Gilah Rittenhouse, Manager, Instructional Publications | Sinclair Community College | Senior Personnel |
| Cinda Mize, Project Manager, Education | Sinclair Community College | Senior Personnel |

National Visiting Committee

This current committee of seven individuals has agreed to continue working with the National Center and will advise the Project Director and staff on the issues associated with the strategic direction, operation, and general oversight of the National Center for Manufacturing

Education. The National Visiting Committee will meet annually during the project to provide advice on the project, and write an annual report to document progress and plans.

| MEMBERS OF THE COMMITTEE | | |
|--------------------------|---|------------------------------------|
| INDIVIDUAL | ORGANIZATION | ROLE |
| Gloria Rogers | Rose-Hulman Institute of Technology (Terre Haute, IN) | External Project Evaluator |
| Bruce Leslie | Houston Community College (Houston, TX) | Chair, National Visiting Committee |
| Monika Aring | Center on Education and Training for Employment, Ohio State University (Columbus, OH) | National Visiting Committee |
| Mark Stratton | Society of Manufacturing Engineers (Dearborn, MI) | National Visiting Committee |
| Carol Spencer | San Juan College (Farmington, NM) | National Visiting Committee |
| Mark Troppe | National Center on Education and the Economy (Washington, DC) | National Visiting Committee |
| Steve Colston | Makino Corporation (Mason, OH) | National Visiting Committee |

Project Evaluators

The project evaluators have eight years of history working with the National Center.

Their roles will continue for this Resource Center grant. The evaluators will be:

- **External**--The external evaluator, Dr. Gloria Rogers, will be responsible for overall summative evaluation and writing reports to the National Visiting Committee. She will analyze data collected, assess documents and work products, and will use an interview protocol to interview staff, customers, students, and partners.
- **Internal**—Dr. Cinda Mize will be responsible for the coordination of data collection for formative evaluation. A consulting firm will be responsible for the analysis and writing evaluation reports for formative evaluation.

Project Partners

The University of Dayton and Sinclair Community College are the prime movers for this project. Both institutions are substantial and well-regarded members of the national educational community. Founded in 1887, Sinclair Community College is an open door, comprehensive two-year college located in the urban inner city of Dayton, Ohio. It offers over 1,500 university parallel, technical, and career courses to a student body of 22,917 (Fall quarter 2002); the

College serves nearly 100,000 students in credit and non-credit courses annually. In 1998 Sinclair earned the maximum ten-year accreditation by the North Central Association of Colleges and Schools. Sinclair Community College is a recognized local educational leader in Dayton. It is the largest post-secondary institution in the area and has significant community involvement. As one of 20 members of the League for Innovation in the Community College, Sinclair is generally regarded to be in the national forefront of two-year colleges. According to the *New York Times* (March 3, 1996), "If there is one institution that is trying to prepare Daytonians for the future, it is Sinclair Community College." Sinclair has been the fiscal agent for the National Center for Manufacturing Education since it began in 1995 and has extensive experience in managing federal grants.

The National Center for Manufacturing Education (formerly called the National Center of Excellence for Advanced Manufacturing Education) has significant experience and assets that can be brought to bear on the process of identifying potential products to include in the resource center. Established in 1995 as one of the first three centers sponsored by the ATE program, The NCME employs a staff familiar with all of the other centers and many of the projects. Twice in recent years Center staff completed comprehensive reviews of manufacturing-related products that were being developed at other 23 ATE sites. The results of those studies will be the initial sources of information for the resource center/clearinghouse.

As an integral part of the curriculum development process for the instructional modules developed by the National Center for Manufacturing Education, staff employed well over 300 educators and industrial professionals as module authors and reviewers who will be contacted to serve as potential subject matter experts and to suggest resources to be added to the database. Also over 150 educators from 77 institutions in 28 states across the country participated in the

project as pilot testers of instructional modules and they will be good sources of information and expertise. The National Center for Manufacturing Education staff members have personal knowledge of numerous manufacturing specialists nationwide. The Center employs a team of instructional publications specialists whose combined experience includes:

- Undergraduate degrees in English, education, communications, and visual arts
- Graduate degrees in English (all 4 team members) with concentrations in education/instructional design, English as a second language (2), and women's studies
- Professional experiences in teaching (junior high through university), technical writing, project management, journalism, public relations, graphic arts, magazine publishing, and event management
- Extensive expertise in the Module Architecture[®]
- 12 years combined experience in module development at the AIM Center's NCE/AME
- Numerous professional technical writing awards, as well as creative writing awards

Sinclair's Advanced Integrated Manufacturing Center maintains a high degree of visibility within the community of manufacturing professionals. It houses a versatile, modern, well-equipped laboratory that serves as a teaching factory and project development center for industries and educational institutions that should be useful for testing manufacturing education materials. On-going relationships are maintained with the Society of Manufacturing Engineers and a consortium of manufacturing educators called CIM in Higher Education, the National Coalition of Advanced Technology Centers (NCATC), and the League for Innovation in the Community College.

The University of Dayton, Dayton, Ohio, is a private, coeducational, comprehensive university founded in 1850. With approximately 11,000 students, the University of Dayton is Ohio's largest independent university and the eighth largest Catholic university, awarding more than 2,500 undergraduate and graduate degrees annually. Manufacturing is one of the university's four technology focus areas. In addition, the nationally known University of Dayton Research Institute (UDRI) conducts over \$50 million in sponsored research each year.

This NSF ATE Resource Center grant will have additional national partners. The

following table lists the partners and their roles in the project.

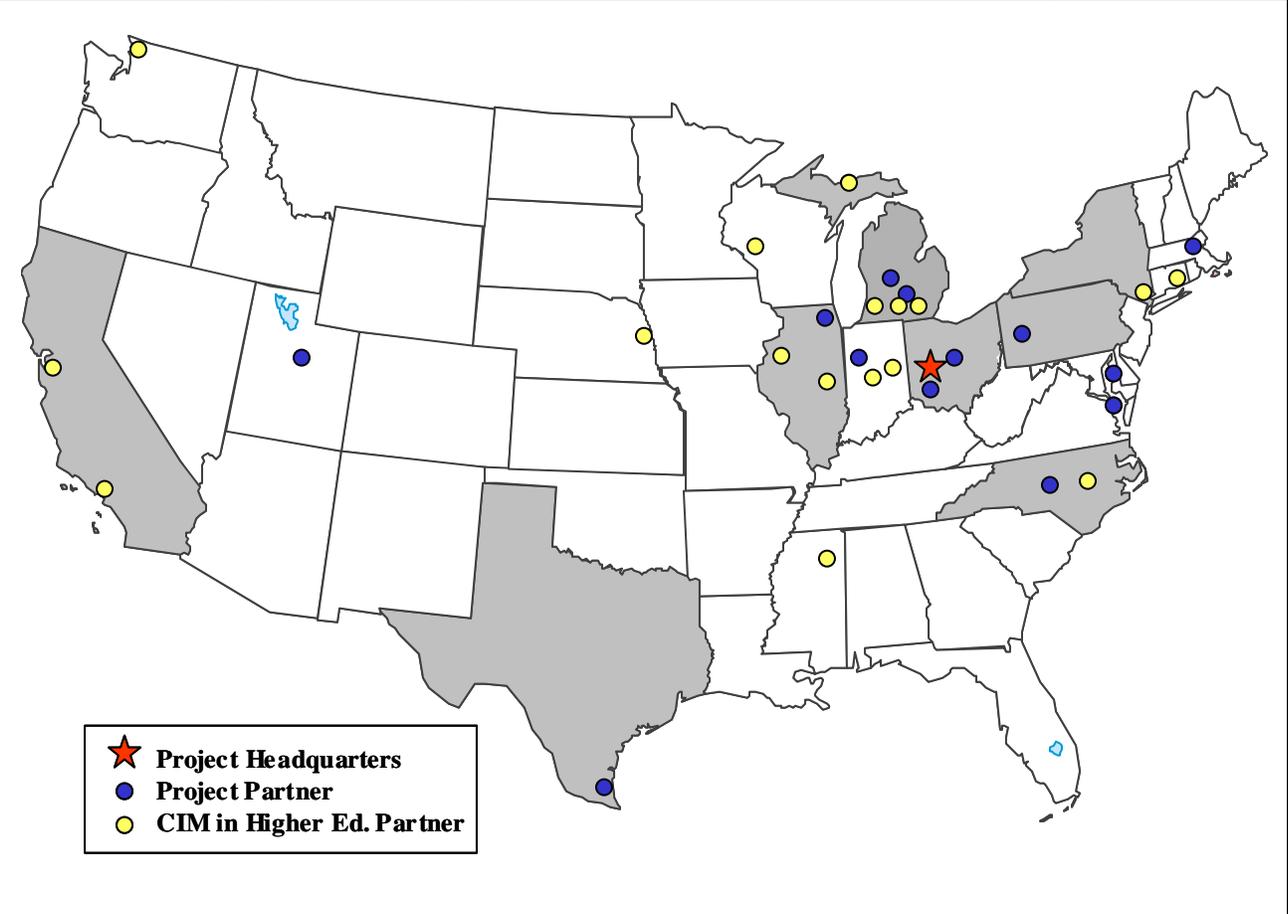
| PARTNERS (Letters of participation attached.) | ROLES |
|--|---|
| Sinclair Community College, Advanced Integrated Manufacturing Center (Dayton, OH) | <ul style="list-style-type: none"> Fiscal agent, overall leadership and management of the project, offer model A.A.S. in Manufacturing Technology |
| University of Dayton (Dayton, OH) | <ul style="list-style-type: none"> Overall leadership and management of the project, provide models of articulation and dual admissions |
| Society of Manufacturing Engineers (SME) (Dearborn, MI) | <ul style="list-style-type: none"> Conduit to prospective users of exemplary materials and a linkage to industry |
| American Society of Engineering Education, Manufacturing Division (ASEE) (Washington, DC) | <ul style="list-style-type: none"> The National Center for Manufacturing Education will become the manufacturing educational resources center for ASEE; ASEE will link directly to our site |
| Center on Education and Training for Employment (CETE) at The Ohio State University (Columbus, OH) | <ul style="list-style-type: none"> Expertise in developing and maintaining a resource center/clearinghouse (ERIC clearinghouse) Assure alignment of deliverables and exemplary materials with the needs of leading institutions for the development of vocational and workforce education |

| ACADEMIC PARTNERS | |
|---|---|
| <ul style="list-style-type: none"> Brigham Young University (Provo, UT) Central Piedmont Community College (Charlotte, NC) Community College of Baltimore County (Baltimore, MD) Mott Community College (Flint, MI) National Center of Advanced Technology Centers (Palos Hills, IL) Purdue University (West Lafayette, IN) Robert Morris University (Pittsburgh, PA) Texas State Technical College (Harlingen, TX) Wentworth Institute of Technology (Boston, MA) | <p>Form basis of user group; provide feedback as evaluators/testers of deliverables and exemplary materials</p> |

| COMPUTER INTEGRATED MANUFACTURING (CIM) IN HIGHER EDUCATION (WEST LAFAYETTE, IN) AND MEMBER COLLEGES | |
|--|--|
| <ul style="list-style-type: none"> Advanced Integrated Manufacturing Center (Dayton, OH) Ball State University (Muncie, IN) Brigham Young University (Provo, UT) Advanced Technology Centers at San Diego City College (San Diego, CA) Central Piedmont Community College (Charlotte, NC) Cerritos College (Norwalk, CA) IBM CATIA Systems (White Plains, NY) Indiana University Purdue University Indianapolis (Indianapolis, IN) Itawamba Community College (Tupulo, MS) Michigan Virtual Automotive College (Ann Arbor, MI) North Carolina State University (Raleigh, NC) Northern Michigan University (Marquette, MI) QFD Institute (Ann Arbor, MI) | <p>Group of individuals from both two and four-year institutions with an interest in manufacturing education; Form basis of user group; Provide feedback as initial evaluators/testers of the resource center.</p> |

- Purdue University's CIM Technology Program (West Lafayette, IN)
- San Jose State University (San Jose, CA)
- Three Rivers Community Technical College (Norwich, CT)
- University of Dayton (Dayton, OH)
- University of Illinois (Champaign/Urbana, IL)
- University of Nebraska (Omaha, NE)
- University of Wisconsin - Stout (Menomonie, WI)
- Weber State University (Ogden, UT)
- Western Illinois University (Macomb, IL)
- Western Michigan (Kalamazoo, MI)
- Western Washington University (Bellingham, WA)

Nearly 50% of the nation's \$1.4 trillion in manufacturing output occurs in the eight major states shaded in gray; the national project partners are located in all of these key states.



6. Evaluation Plan

The Social Science Research & Evaluation, Inc. of Burlington, Massachusetts, wrote the internal process and outcome evaluation.

Process Evaluation: The process evaluation will address four major issues: (1) what were the goals and objectives of the project, and what activities were planned to accomplish them; (2) was the project actually carried out as planned; (3) if not, what changes were made in the project design and for what reasons; (4) what implementation problems, if any, were encountered and how were they addressed? Process data will be collected from project documents (e.g., minutes of staff meetings, dissemination documents), databases created (e.g., databases of materials, consultation services, and dissemination activities), software tracking web use, and biannual interviews with project staff. The following table provides *examples* of the types of data to be collected and examples of their sources. Much of the data addresses four broad questions: (1) how much service was delivered, (2) what types of services were delivered, (3) how were the services delivered, and (4) how were they distributed (e.g., geographically and by type of client). The evaluation will also look at how the data change over time, and will explore possible links to changes in Center activities. For example, is an increase in access to the website linked to distribution of Center brochures?

| TYPES OF DATA ^(A) | SOURCES |
|--|--|
| Total number of Center materials, number by type (e.g., references, web links, curriculum materials), by content (e.g., materials technology), by format (e.g., print, web-based, CD) | Database of Center materials |
| Number of accesses to website by individuals, number by type of user (e.g., student, teacher), by type of organization (e.g., secondary school, business), by location (e.g., state) | Web tracking software (utilizing a log-in registration system) |
| Number of downloads of web-based materials, number by type, by content, by type of recipient, by type of organization, by location | Web tracking software (utilizing a log-in registration system) |
| Number of materials distributed, number by method (e.g., by mail, by hand, etc.); number by type, by content, by type of recipient, by type of organization, by location | Product distribution database |
| Total number of consultation services, number by delivery method (e.g., telephone, e-mail, virtual conferences), number by type, by content (e.g., materials technology), by format (e.g., print, web-based, CD) | Consultation database |
| Total number of dissemination activities, number by type (e.g., brochures, workshops), by content, by type of recipient/audience, by type of organization, by location | Dissemination database |
| Implementation problems and responses | Staff interviews, minutes of meetings |
| ^(A) Changes will be tracked over time for each type of data, e.g., how does the number of Center materials change by month and by year. | |

Outcome Evaluation: Data about outcomes and client satisfaction will be collected through mailed or e-mailed surveys of representative samples of clients receiving materials, consultation, and exposed to dissemination services. To ensure high response rates, evaluators will re-contact non-responders at least twice, offer all responders incentives, and use other tested methods (Miller, 1991, pp. 153-156). Questionnaires assessing intermediate outcomes will be administered shortly or immediately after the service (e.g., a consultation or presentation) occurs and will ask about such issues as: overall satisfaction, satisfaction with key aspects of the service (organization, length, delivery method, content, design, etc.), relevance to the client, usefulness, amount of new knowledge/skills gained, intention to apply these gains, and recommendations/comments about the service. Similar questionnaires assessing long-term

outcomes will be administered several months after a service ends and include questions about application/adoption, such as actual changes in behavior attributed to the service (e.g., use of material received in a class).

Because the Resource Center website will be the primary means of disseminating materials, data will also be collected concerning satisfaction about the site itself (versus material on the site). E-mailed questionnaires will collect data about issues such as ease of navigation, organization, and speed of downloads.

Reporting: The qualitative and quantitative data will be analyzed and results summarized in quarterly and annual evaluation reports that will be submitted simultaneously to the external evaluator, the National Visiting Committee, and the National Center for Manufacturing Education staff. A final report summarizing evaluation results across all years of the project will be completed in Year 4.

7. Dissemination Plan

The National Center for Manufacturing Education will disseminate manufacturing-related instructional materials and its consulting support services to community colleges nationwide. Much of the dissemination, which is described in the Project Plan, is summarized here.

The primary means of accessing the materials housed in the resource center/clearinghouse will be the registered resource center website, www.mfg-ed.org. This website will be established with researchable capability, links to other referenced websites, ample technical platform and design for expansion, and ready access to human technical assistance. Both print and non-print materials will be created and disseminated through direct mail. How-to flyers and brochures will be sent by direct mail to the 664 accredited manufacturing and related academic programs at community colleges and universities.

Staff will attend conferences of appropriate professional societies to promote the products and services. The Center will create a vendor booth and will deliver workshops and presentations at the conferences.

Through further research staff will identify the names and addresses of faculty members and administrators in non-accredited manufacturing programs for direct mail of materials. Abstracts of curriculum materials and ten abstract CD-ROMs will be created with instructions for accessing the resource center web site and selected topic summary resource abstracts. The Center will sponsor 12 virtual conferences on specific topic areas with follow up communications via web discussion forums. These conferences will be held during the second through the fourth year of the project. Additionally 15 CD-ROMs will be created that support the topics presented in the virtual conferences and provide a collection of subject specific resources.