Proposal Evaluation for the Manufacturing Technology Centers Program (1988)

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Proposal Evaluation for the Manufacturing Technology Centers Program

The Committee on Program Evaluation
for Manufacturing Technology Centers
Manufacturing Studies Board
Commission on Engineering and Technical Systems
National Research Council

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This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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November 28, 1988

Dr. John Lyons
Director, National Engineering Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899

Dear John:

Personally, and for the National Research Council committee which I chair, I would like to thank you and the NIST for the opportunity to participate in the process of determining the first group of Manufacturing Technology Center (MTC) awardees. We began the process with a substantial degree of trepidation because of the magnitude of the task, as well as the relatively short time in which to complete it. Some of this uneasiness continues to the present. However, our committee believes that the MTC program will be an exceptional vehicle to accelerate the rate, quantity, and breadth of the transfer of advanced technology to small and medium-sized manufacturers.

We believe that smaller companies are among those that can benefit most from the introduction of advanced manufacturing technology. Unfortunately, many of these companies lack the awareness, sophistication, and resources to apply new technologies. The greatest need of such companies is for education--someone to teach them that technologies are available, applicable to their needs, and cost effective in their plants. A major effort is required to make the technology transferrable to a variety of companies as well as actually to accomplish the transfer.

That was one of the central themes that ran through the 36 proposals we reviewed. The committee was very impressed with both the quantity and the quality of the proposals. Frankly, the level of activity presently under way was an encouraging surprise to the committee.

The committee emerged from our brief but intense review with a number of conclusions and recommendations for you and your colleagues at NIST.

1. The MTC concept and the program as a whole represent an appropriate and effective government role in addressing the current need to introduce advanced manufacturing technologies to small and medium-sized manufacturers. This need justifies sustained and substantial funding at the national, state, and local levels.
2. The MTC program should be extended and supported by multiyear funding to assure sustained, meaningful impact. While the committee recognizes that this first MTC program is a one-time award only, the committee feels strongly that the impact of a good MTC will be in evidence in a time frame longer than 12-18 months. In addition, while it is premature to speculate, you might find that a larger number of interlocked, more narrowly focused centers will be a more desirable way to go as the program grows.
3. Site visits to see firsthand the organizations that you believe merit finalist consideration is critical. While we have tried to do a diligent, high-quality job, we feel that the site visits are an absolutely necessary part of the selection process and should be included in any follow-on to our report. The committee believes that it did the best job possible reading and evaluating the proposals, but these evaluations are limited because of the absence of site visits.
4. The volume of proposals submitted, coupled with the reduced evaluation time, placed a burden on the committee that should be avoided in future efforts. To optimize the process, reasonable time is necessary.
5. Not surprisingly, the presence of "champions"--individuals who are fervent supporters of the concept--both in transferring organizations and among transferrees stood out as a strong contributor to success. This should be supported and fostered in whatever ways can be devised to increase their presence.
6. A potential concern resulting from the quantity and quality of the proposals is the enormous level of activity by state and local government, universities, and other organizations, which could lead to confusion, overlap, inefficiency, and even excessive failure. A clear vision of where we want to go and what we want to focus on should be an integral part of this process. This increases the need for and importance of a group of organizations around the country such as the MTCs.

The enclosed report contains the committee's technical evaluations of the 36 proposals. The evaluations are preceded by introductory sections on the committee's charge and evaluation process. As we stated, we feel strongly that important information is gained on site visits that cannot be captured in written proposals. We therefore conclude with a chapter about what to look for on site visits.

Reviewing the proposals has been a pleasure and an education. On behalf of the committee, we appreciate the opportunity to work with you and the NIST, and we hope that you will continue to feel free to call on us for help.

Sincerely,

Robert E. Fowler, Jr.
Chairman, Committee on Proposal Evaluation for Manufacturing Technology Centers

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Introduction

Successful international economic competition is driven in part by continued development and use of advanced manufacturing technologies. Since 1981 the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards*) has operated a unique engineering laboratory, called the Automated Manufacturing Research Facility (AMRF), that provides an array of manufacturing equipment and systems. One of the purposes of the AMRF is to encourage the modernization of American manufacturing by providing a test bed for research into advanced manufacturing technologies.

In order to bring the results of this research to American manufacturers, especially small and medium-sized companies, the NIST inaugurated the Manufacturing Technology Centers (MTC) program. The purpose of this program is to speed the transfer of advanced manufacturing technologies to U.S. industry. The MTC program will make awards of approximately $1.5 million to a selected number

*The change from the National Bureau of Standards to the National Institute of Standards and Technology was put into effect as part of the *Omnibus Trade and Competitiveness Act of 1988* signed into law on August 23, 1988, during the study period of this project. For the sake of simplicity, as well as consistency, the organization is referred to in this report as NIST, irrespective of its formal name at the time of reference.

of nonprofit organizations. An organization awarded an MTC cooperative agreement would serve as a regional center for the transfer of advanced manufacturing technology, developed at the AMRF or elsewhere.

Applicants prepared proposals in response to a notice that appeared in the *Federal Register* on July 18, 1988, which called on each applicant to address the objectives of the MTCs: (1) to inform and educate the industrial firms in its region about manufacturing technology, (2) to demonstrate the applicability of advanced manufacturing technology to these firms, (3) to actively assist firms in evaluating their requirements, (4) to assist with implementation of desired applications, (5) to support work force training and retraining, and (6) to amplify appropriate transfer experiences for a relevant national audience.

The *Federal Register* notice also indicated that a Merit Review Panel of the National Research Council (NRC) would evaluate all proposals received at NIST by September 16, 1988. Thirty-six proposals were received and forwarded to the NRC for evaluation.

This report presents the 36 evaluations and describes the committee's evaluation process. The report also contains a section on site visits, which the committee believes are essential to a successful selection process.

THE CHARGE TO THE COMMITTEE

At the formal request of the Director of NIST, the NRC, on April 8, 1988, approved a committee study to assist NIST with selection of the MTCs. The committee appointed for this project, under the auspices of the Manufacturing Studies Board, included experts in manufacturing engineering and operations, research management, technology transfer, automated manufacturing technology, training, and state and local government concerns.

NRC committees have undertaken similar activities in the past, including providing guidance to the National Science Foundation in setting criteria for selecting Engineering Research Centers and evaluating proposals for the Department of Energy's superconducting super collider. Recently, the Transportation Research Board assisted the Department of Transportation with a committee peer review of applications for the new University Transportation Centers Program.

The study approval stipulated that peer review activities for outside agency award programs should be undertaken only under certain

conditions in order to ensure the autonomy and independence of the NRC committee process. It is not appropriate for an NRC committee to select winning proposals, nor is it advisable for a committee to rank proposals in any manner. Instead, the most appropriate advice a committee should offer is a technical evaluation of the strengths and weaknesses of all proposals. This evaluation would contain no overall figure of merit nor would proposals be categorized.

The original charge, then, of the Manufacturing Studies Board committee appointed to assist the NIST with the MTC proposal evaluation consisted of four main tasks: (1) to comment on the selection criteria promulgated by NIST for public comment, (2) to develop a proposal evaluation process, (3) to conduct site visits to each proposing organization in a manner that ensures that the same committee members perform all site evaluations, (4) to prepare a report to NIST that combines the technical evaluation of each proposer's qualifications with the findings from the site visits.

The NIST determines the final selection of MTC awards.

Two unforeseen events necessitated modifications to the committee's charge. First, the original announcement of the MTC program that requested public comment on the selection criteria and that was to appear in the *Federal Register* was modified to become a program announcement soliciting applications. This led to dropping the committee task to comment on the proposed selection criteria. At its first planning meeting on September 7-8, 1988, the committee formally accepted use of the given criteria to undertake the proposal evaluations.

Second, the original estimate of the number of expected proposals was 12; 36 were received. While this number was evidence of widespread interest in the MTC program, it also called into question the feasibility of the same members of the committee visiting all proposing sites. A further complicating factor concerned the tight time schedule for making a public announcement of the awards. After much discussion among NIST, the NRC program staff, and the committee chairman, it was decided that the committee would not conduct site visits; instead, the site visits will be conducted by NIST staff using the technical evaluations prepared by the committee. NIST would make its award decision based on the technical evaluations prepared by the committee and its own site visit findings. The committee's job ends with the transmittal of this report.

At its meeting on October 27-28, 1988, the committee expressed

its concern that the quality of the evaluations is diminished without the benefit of conducting site visits. The committee believes that many of the selection criteria for the MTC program can be verified and substantively evaluated only after seeing the facility and equipment and interviewing the staff and potential clients for the technology. However, the committee also believed that it could provide a valuable service to NIST and to the MTC program by completing the evaluations of the written proposals. At the meeting, the committee formally agreed to issue its report to NIST and, further, to offer NIST suggestions on issues that the committee would have addressed had it made site visits (see page 78).

THE EVALUATION PROCESS

The 36 proposals received were in response to a *Federal Register* notice (Docket No. 80335-8138) announcing a program to fund cooperative agreements for Manufacturing Technology Centers. (A list of the 36 proposals can be found in Appendix A; a copy of the *Federal Register* notice appears in Appendix B.) The notice describes basic proposer qualifications and details the proposal review process including six general categories of selection criteria. Proposers were required to show that operation of the MTC would be by a nonprofit organization and were required to prove that matching funds meet the criteria contained in Attachment E of OMB Circular A-110. In addition, proposers were to respond to the six general criteria (divided into 22 more specific criteria) in sufficient detail to allow the NRC committee to evaluate the proposals and NIST to consider the evaluations to make a selected number of awards.

The 22 criteria listed in the notice are:

(a) *Program Relevance*

(1) The specified advanced manufacturing technologies including those developed at the NIST Automated Manufacturing Research Facility which will be demonstrated and transferred to a wide range of companies and enterprises in the region and whenever possible, small and medium-sized manufacturers.

(b) *Technical Capability*

(1) Relevant experience and education of the full-time key technical staff.

(2) Adequacy of the facilities and equipment to support the proposed Program.

(3) Proximity and availability of staff to service the targeted industrial base.

(4) Adequacy of the work force training and retraining activities.

(5) Relevance of the applicant's technical capabilities to the needs of the regional industrial base.

(c) *Market Requirements*

(1) Appropriateness of the regional target user groups; i.e., the identification, analysis, and justification of the regional industries to be served. This includes an assessment of the needs and receptivity of these groups to technology transfer efforts.

(2) Appropriateness and potential effectiveness of the Program in producing technology transfer to the target industries. Where the service area of the center includes firms from other states, the approach for linking with these states to serve these markets should be detailed.

(3) Appropriateness of national audience; i.e., identification, and analysis of national audience that would be most usefully served.

(4) Appropriateness and effectiveness of the center's programs, plans, and mechanisms (e.g., plan for allocating intellectual property rights) for producing technology transfer to a larger national audience.

(5) Budget, personnel, and facility allocations to the program activities.

(d) *Regional Relationships*

(1) Demonstrated linkages with regional/state/local economic development and extension organizations.

(2) Demonstrated linkages with regional, industrial, educational, and training organizations.

(3) Demonstrated interest of the region (local, state, industrial, or other entities) in improving its manufacturing capabilities.

(4) Geographic location of the proposed center vis-a-vis the concentration of target industries, the location of other centers and similar Programs and the technical focus of other centers.

(e) *Organization and Management Staff*

(1) Appropriateness of the legal and organizational structure proposed for facilitating technology transfer.

(2) Appropriateness of the full-time staffing levels of management and technical personnel, and the quality of this staff's manufacturing, marketing, and technology transfer experience.

(3) Record among the management team for attracting top personnel and for raising funds with industry, industrial associations, and state/local governmental bodies.

(4) Record of the management team in building successful organizations and the team's commitment to technology transfer.

(f) *Funding*

(1) Stability and duration of the applicant's matching funding commitments.

(2) Percent of operating costs guaranteed by the applicant.

(3) Ability to continue to operate when NIST funds terminate.

The committee developed an evaluation process at its first planning meeting, prior to receipt of the proposals. At the outset, the committee decided that all material contained in the proposal would be treated as confidential; after committee use, the proposals would be returned to NIST. The committee also decided that an evaluation process should be consistent in as many ways as possible with the instructions and criteria contained in the invitation to proposers.

To begin the process, all members of the committee received an extensive briefing and tour of the NIST Automated Manufacturing Research Facility. NIST program personnel described to the committee the origin and interpretation of the selection criteria. The committee noted ambiguity on two elements: (1) the program is a one-time effort with a short time frame, yet the criteria imply a much longer continuation; the committee agreed to accept the one-time only limitation within the intent of the stated criteria, and (2) the *Federal Register* notice is not clear on whether the proposer must use AMRF technology; the committee decided that a proposer is not required to demonstrate use of AMRF technology but must demonstrate use of AMRF or similar technologies.

The committee discussed the criteria at length to reach a common understanding of each criterion. This was accomplished through the development of how an "ideal" MTC would be structured and operate if it fulfilled and exceeded the stated criteria.

The committee realized that it was established to do more than inventory and verify a proposer's response to each individual criterion. Although the committee did not rank or even categorize

proposals, it did include a summary statement in each of the 36 evaluations. This summary statement is the committee's collective judgment on how well the responses to the criteria complement one another. It is the committee's statement on the overall proposal's strengths and weaknesses that would increase or impede the likelihood of success of the proposed MTC.

Each proposal was reviewed by at least two committee members and one staff member; proposals were distributed to avoid regional bias. Committee members completed summary evaluation forms for all of their assigned proposals. These evaluations were combined by staff for discussion purposes by the entire committee at its meeting in Chicago on October 27-28, 1988.

At the Chicago committee meeting, each proposal was described by the two reviewing committee members and was then discussed by the entire committee. For each proposal, the committee agreed on the overall strengths and weaknesses that would appear in the final evaluation. The final evaluations, drafted after the Chicago meeting, were reviewed by the two initial committee members and the chairman, and later by the entire committee.

At the conclusion of the Chicago committee meeting, the committee expressed its confidence that each proposal received adequate and equitable attention, and that the evaluations represent a thorough review of the proposer's response to the selection criteria as well as an overall statement of the proposal's strengths and weaknesses.

Technical Evaluations of MTC Proposals

CHATTANOOGA STATE TECHNICAL COMMUNITY COLLEGE
Proposal No. 101

Chattanooga State proposes to establish a Manufacturing Technology Center (MTC) that represents an expansion of the existing Advanced Technology Center at the college. The MTC will expand the Center geographically to serve 13 southeastern states and enable Chattanooga State to expand its capabilities in certain Automated Manufacturing Research Facility (AMRF) technologies developed at the National Institute of Standards and Technology (NIST). The MTC will transfer technology through agreements with other technical colleges.

Program Relevance

The proposer's existing manufacturing technology transfer center has been dedicated to serving manufacturers in Tennessee and neighboring states for the past five years. The center's technologies match those of AMRF. The proposer intends to demonstrate and transfer eight technologies, including seven developed at AMRF. The staff

is well grounded in manufacturing technology. The existing center has enjoyed substantial participation by companies, educational organizations, state government, and trade associations.

Technical Capability

The center currently has four full-time technical people dedicated to transferring technology to small and medium-sized manufacturing companies. Their academic credentials are in business and engineering, and all have extensive experience in manufacturing. More information would be desirable on other people at the center—for example, in technology maintenance. Equipment similar to AMRF is in place. Plans exist to double the existing floor space to 30,000 square feet. Computer-integrated manufacturing capabilities have been developed. Training programs appear to be excellent, and personnel from some 100 companies have been trained. The center has been ranked as the No. 1 AUTOCAD training center in the nation in competition with 151 other centers.

Market Requirements

The proposer plans to serve manufacturers of discrete parts—metal, wood, plastics—in the planned service area, and manufacturers have been identified. The number of potential clients is growing because new automobile plants are being opened in the region. Technology transfer within Tennessee would be handled through the five offices of the Tennessee Center for Industrial Services. Use of videotapes on each technology is a good strategy for technology transfer. Contacts will be established with trade associations. Teleconferencing will be considered for transfer through technology colleges in each of the other states in the service region. Existing hands-on training is good and will be expanded to other states through the Southern Growth Policies Board. Not noted in the proposal were an analysis of the need for advanced manufacturing technology and comments on barriers to adoption of new technology.

Regional Relationships

The proposed service area is rather large. Linkages have been established with many organizations at the local, state, regional, and national levels. Support and funding are indicated from both government agencies and manufacturers, such as the state of Tennessee, the

Tennessee Valley Authority, General Electric, Boeing, and Kaiser. Chattanooga is at the geographic center of the southeastern industrial area, and highway and air transportation are excellent. The statement of a track record of transfer of manufacturing technology was not backed up by details.

Organization and Management Staff

The existing full-time staff of four people will be increased by four if the NIST funds are granted. The proposer claims a proven record for attracting talent, raising funds, and building and operating a successful organization for manufacturing technology transfer. However, no details were given as to how small and medium-sized companies' work with the center would be facilitated.

Funding

The proposal would spread NIST funds over three years. Matching funding is in place in the form of current operating funds. The proposer has a good record of funding from companies, TVA, and the state of Tennessee. The five-year history of operation demonstrates stability and the ability to operate after NIST funds are expended, as is planned.

Summary

The committee found many strengths in this proposal, particularly the stability of the existing center that has been serving industrial clients for five years. The technical capabilities of the proposer are excellent. The committee believes the NIST funds would be effectively leveraged to small and medium-sized manufacturers in a larger area than is currently being served. The committee also noted some weaknesses in the proposal, including the lack of detailed examples of manufacturing technology transfer, no analysis of small and medium-sized manufacturers in the region, and no discussion of possible barriers to technology transfer. Also missing are details on support staff, including equipment maintenance staff. Further, the proposed service area—13 southeastern states—is larger than the area currently served and may be unrealistically large.

THE HARTFORD GRADUATE CENTER
Proposal No. 102

The proposal is to establish a Manufacturing Technology Center (MTC) at the School of Management of the Hartford Graduate Center in Hartford, Connecticut. The MTC would serve small and medium-sized manufacturers in upstate New York and in the New England region. It would focus on the needs of regional manufacturers for advanced technologies to automate manufacturing, to acquire production planning and control systems, and to learn material management techniques.

Program Relevance

This proposal contains little discussion of AMRF or similar technologies. The emphasis is on existing projects that the proposer would like to expand. The proposer intends to operate the MTC in the school of management, raising some concerns about the balance between theory and practice.

Technical Capability

The proposer has strong capabilities in computer use, but limited experience with high-technology manufacturing. The availability of machinery is very limited. Most of the faculty and students are part-time. The school has emphasized training, rather than implementation.

Market Requirements

The proposer is located in an industrial region that uses many new technologies. The proposer makes a case that the target groups could be reached and are now reached for educational purposes. The national audience would be difficult to reach, but research and development in the group technology area may be of national interest.

Regional Relationships

Linkages are adequate within the state, but not extensive outside it. The proposer is a member of various regional groups.

Organization and Management Staff

The MTC would be led by the Dean of the School of Management on a part-time basis. The Technical Director, who also would be part-time, is an Associate Professor of the School of Management and Chairman of the Manufacturing/Operations Management curriculum. Consultants would be part-time. The administrative coordinator would be full-time, as would the programmers and a clerk-typist.

Funding

The NIST money would be spread over the five years and matched 1/3 out of pocket cash, 1/3 services in kind, and 1/3 fees from clients. Technology transfer activity would begin after six months. Developing the new structure classification system would take two years, and testing would take another two years.

Summary

The committee notes many successes of the proposer in other areas, but believes that this proposal does not substantiate adequately its methods or plans for successfully transfering AMRF or other advanced manufacturing technology. Weaknesses include limited manufacturing experience, limited discussion of AMRF or similar technologies, and the proposed use of part-time personnel in leadership roles. Particularly questionable is the idea of attempting to transfer advanced technology to small and medium-sized manufacturers using as transfer agents a nontechnical school and mostly nontechnical people. The committee notes, on the other hand, that the faculty has extensive computer background and that development of a computerized group technology system may be of national interest.

AUGUSTA TECHNICAL INSTITUTE
Proposal No. 103

Augusta Technical Institute proposes to expand its Center for Advanced Manufacturing Technology Transfer to small and medium-sized manufacturers in a region encompassing 13 southeastern states. The Augusta Technical Institute, located in Augusta, Georgia, is a public, postsecondary institution that offers programs for employment in business, health, and technical careers.

Program Relevance

The proposer has a plan complementary to the aims of the MTC program, but the extent to which AMRF or similar advanced manufacturing technologies would be involved is not clear in the proposal.

Technical Capability

The program director has analyzed the need for manufacturing technology in his region, consulted on the subject, and has had some experience with high-technology systems. However, he is the only proposed MTC staff member with any technical experience. Tabletop models would be used, along with a full-sized robot and a CNC lathe and mill.

Market Requirements

The Augusta area has more than 450 manufacturers, and the proposer's experience indicates that a great amount of help is needed in all phases of manufacturing in the area; the proposer has been in operation for over 20 years, training people for industry in two-year programs that go beyond secondary school. A market survey has been completed: 457 organizations were asked to complete and return a questionnaire, and 143 of them did so. Most were companies with more than 50 employees, and 90 percent of them said they planned to automate some of their operations within the next two years.

Regional Relationships

The proposer's Center for Advanced Manufacturing Technology Transfer has contacts with local industry. Through the Alliance for Manufacturing Productivity and the Consortium for Manufacturing Competitiveness it expects to reach 13 southeastern states with its work.

Organization and Management Staff

The current staff is oriented to postsecondary education and training. Personnel qualified to transfer AMRF or similar technologies would be hired and trained during the early months of the project.

Funding

The matching contribution would be largely in-kind facilities, with some state funds for a building addition; $500,000 of the NIST grant would be used for this addition. Continuing funding would depend largely on negotiating one-year consortium agreements with customers on four possible levels of participation from $2,500 to $10,000.

Summary

The committee notes that the proposer has developed a good plan that is complementary to the MTC program. But the committee would point out weaknesses that include the following: (1) the long time needed to construct the building addition and to hire and train people for the program, (2) the use of tabletop models and the few full-sized machines available may make it difficult to demonstrate advanced technologies unless customers provide the machines, and (3) continuing funding may be difficult unless or until some results are demonstrated. The committee believes that a need for advanced manufacturing technology does exist in the area, however, and the proposer has more than 20 years' experience training people to work in industry.

BRIGHAM YOUNG UNIVERSITY
Proposal No. 104

The CAM Software Research Center (CSRC) of Brigham Young University (BYU), located in Provo, Utah, proposes to establish a Manufacturing Technology Center (MTC) for the Rocky Mountain region, defined as the states of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming.

Program Relevance

Combined technologies developed by the proposer, AMRF, and industry would be demonstrated and transferred to industry in the eight Rocky Mountain states. The first year would be devoted to setting up prototype production and training facilities. The next four years would be devoted to establishing cooperating organizations and implementing a manufacturing extension agents program

in the region. This concept, modeled after the Agricultural Extension Service, is appropriate, but the specifics of how technology would actually be transferred are not described.

Technical Capability

The technical capability of the staff intended to be the core of the MTC is high. The proposer would provide facilities (60,000 square feet) and equipment (valued at $1.7 million).

Market Requirements

The proposal gives no specific analysis of the number of manufacturers in the eight-state service region or other indication of the size of the potential user group. Users and their requirements would be determined during the first year of the MTC operation. The proposal does indicate that some efforts have been made to reach manufacturing firms, but that the firms have not been highly receptive. Previous attempts to involve small and medium-sized manufacturing firms directly in the activities have not met with great success. The proposal does lay out a thoughtful approach to attempting to reach out to manufacturing firms in the region. However, it gives little persuasive evidence, based on either experience or identification of the market and steps to be taken, that successful and productive contacts would be made for the actual transfer of technology.

Regional Relationships

The governors and economic development offices in the eight states have been contacted, but not all have responded. Support from other academic institutions and industry is not indicated. One of the highlights of the proposal is the planned attempt to develop a multistate network of relationships. The MTC would be in Provo, Utah, but specific institutional linkages would be established through a network in the eight states. This interstate network, however, seems tentative at this point, and, given the inclination toward interstate competitiveness (acknowledged in the proposal), insufficient information is given on how the network would be coordinated. Nor is it clear precisely how the interstate network would interact with the small and medium-sized manufacturers in the region. The location of the MTC in the general vicinity of Salt Lake City seems appropriate;

the location is central, and the city is one of the principal economic centers of the Rocky Mountain region.

Organization and Management Staff

The legal and organizational structure proposed for the MTC appears to be appropriate. The center would be a subcontractor to the proposer's CSRC for transferring technology. The MTC research staff, identified by name, includes a principal investigator, three or four coinvestigators, and two research associates. The percentages of their time to be devoted to the MTC, and other MTC staffing, are not indicated.

Funding

Matching funds of $1.559 million are indicated, but not supported. The proposal makes a strong case, however, that adequate matching funds would be obtained, and that the proposer has a clear commitment and the ability to operate the MTC when the NIST funds terminate.

Summary

This proposal candidly addresses each of the key issues and lays out an imaginative, if unimplemented, approach to transferring technology throughout the planned eight-state region. It also identifies some of the deficiencies in AMRF technology that would have to be corrected before the technology could be transferred successfully. However, the committee sees two principal problems. One is the lack of specific description of the size and nature of the manufacturing industry to be served and the absence of any convincing evidence that small and medium-sized manufacturers will participate. The second problem concerns the proposal's lack of specificity about how an MTC would relate to BYU or other regional agencies or academic institutions. Information on regional relationships is tentative, at best. The committee wishes to point out, however, that the CSRC has demonstrated the ability to attract top personnel and raise funds and has worked to build a successful organization and team commitment to technology transfer.

STATE UNIVERSITY OF NEW YORK AT FARMINGDALE
Proposal No. 105

The State University of New York (SUNY) at Farmingdale proposes to change current activities of its Center for Advanced Manufacturing Technology Transfer (CAMTT) to a NIST Manufacturing Technology Center (MTC). The existing CAMTT combines student instruction with service to local small manufacturers to transfer technology and improve their operations. The proposed MTC will focus on the industrialized area of Long Island, where Farmingdale is located.

Program Relevance

The proposer demonstrates a good understanding of AMRF technology, and the proposed MTC would serve a significant group of manufacturing firms. The proposal has not identified specific technical needs of prospective clients; however, it shows a sophisticated understanding of the technology transfer process, including the importance of the proposer's extensive technical education and training capacity to that process. In essence, the proposer would modify the operations of a well-established institution to transfer AMRF technology to small and medium-sized manufacturers on Long Island, and in New York City and the vicinity.

Technical Capability

The proposer has specialized in manufacturing technology for the past 30 years. Substantial personnel and facilities are in place at the existing CAMTT. NIST funds would be used for marginal additions to the tools and computers, with most of the budget being allocated to personnel and technology transfer activities.

Market Requirements

The local client group is substantial and representative of the national population of precision metalworking and assembly shops that supply the aerospace, defense, and machinery industries. Because the CAMTT is long established, it presumably has ongoing ties with national organizations. Since a technology transfer center for manufacturing is already in existence and undertaking technology transfer

work, it would be difficult to distinguish conclusively between current activities that are related to the AMRF project and those that would be added through the resources of the institution itself.

Regional Relationships

The proposer is one of the technology campuses of the SUNY system. The proposed MTC's activities would be linked with the Center for Innovative Technology Transfer at the SUNY campuses at Oswego and Utica. Strong support is indicated from state and local government and business organizations.

Organization and Management Staff

The proposer would redirect the activities of the existing CAMTT, which offers very strong and experienced management combined with experienced technical experts properly organized and supported by administrative staff. The principal change would be the addition of people, equipment, and programs to address more specifically the way in which AMRF technology could be transferred to small and medium-sized manufacturers.

Funding

Matching funds are promised from funds already controlled by the proposer. Because CAMTT is already functioning, a stable and durable presence in manufacturing and technology transfer is likely after the NIST funds are expended.

Summary

The committee believes that this proposer is well qualified to operate an MTC in terms of both manufacturing technology and technology transfer. The only noteworthy weakness in the proposal is in specification of technical needs of prospective clients, but the proposer's track record suggests strongly that this weakness is more apparent than real. An extensive facility and program are already in place. The additional technology and staff needed for efforts focused on AMRF technology could be acquired quickly and added to the existing infrastructure to serve a significant number of manufacturers in both the short and long term.

DEMATEC FOUNDATION
Proposal No. 106

The University of Missouri-Rolla, through its Center for Technology Transfer and Economic Development, has formed the DeMaTec Foundation to transfer manufacturing technologies to small and medium-sized manufacturers. This proposal describes a time-shared flexible metal-cutting facility to give manufacturers access to state-of-the-art technology and business systems for production.

Program Relevance

The proposal correctly identifies the need for Flexible Manufacturing System (FMS) technology directed to smaller firms in precision metalworking. It contains no discussion of AMRF or similar technologies that would meet specific needs of the client group, however, and gives no indication that the Kearney and Trecker Company (which would help with design) will use any advanced technologies to better focus the design of the FMS on the needs of smaller firms.

Technical Capability

The proposal is at too early a stage to judge the technical capability that would be brought to the MTC project; very little technical capability is yet in place. The associated institution has high-quality engineering capability, but it is likely to be several years before technology is successfully transferred.

Market Requirements

The proposal identifies an important group of clients and products that are representative of a national population and an important problem. It does not, however, make any linkage between AMRF or similar technologies and the solution to the problem identified.

Regional Relationships

The limited data in the proposal make it difficult to assess the extent of relevant regional relationships.

Organization and Management Staff

The organization and staff proposed seem satisfactory, but the individuals have no track record as yet.

Funding

Start-up funds do not seem to exist as yet. The proposer's concept of long-term self-funding from fees for production is a good idea.

Summary

This proposal is innovative, but is not far enough advanced to permit effective use of NIST funds for the intended purpose. Also, the committee discerns some confusion between efforts to demonstrate an FMS and the requirement for use and transfer of AMRF or similar technologies. As noted above, however, the institution does have the engineering capability needed for the job.

THE UNIVERSITY OF ALABAMA
Proposal No. 107

This proposal describes a Manufacturing Technology Center (MTC) that expands activities already under way at the University of Alabama to transfer technology to small and medium-sized manufacturers. This proposal is submitted in conjunction with the Bevill Center for Advanced Manufacturing Technology, which was established in 1987 to develop and retain the local industrial base and provide a technological support base for new industry.

Program Relevance

The proposal implies that AMRF metalworking technologies fit the needs of manufacturing industry in Alabama. An "aggressive, interactive program" with AMRF is proposed.

Technical Capability

The proposer has an established capability in manufacturing technology, especially with the large, new, well-equipped Bevill Center. A welding cell is planned. The proposal contains many academic resumes, but none of the people involved is yet attached to the project.

Market Requirements

No analysis is given of the needs or sizes of the state's manufacturers, but the proposer seems to have a strong program, well accepted by manufacturers in the general metalworking field. The Bevill Center is projected to handle the hands-on technology transfer projects. The plan is to use consultants to help with technological concerns; community colleges would handle training. On-site/regional personnel are proposed to visit and consult with clients and possibly conduct training.

Regional Relationships

Good connections exist with economic development organizations and regional staff, with the community college system, and with a few other institutions. Good connections exist also with a few multistate programs.

Organization and Management Staff

The organization will involve an Office of Technology Transfer, which has not yet been formed. The staff will be drawn from the proposer's administration or numerous faculty, but no one is yet assigned to the MTC project. Five top technical directors are planned, but only three are to be hired in the first year of the project.

Funding

The proposal shows matching funds ($1.5 million) from prorated use of various facilities. It says that state funds would not be requested until the status of the MTC program is decided. No plans are discussed for funding the MTC after the NIST funds are expended.

Summary

This proposal is not as strong as could be desired on several scores, including the lack of analysis of the state's manufacturing needs, the lack of specificity about the individuals to be assigned to the MTC staff, and the uncertainty about continued funding. At the same time, the committee notes that the proposer has established capabilities, has the new Bevill Center operating, and has experience in extension seminars and general projects with industry.

UNIVERSITY OF ARKANSAS
Proposal No. 108

The University of Arkansas' Department of Industrial Engineering and the Arkansas Center for Technology Transfer propose a Manufacturing Technology Center (MTC) for northwest Arkansas. The MTC will focus on the metalworking industry in Arkansas and neighboring Oklahoma.

Program Relevance

The proposer is active in work similar to that to be undertaken by the proposed MTC. No detailed analysis was given, however, of the industries to be served, the sizes of the manufacturers, or the technologies they need.

Technical Capability

The technical capabilities of the proposing institutions are high, and staff has experience in advanced manufacturing methods. The staff understands what AMRF is doing; it is working with various robots and automation systems in existing programs and should be able to apply this experience in the proposed MTC.

Market Requirements

Analysis of manufacturers and their needs is limited. The industry to be served comprises mainly small and medium-sized manufacturers, but many of them are in fields other than metalworking. The proposer's general area has 108 manufacturers; many of the other prospective clients will be a three-hour drive from the proposer, around Tulsa, Oklahoma, which has some 901 manufacturers. A survey of regional interest indicated that 5 percent of the firms contacted would highly utilize the MTC and 50 percent might use it on occasion. A technology transfer program has been operating for several years and has a membership of five Arkansas firms. An Entrepreneurial Service Center has served 213 clients in the past 24 months.

Regional Relationships

Very little is said about linkage to any organizations except a few

in Arkansas. No industry links or other training facility connections are mentioned.

Organization and Management Staff

The existing Arkansas Center for Technology Transfer would expand its Center for Robotics and Automation to include the proposed MTC. The center would be administered jointly by the director of the Center for Technology Transfer and the head of the proposer's Department of Industrial Engineering. The available staff is well educated in the relevant fields; a number have doctoral degrees in industrial engineering. The staff is lacking in industrial experience, however.

Funding

Funding would be largely from university and state funds, with a relatively small amount from clients. The budget shows $1.7 million in matching funds, mostly for staff salaries and university overhead. Fees would be charged for use of equipment. State funding is likely to continue, but it is not known how much funding might be obtained from other states, where many of the clients would be located. Funds for continuing the program after the NIST funds terminate have not been identified.

Summary

The proposer's current staff in the relevant fields has experience in advanced manufacturing and understands the AMRF program. The committee believes, however, that certain difficulties warrant attention. One of these is the limited analysis of the potential market and its needs; another is the proposed MTC's distance—100 miles or more—from most of the potential clients, which can be a major problem in working with small and medium-sized companies. Countervailing strengths include the proposer's current activities and experience in technology transfer.

OHIO STATE UNIVERSITY RESEARCH FOUNDATION
Proposal No. 109

This proposal describes a plan to establish a Manufacturing Technology Center (MTC) for small and medium-sized companies

that manufacture and use dies and molds. It is submitted by the Engineering Research Center for Net Shape Manufacturing of the Ohio State University in Columbus. The area to be served comprises Ohio, Michigan, and Indiana.

Program Relevance

The proposer understands AMRF developments and has outlined a very specific plan to transfer applicable AMRF technologies to the die and mold industry. One example is surface sensing, which could be highly important in automating mold polishing, which is now very labor-intensive. Successes in the die and mold area would have spinoffs for many other areas of manufacturing.

Technical Capability

The staff has a long history of research in areas closely related to the work proposed. Staff has good experience working with companies, and some have good industrial background. The considerable equipment in place includes heavy presses, die casting gear, a die polishing cell, and 5- and 10-ton cranes in a 10,000 square foot bay, which is available for the project. Extensive computing facilities are available as well as a large collection of software for mold making. Previous work shows a technical grasp of the die and mold industry and a solid basis for progress with AMRF or similar technologies.

Market Requirements

The U.S. die and mold industry is centered in Ohio, Michigan, and Indiana; the three largest mold makers in the country and 50 percent of the capacity are in Ohio. Die and mold makers are mostly small manufacturers. The proposer knows the companies and their needs and has 45 manufacturer members for other die/mold projects. Technology transfers in the field are applicable to a national audience, although the regional transfer mechanisms would need some additions. Existing close ties with the Ohio Technology Transfer Organization (OTTO) will be important as will ties to other Ohio schools, particularly those in the Edison program. Specific plans are outlined for use of a mobile demonstration van not yet acquired.

Regional Relationships

The proposer works with Battelle and Wright-Patterson AFB (in nearby Dayton). Links with OTTO and other Ohio schools were noted above. The planned cooperation with the Edison program would add complementary locations and programs of other MTCs. Letters of support from associations are listed. Little evidence is given of linkages outside Ohio.

Organization and Management Staff

The proposer was organized originally for technology transfer to the die and mold industry and cites a number of transfer accomplishments. A deputy director for the proposed MTC is identified. Staff initially will comprise four or five engineers. Current staff will devote 75 percent of their time to the project for the first six months and 50 percent thereafter as new people are hired. These hires are planned for a three-year project.

Funding

The request is for $500,000 for each of three years. The state of Ohio will provide matching funds. The proposer has a good record of support from industry.

Summary

This proposal outlines a very specific plan for transferring identified AMRF technologies to a specific industry composed largely of small to medium-sized manufacturers centered in a geographical area readily accessible to the proposed MTC. The committee believes that the proposer is well qualified but is concerned that it will take over three years to execute this plan. Set against this are the importance of the die and mold industry nationally and potential spinoffs from the project to other manufacturing industries.

GMI ENGINEERING AND MANAGEMENT INSTITUTE
Proposal No. 110

GMI Engineering and Management Institute, located in Flint, Michigan, is an accredited college offering degree programs in engineering and management systems. It was established in 1919 as a

wholly-owned subsidiary of General Motors Corporation; in 1982 the Institute changed its status to a private college. The Institute proposes a Manufacturing Technology Center (MTC) to serve a region that will extend from Minnesota to upstate New York and centrally along a corridor from Michigan to Mississippi.

Program Relevance

The proposer is strong in faculty, facilities, and outreach mechanisms and has an established record in advanced manufacturing technologies including those developed at AMRF. It intends to use those technologies, along with its own specific capabilities and interests, to transfer technology to small and medium-sized manufacturing companies.

Technical Capability

The proposer has the staff, equipment, and experience needed to develop an MTC as envisioned. Its strength lies in automotive-related manufacturing, where it has extensive experience in education and training in support of technology transfer.

Market Requirements

The area the proposer plans to serve may be unrealistically large—a region extending from Minnesota to upstate New York and from Michigan to Mississippi. The proposal was not as specific as it might have been in identifying prospective clients and their more specific needs. As a consequence, the impression is left that the focus would be on the traditional base in automotive-related firms which tend to be medium-sized to larger firms. The proposer estimates that about 10 percent of the work force of Michigan is employed by independent manufacturers who supply the major automotive companies. Most of these suppliers are small companies, although no specific estimate of their number is given. The proposal notes the likelihood of consolidation of small and medium-sized automotive suppliers to yield a smaller number of larger suppliers. The proposer's history of working with the large automobile manufacturers is a potential advantage in this environment. On the other hand, the proposal indicates no special interest in or accommodation to small and medium-sized manufacturing firms that are not in the automotive industry. Nor

does it estimate the number of small and medium-sized manufacturers in states other than Michigan that could be served by the MTC.

Regional Relationships

The proposer has close relationships with many companies in its home area (centered in Flint, Michigan), which is strongly oriented toward manufacturing. It also claims close relationships with industrial firms throughout Michigan and in some other states. Relationships with small and medium-sized firms in other states are not specified in detail, however. The proposer claims to have established strong relationships with local, regional, and state agencies and organizations interested in supporting local manufacturing capabilities, but these linkages, again, are not given in detail.

Organization and Management Staff

The proposed organizational structure is not described as specifically as it might have been. This does not necessarily argue that a solid organization and staff would not be put in place. The proposer does not plan to establish formal linkages with other institutions in the development and operation of the MTC. It maintains that this will minimize organizational complications and overhead costs.

Funding

The proposer plans to use the NIST grant to finance about one-third of its costs in the first two years and to be self-supporting by the third year. Outside support is predicted to be generous, but is not described specifically. The proposer has a record of attracting outside funding from large companies, principally General Motors, as well as from other private sources, government, and private foundations, particularly the Flint-based Mott Foundation.

Summary

Notwithstanding the lack of specificity in descriptions of regional relationships, staff, and prospective clients, the committee believes that the proposed MTC is well within the scope of the proposer's

capabilities and experience, which are largely automotive. Less certain is the extent to which the proposer would be able to expand technology transfer activities beyond that scope.

INDUSTRIAL TECHNOLOGY INSTITUTE
Proposal No. 111

The Industrial Technology Institute (ITI) proposes to establish a midwest Manufacturing Technology Center (MTC) with the Research and Technical Institute in Grand Rapids, Michigan, and Indiana State University. The focus of the MTC will be on advanced manufacturing technologies, particularly those that are computer controlled. The market emphasis is on the durable goods sector, especially the small and medium-sized companies that supply the larger equipment manufacturers. The MTC will serve Michigan and Indiana.

Program Relevance

The proposer has investigated AMRF technologies and has more than enough resources, technical capabilities, and facilities to cater to the small and medium-sized manufacturers in the specified service region. Manufacturing firms have been identified by several studies showing results by size and type of manufacturing. Results from the studies show the need for training, job redesign, organizational changes, and specific areas where advanced manufacturing technology would be useful. A long list of advanced manufacturing technologies has been investigated. Many software systems have been developed by the proposer, and seminars together with newsletters, tapes, and hands-on training have been used to disseminate information on advanced manufacturing technology. The proposer has developed a flexible automated cell for electric motor assembly for a major auto supplier and has developed systems integration for a MAP/TOP users group.

Technical Capability

The planned staff, facilities, and equipment are excellent at all three sites that would be involved. The proposer has a staff of more than 150, many of them with backgrounds in industry, academe, and government. The major disciplines are adequately covered. The proposer has a 9,000 square foot area, and the new applied technology center, when completed, will have 200,000 square feet. Equipment

in place is worth many millions of dollars. Visiting companies is an established operation.

Market Requirements

The market has been well defined and clearly can benefit by adopting advanced manufacturing technologies. Means of allocating intellectual property rights have been carefully considered. Companies have been identified as to size, location, and needs. The needs have been tabulated, and the barriers to automation have been listed. To support rapid adoption of developments, 20 equipment vendors with a select group of 50 to 75 companies have been identified. Technology transfer services exist in both states, and the need for personal contact is recognized.

Regional Relationships

The proposed partnership is a logical one, and regional state support is assured. Both Indiana and Michigan are clearly committed to this enterprise. Existing outreach programs already are successful, and people of both states have done much background work to show how they will work together to provide service and support.

Organization and Management Staff

The organizational structure is comprehensive. Neither of the codirectors (program management) has much technical training, but they would be supported by a staff with excellent technical qualifications. A cooperative agreement adviser would negotiate with vendors for commercialization. It would be desirable to have more detail on the background of the personnel who will work with the small and medium-sized manufacturers, how they would work with these manufacturers, and whether one individual will have full-time responsibility for the MTC.

Funding

The applicant proposes that the MTC be funded 75 percent by vendors and 25 percent by NIST. To date, the state of Michigan has provided $40 million over five years for transfer of manufacturing technology to small and medium-sized manufacturers. Funding of future operations appears secure.

Summary

This proposal indicates that all of the elements necessary to success are in place. Given the large established operation, however, the committee is concerned that the NIST program might not receive the focused attention it would require. A related concern is the planned use of codirectors rather than one full-time director for the MTC. Also, the committee would like to have seen more detail on the qualifications of the people who would work with small and medium-sized manufacturers and on how they would work.

RURAL ENTERPRISES, INC.
Proposal No. 112

Rural Enterprises, Inc., located in Durant, Oklahoma, will coordinate a consortium composed of the Oklahoma Vocational Technical Education Department, Oklahoma State University (Engineering Extension and the College of Engineering, Architecture and Technology), University of Oklahoma (College of Engineering), and The University of Tulsa (College of Engineering). The consortium will establish a Manufacturing Technology Center (MTC) serving a six-state region in the central United States.

Program Relevance

The proposal demonstrates a clear understanding of the need to make the manufacturing base more competitive, the need for better technology, and the importance and difficulty of technology transfer. It shows a clear focus on many areas related to work at AMRF, but gives almost no indication of knowledge of developments at AMRF.

Technical Capability

The six participating organizations have high and relevant technical capability. Among the proposed personnel assignments, capability is very high, but would be widely shared. Judgment of full-time personnel is possible only by inference because no specific appointments were documented. The MTC would share its members' facilities; $450,000 is proposed for new, but unspecified equipment. The staff would be located within 150 miles of Durant.

Market Requirements

General understanding of the market appears to be good. The proposer indicates 720 manufacturing businesses in Oklahoma and 5000 in the six-state service region. Target companies and their technological needs are not specified, however. Knowledge of the market is much stronger for Oklahoma than for the other states of the region. The proposer has the knowledge and infrastructure needed for technology transfer and has had some successes at it.

Regional Relationships

The proposal is highly focused on Oklahoma, with most of the regional work yet to be done. Relationships with government agencies, industry, and other academic institutions are not indicated. Also not indicated is a formal relationship among members of the proposed MTC.

Organization and Management Staff

The proposer would use its existing staff on a part-time basis to coordinate MTC operations. Seven full-time positions would be filled in three of the member organizations. The structure as described appears to be an organization within an (existing) organization, with responsibility for the MTC likely to be somewhat diffused.

Funding

Matching funding is based on utilization of assets of member organizations of the MTC. More than 67 percent of the total operating cost of the MTC is guaranteed by members; the remaining matching funds are not identified. The proposer has built a sound, broad funding base, however, and the probability of securing matching funds and continuing funding appears to be high.

Summary

The linkage of organizations to form an MTC is a fine idea. The committee believes, however, that the proposal is not sufficiently concrete: it lacks a business plan with organization, financial projection, firm goals and objectives, and support from the region to

be served. Still, the region has needs for manufacturing technology, and the proposer evidently has had some success in transferring technology.

CLEVELAND ADVANCED MANUFACTURING PROGRAM
Proposal No. 113

The Cleveland Advanced Manufacturing Program (CAMP) proposes to establish a Manufacturing Technology Center (MTC) at the Unified Technologies Center (UTC), a new facility for technology demonstration and training near downtown Cleveland, Ohio. CAMP is a private, not-for-profit organization that was created on the initiative of Cleveland Tomorrow, an organization of 50 chief executive officers of large corporations and institutions in the Cleveland region. CAMP is an Edison Technology Center. Ohio's Thomas Edison Program provides statewide services and support to solve manufacturing problems and increase the rate at which new technology is put to use in the workplace.

Program Relevance

The proposer runs a substantial program for encouraging, helping, and training companies of all sizes in advanced manufacturing technologies. The operation includes space, facilities, equipment, and a large communications system. Hundreds of manufacturing companies have been identified, with metal forming and polymer processing as major classifications. These companies are located in Ohio and elsewhere in the proposed service area—the industrial corridor from New York to Illinois. Specific advanced technologies have been identified for the region; they include retrofitting, which is important to small and medium-sized manufacturers. In place is an outstanding training program, including hands-on seminars, with participation by industry, trade associations, educational organizations, and state and local government. The proposal states that proposed MTC would require 18 months from the time of the NIST award to get started.

Technical Capability

Personnel include 42 full-time staff, 17 full-time equivalent university professors, and 85 students. The UTC at Cuyahoga Community College has 96,000 square feet and is the focal point for activities such as demonstrations, seminars, and workshops. Training efforts

are very strong and are rated highly by small companies, many of which are periodically visited. A Manufacturing Resource Facility and, after careful study, a few million dollars worth of advanced manufacturing equipment will be added. Working agreements with local organizations provide easy access to capabilities in automated intelligence systems and mechanical/optical and sensor technology.

Market Requirements

The proposer, as noted above, has identified hundreds of prospective clients in the planned service area. Greater Cleveland alone has 5,500 manufacturers (70 percent durable goods). The five neighboring states have more than 4 million manufacturing employees (22 percent of the U.S. total). A 1985 study by the proposer showed 443 companies with limited use of advanced manufacturing technology; 46 percent had some advanced technology, and 46 percent had no plans to buy. The proposer demonstrates a strong understanding and good experience in providing outreach services to small and medium-sized manufacturers.

Regional Relationships

Having been created by Cleveland Tomorrow, the proposer has established excellent linkages in the Cleveland area. Written support has been expressed by a variety of organizations. The proposer demonstrates an impressive grasp of institutional relationships with state, local, and regional institutions, both public and private.

Organization and Management Staff

The proposed MTC would be an extension of the existing organization, which has investments of $85 million and an annual budget of $13.4 million. Because of this financial strength, the proposer has been able to attract many capable people. If the NIST grant is awarded, full-time people would be assigned to the MTC. The center would be located at the UTC and could call on the existing network and facilities to assist small and medium-sized manufacturers. The staff would include agents assigned specifically to visit and work with such firms.

Funding

The state of Ohio has provided or will provide $1.5 million in matching funds. The proposer has received $8.1 million from the Edison program, $18.1 million from the state, and $16.2 million from other sources.

Summary

This proposal indicates to the committee a highly successful organization that knows its clients and their needs and has the people and facilities to transfer advanced manufacturing technology. The track record suggests further success, with AMRF technologies as well as those already in place. The only major question is whether NIST funding would make a significant difference, given the size of the existing operation, and the response presumably would lie in the planned assignment of full-time people to the MTC.

MINNESOTA ADVANCED MANUFACTURING TECHNOLOGY CENTER
Proposal No. 114

The Minnesota Advanced Manufacturing Technology Center (MAMTC), incorporated in July 1988, is located in Minneapolis in the Minnesota Technology Corridor. The proposer emphasizes multistate cooperation through partnership among six states—Illinois, Kansas, Minnesota, Nebraska, North Dakota, and South Dakota—referred to as the North Central Regional Advanced Integrated Manufacturing Service Centers Partnership. The proposed MTC will initially focus on the metal cutting industries in the region. MAMTC will work with local centers, the first being Rock Valley College Technology Center in Rockford, Illinois, and field teams that work with manufacturers to move AMRF or similar technologies to designated industries.

Program Relevance

The North Central Region, the proposed service area, contains a high percentage of employment in metal fabrication. A survey indicates that half of the firms say they will need high technology, but are skeptical of it until they see some actual, hands-on demonstration. The proposer indicates a good choice of AMRF technology and

demonstrates the need for it in the regional industry. The proposer has developed complementary technology in the sensor area, and the proposal shows a clear understanding of the technology transfer process as well as of the need to make the technology transferrable to the target group.

Technical Capability

The proposer appears to have all the initially needed facilities and technology already in place, as well as substantial experience in manufacturing. The proposer's board of directors has a broad base of technical and nontechnical members representing clients, government, and associated organizations. However, only a relatively small proportion of the people whose resumes were in the proposal appendix has experience in industrial technology. The proposer, in cooperation with personnel of the University of Minnesota Productivity Center, will convene a Regional Technical Team to undertake the adaptation and enhancement of the horizontal workstation technology as the first program for technology transfer.

Market Requirements

This proposal would use a number of existing regional manufacturing programs to advance the use of AMRF or similar technologies. Industries in the area make many machined and molded parts and can use the new technologies, although the committee has some concern over the lack of industrial concentration in this region compared with other areas. The plan to have the first technology transfer take place in Illinois but managed in Minnesota is unorthodox, but the proposal makes a convincing case that it will succeed.

Regional Relationships

Six states have indicated support for this proposal and pledged cooperation through their existing organizations operating in this field. Existing organizations such as the National Advanced Integrated Manufacturing Service Centers Partnership, Inc., and the University of Minnesota Productivity Center will work closely with clients in the transfer of technology.

Organization and Management Staff

The proposer already has a board of directors and will have seven full-time employees. It will coordinate the North Central Regional Advanced Manufacturing Service Centers Partnership and will help local technology centers apply AMRF or similar technology. Field teams to be convened and trained in each state will build relationships with existing and start-up manufacturers.

Funding

The proposer has received excellent local industry and state government support. Funding is assured in the first year by $500,000 from the Minnesota legislature, $500,000 from foundations, $2 million from the Greater Minnesota Corporation, and the NIST funds. The proposed three-year program would include other state in-kind matching funding of $1 million to $2 million per year. The Greater Minnesota Corporation has guaranteed a continuing $2 million contribution in the second and third years. The Minnesota legislature is expected to contribute $10 million for a building in the second year.

Summary

This proposal demonstrates strength in all aspects; it describes a three-year program that would show results in the first year with broad regional progress in the second and third years. The proposal shows a clear understanding of the process required for successful technology transfer. The funding is well covered with strong university, state, and industrial support. The program will work if capable people are assigned to the central staff and field teams. At this point, only the board of directors has been named.

TECHNOLOGY DEVELOPMENT AND EDUCATION CORPORATION
Proposal No. 115

This proposal is to establish a Manufacturing Technology Center to facilitate technology transfer to smaller manufacturers in the Northeast and Midwest. It is submitted by the Technology Development and Education Corporation on behalf of the Southwestern Pennsylvania Industrial Resources Centers, the National Institute of

Flexible Manufacturing, and the Marshall University Research Corporation in conjunction with the Center for Education and Research with Industry.

Program Relevance

This proposal covers a large region, many industries and manufacturers, and a wide range of technologies, generally involving use of computers. It is not well focused, however, and does not reflect an awareness of problems in packaging and transferring AMRF or similar technologies.

Technical Capability

The suitability of current technical capability depends on whether the available skills match the technological needs of the small and medium-sized manufacturers in the region. The necessary surveys of needs remain to be done, so the extent of the match, if any, is not clear.

Market Requirements

The service region clearly has a plethora of small metalworking firms. It is also clear that a tremendous amount of technology transfer activity is under way and that it will continue.

Regional Relationships

Relationships are adequate and seem strong between Pennsylvania and West Virginia. The proposed MTC's geographic location would facilitate serving more than one-third of the nation's manufacturing economy.

Organization and Management Staff

The proposal suggests a brokering administrator's role, which is adequately covered. The organization chart shows a very complex matrix organization staffed by a significant number of people who would be devoting only part of their time to the MTC.

Funding

The proposer envisions a first-year budget of $5 million for the MTC, with guaranteed non-NIST funding of $3.5 million. Of the latter, more than 90 percent is public funds.

Summary

This private-sector proposer is experienced and seems to be well funded. But the committee is concerned about the complex organization proposed for the MTC, the lack of specific focus on the program, the use of part-time staff, and the many competing programs. On the positive side, the proposer is user-oriented, well located in terms of prospective clients, and has good ties with regional universities and industries.

BOISE STATE UNIVERSITY
Proposal No. 116

This proposal, submitted by Boise State University in Idaho, plans to establish a Manufacturing Technology Center (MTC) for 13 western states (Washington, Oregon, California, Nevada, Idaho, Montana, Utah, Wyoming, Colorado, New Mexico, North Dakota, South Dakota, and Arizona). The focus of the MTC will be on metalworking and food and lumber processing.

Program Relevance

The proposer presents a short, but excellent outline of AMRF technologies that would be transferrable. It also describes well the client business and operations needs, but it fails to document the linkages between client technology needs and the specific vehicles (such as working models or demonstrations) that would enable the technology to be transferrable.

Technical Capability

The proposer has very capable staff and good technology for information transfer and training—vocational/technical training, video, teaching at high school through advanced levels (some across the country). A strong faculty and industry advisory technical system is in place. The proposer is weak, however, in people and facilities for

manufacturing. A $15 million flexible manufacturing system (FMS) facility is expected to be operating in five years. A new, $7 million teleconferencing facility is in place.

Market Requirements

The proposer assumes that what industry has been requesting is what will be needed. It further assumes that this view will be validated by a current (September 1988) needs survey of some 2,900 smaller manufacturers in Idaho. The target group, mainly small business, is a good one, and one the proposer has proven it can reach. Unique video/interactive training facilities may permit coverage outside of Idaho.

Regional Relationships

Linkages seem to be complete and well developed in Idaho—economic development organization, community colleges, and vocational-technical training organizations. Linkages outside of Idaho are not clear, although the proposal cites two to five organizations in each of the other states.

Organization and Management Staff

The faculty is broadly multidisciplinary and competent in training and information transfer, but, as noted above, apparently weak in manufacturing and manufacturing technology. The proposer's strongest suit seems to be the ability to create and implement new organizational structures, acquire state funding for new facilities, form industry advisory bodies, and garner industry/private funding.

Funding

The proposal shows $1.518 million of in-kind funding, although the two-year budget shows no equipment funds. $410,000 is budgeted for the first two years of "administrative operating costs"; the proposer will provide $200,000 for the third year. Postgrant continuity of the proposed MTC is said to be part of the plan, but is not discussed further.

Summary

The committee recognizes a great amount of expertise in training

and communication in the proposing institution. The MTC program is consistent with the proposer's goals and with its facility expansion plans. The new FMS due in five years would round out an attractive combination of strengths in technology transfer. The committee recommends close attention, however, to the current lack of information on manufacturing equipment and facilities. While the proposer has demonstrated the ability to communicate information well, it has not demonstrated the ability to develop usable technology from AMRF or similar types of developments.

GEORGIA TECH RESEARCH CORPORATION
Proposal No. 117

Four universities in four southeastern states—Clemson University (South Carolina), Georgia Tech, North Carolina State University, and the University of Kentucky—have formed the Southeastern Manufacturing Technology Center (SEMTC) consortium. The purpose of SEMTC is to accelerate the diffusion of advanced manufacturing technology with a focus on small and medium-sized manufacturers in the four consortium states.

Program Relevance

This proposal calls for transfer of specific advanced manufacturing technologies through existing industrial extension vehicles in the four SEMTC states. It shows no history of association with AMRF, however, nor awareness of the needs and problems of packaging AMRF or similar advanced manufacturing technologies for transfer.

Technical Capability

The existing and planned staff, facilities, and equipment at sites in the four states clearly amount to the critical mass needed to support an effective technology transfer program. Proven industrial extension services are in place.

Market Requirements

The proposal identifies appropriate industries in the region whose members can benefit by adopting advanced manufacturing technology. These industries include small and medium-sized manufacturers that are receptive to modernizing their manufacturing capabilities

through technology transfer and education. Many of the prospective clients could become competitive in world markets. No evaluation of specific regional technology needs is given, however, nor any indication of support from small and medium-sized manufacturers.

Regional Relationships

Regional relationships are well documented. Industries identified on a state-by-state basis indicated responsiveness to participation in adoption of manufacturing automation. SEMTC would be headquartered in Atlanta. It would reach its targeted industries through a regional center in each of the other three states and through existing industrial extension services in all four states.

Organization and Management Staff

The proposed organizational structure includes a consortium of four state-level technology transfer programs. SEMTC would be administered by a director, who is currently associate director of Georgia Tech Research Institute, and four state program directors comprising a five-member technical coordinating committee. An industrial advisory committee would be used. Plans include use of formal program evaluation.

Funding

The nature of the organizational structure, including existing state-level industrial outreach programs, suggests a high probability of matching and continuing funding and growth.

Summary

Demonstrated activity in technology transfer and involvement of the personnel and facilities of four major universities are definite strengths of this proposal. The committee questions the use of a part-time director and the apparent lack of focus on AMRF or similar technologies and specific needs for them among small and medium-sized manufacturers. At the same time, the need for advanced manufacturing technologies is recognized, outreach programs are in place, and substantial participation is evident by state and local governments, manufacturers, trade associations, and educational organizations.

MASSACHUSETTS CENTERS OF EXCELLENCE CORPORATION
Proposal No. 118

This proposal describes a program to create a New England Manufacturing Technology Center (NEMTEC) to build a regional technology transfer program directed toward small and medium-sized manufacturers in New England. The proposal is submitted by the Massachusetts Centers of Excellence Corporation on behalf of the NEMTEC consortium members, which include government and quasi government agencies, academic institutions, industry, and labor groups in Massachusetts, Vermont, Connecticut, and Maine.

Program Relevance

This proposal clearly defines the target sectors: metalworking and electronic/mechanical assembly, with a third sector, foundry operations, also mentioned. It develops a plausible, well-documented rationale on why these sectors are important to the planned service region. The proposal demonstrates a knowledge of what has been developed at AMRF and how it can be related to the region and target sectors and gives examples of how AMRF or similar technologies can be expanded, enhanced, simplified, and packaged for transfer to small and medium-sized manufacturers.

Technical Capability

The combined technical capabilities of the institutions included in the proposal are of very high caliber. Also included are about 13 universities, among them the Massachusetts Institute of Technology and the Massachusetts Manufacturing Resource Center at Tufts University and the University of Lowell. The professional capacity and the facilities and equipment of these institutions are substantial. The proposer emphasizes the central role of workers in technology transfer, reflected in the involvement of the Bay State Skills Corp., which has developed a reputation as a leader in training programs for business.

Market Requirements

The proposal gives a clear indication of a knowledge of the market,

including substantial data focused on the target manufacturers, although it tends to be demographic in nature rather than specific. It is noted that Massachusetts has an estimated 1,200 metalworking firms, employing 15 percent of the state's manufacturing labor force. The electronics industry comprised 20 percent of the state's manufacturing employment in 1987. The proposer lays out a comprehensive and imaginative approach to technology transfer, especially to small and medium-sized manufacturers. The region's metalworking firms are categorized in basic, intermediate, and advanced levels of sophistication in manufacturing technology. The basic level involves little advanced technology; the advanced level involves use of advanced technologies, including a changeover of at least 30 percent of machining systems to computer numerical control. The proposal estimates that nearly 40 percent of Massachusetts' manufacturers would be in the basic category, 42 percent intermediate, and 18 percent advanced. A strategy is presented to deal with this range of sophistication. One aspect of that strategy would be to reconfigure technologies to meet the specific needs of small and medium-sized manufacturers. Another would be designed to deal with the highly variable expertise and skills within specific industries and manufacturers and provide feedback to NIST.

Regional Relationships

The proposal is heavily weighted toward Massachusetts organizations as a core. It identifies regional organizations that are part of the proposed consortium, defines their expected roles, and documents their strong desire to participate, including a considerable willingness to contribute people and dollars. The consortium would include state, business, university, and labor institutions in the four states of the service region. The range of members reflects high sensitivity and capacity for relating regional, state, and local institutions in key sectors that would be involved in transfer of manufacturing technology.

Organization and Management Staff

The proposed organization and staff fit well in the overall plan. The concept appears manageable and sufficiently structured to do the job. The talent and experience of the contributors to the consortium are deep and considerable. The proposal calls for NEMTEC to be

based on networking of consortium members to pursue a multifaceted strategy for technology transfer. It gives little detail, however, on the specific organization of NEMTEC or the specific members of its proposed management staff. The intent is to hire personnel as needed after the center is created; without greater specificity, it is difficult to say what the caliber of the staff would be. Also, it is not clear whether the creation of NEMTEC is premised on receipt of the NIST grant.

Funding

The proposal pledges $1.13 million of in-kind contributions and $799,000 in cash contributions from consortium members to NEMTEC. Verbal commitments from corporations total about $100,000, but are not included in the proposed budget. Long-term funding after NIST funds are expended seems probable.

Summary

In this proposal the committee sees a number of strengths: the broad base and high quality of institutions; solid, broadly based funding; the importance of metalworking and electronics manufacturing in the region; and the imaginative conceptual approach to technology transfer. However, the management staff is not identified, and the linkages in Massachusetts are stronger than elsewhere in the region. The major question, the committee believes, is whether NEMTEC, an overlay rather than a hands-on organization, would be able to implement the concept and strategy so well articulated in the proposal.

ROCHESTER INSTITUTE OF TECHNOLOGY
Proposal No. 119

The Rochester Institute of Technology (RIT), located in Rochester, New York, is a career-oriented and applications-oriented university with programs in industry training and professional development. The proposed Manufacturing Technology Center (MTC) will serve small and medium-sized manufacturers in New York state and across the New England states.

Program Relevance

The proposer has chosen manufacturing automation and imaging

science and technology (along with microelectronics) as top priorities. It has courses related to AMRF areas, and the technology in existing centers relates to AMRF. Emphasis would be on manufacturers needing assistance in robotics, imaging, computer-aided design and manufacturing, automated production, materials handling, computer numerical control (CNC) machining, and artificial intelligence as they relate to computer-integrated manufacturing technology. The target area of New York and New England represents 14 percent of U.S. manufacturing industry, with 65 percent being small companies.

Technical Capability

Staff and equipment exceed the critical mass necessary to support an effective technology transfer program. Background given for 46 selected faculty members indicates that most have good industrial experience that would blend with the MTC. Input for the MTC would be provided by many labs: robotics, microelectronics, intergraphics, CAMCELL, materials, computer science, imaging science, quality control and statistical science, productivity and inventory management, and computer-aided engineering design. The proposer grants degrees in manufacturing and each year graduates 14,000 students and trains 20,000 employees. Training programs have been attended by more than 200 companies. These programs have used video, interactive video, seminars, and demonstrations. Some programs are conducted at company sites.

Market Requirements

The proposer has had relationships with some 1,500 manufacturers in New England; 60 percent of them are small companies. Potential clients and their needs are not specified, but the proposal shows linkages with many manufacturers—for example, 60 in quality control and applied statistics, 42 in production and inventory management, and 56 in graphic arts. Forty-seven manufacturers contributed to the new $5.5 million microelectronics center, and 14 contributed to imaging science and technology facilities. Introductory programs, workshops, and seminars are offered for small manufacturers at no cost. For specific manufacturing problems, user fees and the proposer's funds will be used. Technology transfer would be done through technical and professional societies, regional and national conferences and symposiums, video, teleconferencing, and computer messaging. The organization is in place for handling intellectual property.

Regional Relationships

The proposer documents an excellent record of interacting with industry and other organizations. The proposed regional relationships are coherent and comprehensive. The proposer is tied in with New York State Department of Economic Development, Industrial Innovation Extension Service, and the Centers for Advanced Technology Program. It is in a consortium with the University of Rochester and Monroe Community College and is tied in with the Upstate Roundtable on Manufacturing and the Economy (industry and university presidents), the High Tech Task Force, and the Industrial Management Council (200 members) for manufacturing in the Finger Lakes Region. High Tech of Rochester will also work with the proposer.

Organization and Management Staff

The proposed MTC would report to the president of the Research Corporation of the university. It would embrace a demonstration and learning center and an extension, outreach, and research services group. The MTC setup would include one director, two professional education people, one resource coordinator, and three outreach staff (a leader, an administrative assistant, and a writer). The proposer recently reorganized to strengthen its outreach program for small companies. The assistant provost will push for coordination, and a new senior management team will be the governing board for the MTC.

Funding

The proposer has an enviable record in generating support for its activities and has positioned itself to ensure that the MTC effort will not end when the NIST grant terminates. It plans to carry on with user fees and its own funds.

Summary

This proposal, the committee believes, meets all of the criteria for an MTC of the kind envisioned. In addition, the proposer has a longtime record of successfully working with industry.

THE INSTITUTE OF ADVANCED MANUFACTURING SCIENCES
Proposal No. 120

The Institute of Advanced Manufacturing Sciences (IAMS), located in Cincinnati, Ohio, is an Edison Technology Center. Ohio's Thomas Edison Program provides statewide services and support to solve manufacturing problems and increase the rate at which new technology is put to use in the workplace. The proposed Manufacturing Technology Center (MTC) would service a region covering parts of three states (Ohio, Indiana, and Kentucky) in a 120-mile radius of Cincinnati.

Program Relevance

The IAMS was formed in 1982 to meet goals almost identical to those of the MTC program. It contemplates transfer of eight AMRF technologies through provision of hands-on demonstrations. Although aware of the AMRF technologies, the proposer has not studied them.

Technical Capability

The existing staff includes six people with exceptional backgrounds in manufacturing and 14 with appropriate supporting backgrounds in manufacturing. The Rapid Response System would include a computer numerical control (CNC) lathe, a CNC machining center, and a coordinate measuring machine. This equipment remains to be acquired, and the staff has no appreciable hands-on experience with it. All staff members will be located in a 65,000 square foot (two floors) technical center. The center includes a 3,000 square foot bay, which would house the MTC.

Market Requirements

The region has 9,700 manufacturers, 2,200 of them in general metalworking. The proposer conducted surveys of 527 manufacturers in 1983 and 301 in 1988 to determine needs and establish direction. The proposer has transferred technology to many companies, small and large, that say the transfer has made them more competitive. The problems solved were more in everyday areas than in advanced manufacturing. Feedback would indicate that small companies first need some basics, with follow-on in more advanced technologies. Some 37

percent of revenue for the year ending in June 1988 came from small companies. Linkages are in place with national forums. Policies have been established for safeguarding intellectual property.

Regional Relationships

Because the proposer is part of the Edison program, it is tied in with the other Edison centers. The proposer has a working agreement with the Advanced Technology Center at Lorain Community College, 250 miles away, for technology transfer programs. Support is said to have come from other centers, universities, technology schools, associations, governments, and chambers of commerce.

Organization and Management Staff

Existing staff would be used for startup of the MTC; it would have a director with seven staff members for the first year and four staff members thereafter. All business elements are in place. The proposer has demonstrated the ability to attract funds, work, and talent.

Funding

Funds have come mostly from the state of Ohio, which is guaranteeing $1.5 million in matching funds. Annual revenue grew from $368,000 in 1985-86 to $650,000 in 1987-88.

Summary

The proposer is really in the startup stage (the technical center was completed only in summer 1987), but its charter and operation provide a fine prototype for future activities. The time that would be required to procure advanced manufacturing equipment and complete the break-in/ learning period makes significant progress with the MTC's goals unlikely in the short term.

UNIVERSITY OF NEW MEXICO
Proposal No. 121

The recently established Southwest Industry Manufacturing Technology Center (SIMTC) is a coalition of states (New Mexico, Colorado, Arizona, and Texas), universities (University of New Mexico, New Mexico State University, Arizona State University, Colorado

State University, and Texas Tech University), federal laboratories (Los Alamos National Laboratory, Sandia National Laboratory), and the BDM Corporation. SIMTC will be headquartered in Albuquerque on the University of New Mexico campus.

Program Relevance

This proposal calls for building an organization in a four-state region to transfer technology from regional sources and the AMRF to small and medium-sized manufacturers. It identifies a wide range of technologies for transfer, but shows no real tie to AMRF developments.

Technical Capability

The theoretical and academic capability is outstanding. Lacking, however, is indication of a technical tie to nuts-and-bolts manufacturers at the level of the technician, the computer numerical control machine operator, and the chemical processor. This apparent lack would make technology transfer difficult.

Market Requirements

The region covered is large and one of the country's fastest growing manufacturing areas. Markets are defined adequately, although mostly in nonspecific, demographic terms. Ties to laboratories and universities are much stronger than those to small and medium-sized (or even large) manufacturers.

Regional Relationships

Ties to the university network, economic development offices, and laboratories through the proposed service region are excellent. Broad ties to target manufacturers are not apparent.

Organization and Management Staff

The proposal outlines a distributed management approach with an overall director and a director at each coalition site. It gives no particular plan as to how funds would be allocated to the sites and what, if any, areas of concentration and direct tasks would be handled by each. The hands-on transfer aspects of the organization are not well defined.

Funding

Funding is spelled out in detail and seems firm. The amount is impressive, but a smaller fraction than is desirable comes from industry directly or from other private-sector areas.

Summary

The coalition includes strong and capable members, and manufacturing in the region is growing rapidly. A major concern of the committee is whether the NIST funds would be used for the intended purpose or absorbed by ongoing programs of research and training. The proposal is unclear about specific responsibilities; it is weak in presenting a comprehensive plan. The proposal does make a strong case that the region wants to excel in manufacturing.

UNIVERSITY OF SOUTH CAROLINA
Proposal No. 122

The University of South Carolina, Clemson University, and the South Carolina Technical College System propose to establish a South Carolina Technology Transfer Cooperative (TTC) to transfer AMRF or similar technologies to the fabricated metals industry.

Program Relevance

The proposer would transfer AMRF or similar technologies to manufacturers in the state of South Carolina. The state has about 1,250 small and medium-sized metal-related manufacturing businesses. In the first year the MTC would focus on some 235 metalworking firms in that group.

Technical Capability

The universities and technical colleges that would be involved have technically capable staff that would be drawn on for this program. Suitable equipment is on hand and would be used; other government and private concerns in the region have AMRF-type equipment that could be used for demonstration purposes.

Market Requirements

The proposer notes that the 1,250 metal-related manufacturers mentioned above is a relatively small base, although it is growing. Capital investment in the metalworking industry in 1987 was $600 million. The growth of skilled labor in this area should make AMRF or similar technologies more welcome than in areas that are not growing. The TTC would include Clemson University and the 16 state technical colleges, which would facilitate the transfer of technology (the technical colleges now work with industry). A select group of faculty would be designated AMRF technology transfer agents and would act as technical consultants within the TTC. An existing Small Business Development Center associated with the proposer would provide a statewide network to refer potential clients to the TTC.

Regional Relationships

The proposal focuses almost exclusively on South Carolina. One of the state technical schools (Trident) is one of 13 southern technical schools participating in a manufacturing consortium organized by the Southern Technology Council, an affiliate of the Southern Growth Policies Board; South Carolina is a member of these regional efforts. South Carolina may be potentially a significant geographical location for a manufacturing technology center, but the proposal does not elaborate on the state's position within the larger regional framework.

Organization and Management Staff

Financial and administrative responsibility for the project would lie with the proposer's Center for Industrial Research. The indicated intent is to use the Michigan Modernization Service as an organizational model for the TTC, but details are not given. The TTC would be supported by facilities and personnel from its member institutions. Initially, the program would be headed by the director of the proposer's Center for Technical Research and an identified representative from the State Board for Technical and Comprehensive Education. They would function until a permanent director was named. The AMRF technology is known to those involved.

Funding

The program is scheduled for 12 months, and the NIST grant would

be matched largely by in-kind equipment already purchased. Salaries would be paid from the grant, which would be expended in the one year. It is not clear how the program would be financed for subsequent years unless government funds were provided. Funds for operation in other states would be expected to be raised in those states.

Summary

This is a well-stated plan. The committee believes that it could work quickly because the facilities are available and the work would be decentralized to existing organizations. The proposer demonstrates knowledge of the AMRF technologies and the goals of the program. Success would depend on assignment of the right people for a sufficient amount of their time and the ability of the proposed TTC to coordinate the several institutional efforts as planned.

NEW JERSEY INSTITUTE OF TECHNOLOGY
Proposal No. 123

The New Jersey Institute of Technology (NJIT), located in Newark, proposes to establish the NJIT Manufacturing Technology Center (MTC). The MTC will provide technical assistance for the demonstration and transfer of advanced automation technologies for small and medium-sized metalworking, microwave, and plastics industries in the New York/New Jersey metropolitan area.

Program Relevance

This proposal identifies relevant and important target manufacturing sectors. It shows good understanding of the technology transfer process and the types of people needed to handle it. The proposal gives no indication, however, of any knowledge of the AMRF or similar technologies available for transfer or of the specific technological needs of prospective client groups.

Technical Capability

The proposer's staff and facilities available for an MTC are of very high quality. The MTC would be allocated 13,000 square feet in a building now under construction. Equipment of unspecified value

is available for transfer to the MTC; $450,000 worth of additional equipment would be added under the proposal.

Market Requirements

Manufacturers in the target industries are numerous in the region. The proposal does not, however, identify specific companies, their technological needs, nor their interest in participating in an MTC program. Technology would be transferred through interdisciplinary university/industry teams, which the proposer is currently using successfully.

Regional Relationships

Linkages in the region seem strong, especially the community college linkages, which are very effective in training and in reaching smaller manufacturers. The proposer is linked to the New Jersey Commission on Science and Technology and the Local Development Corporation of East New York. Linkages to other government agencies and industry are only implied. Government agencies in the region seem aware of the need to improve the competitiveness of local industry; however, support from local industry or willingness to improve its competitive position is not indicated. The MTC would be well located to serve the apparent target area—New Jersey and eastern New York City.

Organization and Management Staff

The proposed organization appears to be workable, although specifics are scarce. Co-directors have been named and each would devote half-time to managing the MTC. The staff, yet to be hired, would include six full-time professionals, other part-time professionals, and students. Legal functions are to be handled by the proposer's legal staff.

Funding

The New Jersey Commission on Science and Technology has provided $6 million for the building now under construction and continuing support of $500,000 per year. The New Jersey Department of Higher Education is contributing $3 million for construction and will provide an additional $1 million per year during the startup phase.

Summary

The committee believes that the proposer has the people and infrastructure to support a successful MTC. The proposal does not, however, focus on specific AMRF or other technologies to be transferred, nor on specific prospective clients, their needs, and their willingness to participate. The proposer does have a successful technology transfer mechanism in operation, and manufacturers in the selected target industries are numerous in the region.

TEXAS ENGINEERING EXPERIMENT STATION
Proposal No. 124

A Manufacturing Technology Center (MTC) in the Southwest is proposed by a consortium comprising the Automation and Robotics Research Institute of the University of Texas at Arlington, the Institute for Manufacturing Systems of the Texas A&M University System, and the Texas Engineering Extension Service also of the Texas A&M University System. The MTC, the proposal for which was submitted through the Texas Engineering Experiment Station, intends to service New Mexico, Texas, Oklahoma, Arkansas, and Louisiana, and would be located in the Dallas/Fort Worth area.

Program Relevance

Already existing in Texas is a well-established network of organizations that are involved in the development and transfer of advanced manufacturing technology to industry, including small and medium-sized manufacturers. The proposed MTC would build on this institutional base and would transfer all AMRF technologies.

Technical Capability

The members of the consortium for the proposed MTC have high technical capabilities, but the proposal does not say which of their people would be specifically involved in operating the center. The MTC would be allocated space in the new, 48,000 square foot Automation & Robotics Research Institute (ARRI) in the Dallas/Fort Worth area. It would use equipment of the consortium members.

Market Requirements

Manufacturing is growing in Texas and the Southwest, and the proposed target user groups reflect a very substantial proportion of the national whole that the AMRF program is intended to reach. The Dallas/Fort Worth area alone has an estimated 8,000 small and medium-sized manufacturers. Industries in the area include aerospace, electronics, automobile assembly, machine tools, apparel, and steel production. One small and several large companies (for example, Westinghouse, Texas Instruments, LTV, Tandy) have indicated support for the MTC. The region's needs and the willingness of small and medium-sized manufacturers to participate are not indicated. Members of the consortium have experience in transferring technology, by a variety of means, to the kinds of firms that are the intended targets of the AMRF program.

Regional Relationships

The technology-oriented institutions clustered around the ARRI represent in themselves a rich network of relationships. These institutions also claim strong relationships with state and local economic development and extension organizations. The Texas Engineering Extension Service, for example, is a state agency for technical training. The institutions as a whole also have extensive contacts with regional industrial and training organizations. Links to regional institutions in the Southwest outside of Texas are somewhat more tentative. Location of the proposed MTC in Dallas/Fort Worth would appear to be highly desirable because of the concentration of manufacturing there and the importance of Dallas/Fort Worth as a transportation hub.

Organization and Management Staff

The proposal lays out an MTC organization whose principal function would be to coordinate the activities of the related elements of the consortium's members. The organizational links to the consortium are not defined. Member organizations are already performing tasks of the kind the MTC would be expected to undertake. It would thus appear that the principal benefit of the additional organizational structure would be to use the NIST funds, as the proposal puts it, to "speed up and enhance" programs already under way. The MTC would have a director and a staff of seven full-time technical

professionals. The director and three of the staff have been named to serve on an interim basis until the permanent staff is in place.

Funding

Matching funds of $1.527 million are indicated mostly through in-kind contributions from consortium members. The proposal claims assured post-NIST funding because it envisions speedup and enhancement of existing activities, not the creation of substantial new ones.

Summary

Members of the proposed MTC consortium are capable and well equipped. They are already heavily involved in technology transfer in an area rich in new and growing manufacturing firms. The committee is concerned, however, on several scores. It is not clear, for example, how the MTC staff would function vis-a-vis consortium members. The technological needs of prospective small and medium-sized manufacturing clients are not specified. Substantial changes from existing programs are not planned. It should be recognized, nevertheless, that speedup and enhancement of existing programs can be highly beneficial, depending on the nature of the programs.

EDISON MATERIALS TECHNOLOGY CENTER
Proposal No. 125

The Edison Materials Technology Center (EMTEC), an Ohio-based consortium of 35 industry members, nine universities and colleges, five federal laboratories, and others, proposes to establish a Manufacturing Technology Center (MTC) to serve an eight-state region. The service area consists of Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania, West Virginia, and Wisconsin. The MTC would focus on metalworking firms in the automotive and aircraft industries.

Program Relevance

This proposal outlines a plan to transfer 16 AMRF technologies, educate and inform 10,000 industrial people, and develop short courses

during the first year of the MTC project. The proposer has researched and categorized the AMRF technologies well, relative to regional industry needs.

Technical Capability

The proposer can draw on a strong base of academic and government institutions and laboratories for personnel and equipment. All the equipment needed for the proposed MTC is on hand. The Dayton Tool and Machine Association will support the project and provide potential test sites. Personnel plan to visit AMRF early in the project.

Market Requirements

Detailed analysis builds a strong case for technology transfer to automotive-related manufacturing; 50 percent of the nation's capacity in this field is in the proposed service region. Aircraft-related manufacturing is less important in the area, but the existence of technological need is strongly supported by the government and the Air Force (Wright-Patterson AFB). Both General Motors (GM) and General Electric (GE) support the need to strengthen the base of smaller suppliers, although the proposal shows little evidence of connections with small and medium-sized manufacturers.

Regional Relationships

Linkages appear to be confined to Ohio, but are relatively strong. Most of the 35 industrial members are under $500 million in sales, GM and GE being among the exceptions.

Organization and Management Staff

The proposer is a matrix organization, drawing heavily on academic institutions in the area, with strong direction from industry. Four "core staff" will provide the major direction for the proposed MTC at no charge. The staff is skilled in project management and directing large funded programs. Many additional staff members are identified—the project would call on 15 to 35 of them as needed—but they also have duties with academic institutions.

Funding

The state of Ohio is committed to supplying the entire $1.5 million in matching funds at the outset. Also committed is $1.2 million from members of the consortium, as well as free use of facilities and equipment and academic and industrial time. Much of the funding would go directly to the technology transfer process, not overhead, fixed assets, travel, printing training materials, etc. A credible long-range projection shows 100 percent assured support for the project after the NIST grant ends.

Summary

The proposer has the facilities and knowledge for conducting research. However, very little information was given as to how it would organize and successfully help small companies with applied technology. Also subject to question are claims on the time of faculty used on a part-time basis, the limited evidence of connections with small and medium-sized manufacturers, and the limited evidence of relationships outside Ohio. It is recognized that the core leadership planned for the MTC project has had proven successes with industry in drawing on broad, matrix-managed teams for research.

ADVANCED TECHNOLOGY CENTER/LOUISIANA PRODUCTIVITY CENTER
Proposal No. 126

This proposal is to establish an Advanced Manufacturing Technology, Training, Development and Demonstration Center at the University of Southwestern Louisiana in Lafayette. It is submitted by the Advanced Technology Center and the Louisiana Productivity Center.

Program Relevance

The proposer describes its organization, physical facility, and operating procedures, but does not identify AMRF or similar technologies for transfer. Moreover, it does not explain how a Manufacturing Technology Center (MTC) would affect technology transfer programs made possible by NIST funding.

Technical Capability

The facilities seem satisfactory, as does the staff, although the capabilities of the latter are less well documented.

Market Requirements

A prospective client group is not specifically identified. The proposal offers no discussion of specific manufacturing technology problems and proposed solutions based on AMRF or similar technologies.

Regional Relationships

Regional relationships are not fully addressed, but are strong where indicated.

Organization and Management Staff

The organization and staff are satisfactory.

Funding

Long-term assured matching funds are not committed. It is unlikely that the center would be able to continue when NIST funds terminate.

Summary

This proposal gives the committee little real basis for a technical assessment. No definition is given of a specific client group, its technological needs, or a plan for meeting those needs through AMRF or similar technologies.

RENSSELAER POLYTECHNIC INSTITUTE
Proposal No. 127

Rensselaer Polytechnic Institute (RPI), located in Troy, New York, proposes to establish a Northeast Manufacturing Technology Center (NEMTC) through RPI's Center for Manufacturing Productivity and Technology Transfer. During its first year, NEMTC will focus on AMRF technologies on material removal, assembly, and inspection of mechanical components for the automotive and consumer electronics industries. The service area initially is New York state, but eventually would encompass nine northeastern states.

Program Relevance

The proposer demonstrates outstanding comprehension of the technology and an ability to handle it. Three targeted AMRF technologies—hierarchical robot control, feature-based programming, and computer-aided design-driven inspection—parallel work being done by the proposer.

Technical Capability

The proposer demonstrates broad and deep technical talent that meets or exceeds the technical needs of an MTC in all aspects. Nearly all needed facilities are in place; 15,000 square feet and 50 percent of equipment time are available. Written vendor commitment has been made for a coordinate measuring machine and another computer system, which is needed to support identified technology transfer test projects.

Market Requirements

The initial focus is on metalworking in New York state, but early extension throughout the Northeast is anticipated. Metalworking represents 35 percent of Northeast manufacturing, and an estimated two-thirds of the 4,800 companies have fewer than 100 employees. The proposer has had long-term relationships with more than 100 manufacturers and knows the regional needs, which are well documented. Planned for the early part of the MTC program is another needs survey through workshops for small and medium-sized manufacturers. Within the planned service area, the proposer will pick two implementation test sites for each of the three targeted AMRF technologies identified. A strong training program has been in place between the proposer and Hudson Valley Community College. A method for transferring technology outside of New York state is less well established. The plan is to package the technologies and distribute them to local agencies with outreach capabilities, starting with the New York State Industrial Innovation Extension Service. Also, the proposer is skilled at using workshops and currently provides satellite television programs at many industrial locations.

Regional Relationships

The proposer has strong connections with the New York State Industrial Innovation Extension Service and Hudson Valley Community College, which is responsible for the training. Numerous other institutions, as well as the nine-state Governors' Council, are cited as being supportive. Location is near the center of the nine-state region—about an hour by plane and five hours by car from the farthest point.

Organization and Management Staff

The organization is well defined, and a full-time director is identified. Also identified are six professors who will devote half-time to the three projects. Three full-time project engineers remain to be hired. About three students will be involved. Much of the staff has previous industrial experience. The legal structure for handling intellectual property rights is well established.

Funding

The proposal cites a great deal of equipment and facilities, along with funds from the state of New York. The first year matching analysis shows $1.5 million, of which $400,000 represents full value of equipment contributed by Digital Equipment Corporation, IBM, and Federal Products Corporation. The analysis includes no charges for personnel. Continued funding is not discussed, but the proposal speaks of moving the demonstration facility to the institution's technology park in the second year.

Summary

This proposal is clearly in line with the goals of the MTC program. The proposer has an excellent track record and is well qualified to achieve meaningful transfer of AMRF or similar technology in a short time. Strong industry need and the relationship to the metalworking industry are well documented. Possible weaknesses are the use of faculty half-time and the lack of experience in methods to transfer technology outside of New York state.

UNIVERSITY OF ILLINOIS
Proposal No. 128

The University of Illinois at Urbana-Champaign proposes to establish an Institute for Competitive Manufacturing to conduct research and facilitate technology transfer in areas of design and manufacturing.

Program Relevance

This proposal includes no mention or analysis of AMRF or similar technologies, being focused mainly on research and university-oriented interests. The planned service region is the state of Illinois.

Technical Capability

The proposer's capability for research is excellent. Facilities are good, and good support would be expected from the industrial engineering and mechanical engineering laboratories. The credentials of the few staff people identified are strong.

Market Requirements

No analysis is given of manufacturers in the service region and their technological needs. A mobile demonstration facility (a semi trailer) is proposed to take training on the road and provide hands-on exposure for industry and junior colleges and high schools. Little further discussion was devoted to means of transferring technology efficiently to small and medium-sized manufacturers.

Regional Relationships

Positive experience was cited with the agricultural extension program in Illinois and with industry through the well-recognized student co-op program. Some industry funding was noted. Little was said otherwise about regional linkages.

Organization and Management Staff

The existing organization is designed for research. The proposer envisions a new organization combining some existing (and successful) university facilities. It would have a full-time administrator and

would command 25 percent of the time of each of 25 faculty members. No industry people are mentioned.

Funding

Matching funds would be provided by the state ($1 million) and the proposer ($500,000). Expected expenses include $200,000 for student fellowships and $730,000 (1/4 of the first year's budget) for equipment. Continued state funding was indicated, but an explanation was not given of plans for extending the proposed MTC beyond termination of the NIST grant.

Summary

The proposer is well-respected in certain related fields (engineering, agricultural extension) but is research-oriented, as is the proposal. The co-op program, very limited short courses, and some funding are the main connection with industry. No analysis was given of industry's needs for AMRF or similar technologies. The proposer has competent faculty and good facilities, however, and the committee believes it would do an excellent job in research in manufacturing technology, which is certainly needed.

UNIVERSITY CITY SCIENCE CENTER
Proposal No. 129

The University City Science Center, located in Philadelphia, Pennsylvania, proposes to establish a Caribbean-USA Manufacturing Technology Center (MTC) to improve industrial competitiveness and productivity in Puerto Rico and the mid-Atlantic states of the United States. The proposal is presented on behalf of the Corporation for Technological Transformation in Puerto Rico together with a group of academic institutions and development organizations.

Program Relevance

This imaginative proposal envisions an audit of AMRF or similar technologies, an audit of regional needs, and definition of a transfer package, all to be accomplished at some later date. The intended service region is Puerto Rico, specifically the Puerto Rican facilities of U.S.-based "Fortune 1000" companies as well as smaller Puerto Rican manufacturers.

Technical Capability

Little technical capability is in place that would address technology transfer. Of the two full-time people named, one is qualified technically and is located in Puerto Rico, and the other is qualified administratively and located in Pennsylvania. No equipment is on hand; an 8,000 square foot facility is available.

Market Requirements

The idea is to help Puerto Rican industry by drawing on the technology transfer experience of southeastern Pennsylvania, focusing first on metal fabrication, then pharmaceuticals, furniture, and clothing. The premise is that the MTC program would benefit and help to stabilize local Puerto Rican industry. As noted above, however, an audit of regional needs has yet to be made. It is not clear whether the U.S.-based manufacturers are receptive to the concept.

Regional Relationships

Some trusted personal relationships appear to exist between people associated with the proposer and people in Puerto Rico, but no established working relationship is yet in place for this very complicated arrangement. The proposer's linkages in Pennsylvania are good, but little exists in Puerto Rico and especially between Pennsylvania organizations and Puerto Rico.

Organization and Management Staff

The proposal calls for interaction among laboratories, teaching institutions, technology transfer centers, and manufacturers, connecting the Delaware Valley of Pennsylvania with Puerto Rico. Links would be established later with Massachusetts. The proposed MTC remains to be created, and the counterpart Puerto Rico Corporation for Technological Transformation (CTT) is newly established. Established procedures and legal arrangements do not yet exist, although Pennsylvania has a history of assembling organizations of the kind required. Unclear is the planned number and overall composition of the staff—full time, part time, U.S. consultants, etc.

Funding

Total funding, which exceeds $3 million, includes the NIST grant

and funds allocated by the government of Puerto Rico to the new CTT (the CTT funds are committed in any case). No industry funds are mentioned. Of the total, more than $1.2 million is needed for renovation and equipment; more than $1.3 million for salaries, travel, and consultants (general operations); and about $0.2 million is earmarked for on-site assessments, training, etc. Continuity beyond termination of the NIST funds was not discussed, but it is reasonable to expect that once the original program and facilities were launched, the government of Puerto Rico would support at least part of the effort.

Summary

The committee commends the proposer on an ingenious plan, but believes that the plan is unnecessarily complex and untested. Resources potentially available from Pennsylvania seem good, but the motivation to expend effort and transfer technology off-shore is not clear to the committee, unless industry is more solidly behind the concept than is reflected in the proposal. The committee does see an intriguing potential benefit, however, in the development of a bilingual capability for technology transfer that could be applied in some regions of the United States.

THE STATE UNIVERSITY SYSTEM OF FLORIDA
Proposal No. 130

The State University System of Florida (SUS) proposes to establish a Manufacturing Technology Center (MTC) composed of a consortium of SUS universities, the University of Alabama in Huntsville, industry, agencies of state and local government, and other professional societies, associations, and economic development agencies. The focus of the MTC will be to capitalize on a distributed technology transfer network to transfer advanced manufacturing technologies to small and medium-sized manufacturers in the mechanical parts and assembly and electronic assembly industries. The primary service region is Florida and Alabama.

Program Relevance

The proposer has many qualified people within the State University System who understand AMRF or similar technologies. Their association with NASA and NIST has given them detailed knowledge of

AMRF technologies. The proposer is in contact with the potential clients and is experienced in technology transfer. Government, industry, and academe have given broad support to similar programs and have promised to do the same for the proposed MTC. The proposer has an excellent track record and clearly documents the paths to success in technology transfer.

Technical Capability

Many of the SUS's units and the University of Alabama at Huntsville have experts in computer- and industry-related fields who hold doctoral degrees in computer science and industrial engineering and would be available part-time as needed. Laboratory equipment is available at several locations. The applicant has done some systems work for NIST in the past.

Market Requirements

The MTC would focus on industrial groups most likely to use AMRF or similar developments, namely mechanical parts and assembly and electronics assembly. Twelve thousand firms in the southern region represent major technology transfer potential, although the precise number of potential clients is uncertain. Eleven companies are already committed to working with the proposed MTC; 20 others have expressed interest contingent on the receipt of the NIST grant. The proposal lists appropriate AMRF technologies and indicates what part of the SUS would be assigned. This growing industrial area has good financial and educational resources and labor supply and can benefit from the MTC work.

Regional Relationships

The applicant has established a network of cooperating organizations in government, industry, and academe through its existing technology transfer programs. Through the Southern Technology Applications Center, which has been a very successful technology transfer agency for NASA, it expects to accelerate the spread of the work of the MTC to the southern states.

Organization and Management Staff

The director's functions will be handled by two half-time people

until a full-time director is appointed (within three months). One of the initial directors is experienced in technology transfer, and the other has extensive knowledge of AMRF technologies. A centralized management organization will be located at the University of Florida Progress Center R&D Park. A decentralized technology transfer network will provide easy access to clients. A board of directors will comprise industrial and university people.

Funding

In-kind contributions plus a cash contribution of $250,000 from the SUS will total more than $3 million in matching funds. Industrial partners have also committed in-kind and cash contributions. Added support from industry is expected to enable the MTC to carry on after the NIST grant terminates.

Summary

The committee found no significant weakness in this proposal. The decentralized organization should permit the job to be done quickly, if talented people are assigned to the work and a highly competent director is chosen.

MAINE SCIENCE AND TECHNOLOGY COMMISSION
Proposal No. 131

The Maine Science and Technology Commission, with the support of the nine-state Coalition of Northeastern Governors (CONEG), and on behalf of the proposed Northeast Manufacturing Extension Network, proposes to establish a Northeast Manufacturing Technology Center (MTC). The service area would be the nine CONEG states: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

Program Relevance

This proposal displays an unusually good grasp of the complexities of technology transfer. It proposes to handle the task through a new organization that would be generally responsible for establishment and oversight of the proposed MTC and also would link existing regional organizations in the Northeast. The new organization would

be the Northeast Manufacturing Extension Network (NEMEN). It is not expected to be formed until December 31, 1988.

Technical Capability

The prospective members of NEMEN clearly have excellent technical capabilities on a broad front. Since NEMEN itself does not yet exist, however, it is difficult to tell whether it will have the technical capacity necessary to coordinate the operation envisioned.

Market Requirements

The proposal analyzes the substantial concentration of small and medium-sized manufacturers in the Northeast. It focuses quite specifically on technology transfer throughout the region. Two questions remain, however: (1) whether the proposed network organization, relying on established hub sites, can effectively serve this market in terms of technology transfer, (2) when established, whether it will add value over the organizations currently in place and operational. Because NEMEN remains to be established, its potential is untested.

Regional Relationships

The general concept underlying NEMEN and the proposed MTC places strong emphasis on nurturing regional relationships. Material in the proposal connotes such relationships, but the myriad interfaces implied suggest very complex communications and integration that would be difficult to perfect in a short time. It is not clear where the central staff of the MTC would be located.

Organization and Management Staff

Because NEMEN does not yet exist, little specific can be said about its organization and staff. The overall concept has merit, but a nine-state coalition to oversee operations at three hub sites runs the risk of consuming funds and effort in administrative activities.

Funding

Funding is proposed from Massachusetts and private institutions, but some of the funding is tentative at this point. The proposal states

that unless multiyear funding is secured, the impact of the proposed operation would be negligible, even if NIST funds were granted.

Summary

The concept presented by the proposal is imaginative and has the potential for substantial impact. It also presents imponderables, however. They include in particular the leadership and level of participation of the hub sites and the leadership of NEMEN and the MTC itself as well as the need for multiyear funding to assure that the proposed operation will have an impact.

SOUTHERN UNIVERSITY
Proposal No. 132

Southern University proposes to establish a Manufacturing Technology Center (MTC) at its campus in Baton Rouge, Louisiana. The MTC will serve various industries in Louisiana, Texas, Mississippi, Alabama, and Florida.

Program Relevance

The proposal includes no discussion of the service region, the technological needs of prospective clients (who are not identified) or of AMRF or similar advanced manufacturing technology.

Technical Capability

The MTC would build on the proposer's strengths in computer science and mechanical and electrical engineering and technologies.

Market Requirements

The proposal includes no discussion of prospective clients and their needs for AMRF or other technologies.

Regional Relationships

No regional relationships are identified.

Organization and Management Staff

The MTC would have a director, two associate directors, and a staff of six. None of these individuals is identified.

Funding

The proposal assumes that the needed funds can be raised, but presents no evidence that any funds have been committed.

Summary

The committee concludes that this proposal is not responsive to the selection criteria and so presents insufficient basis for a technical assessment.

CATONSVILLE COMMUNITY COLLEGE
Proposal No. 133

Catonsville Community College, located in Catonsville, Maryland, proposes to establish a Mid-Atlantic Manufacturing Technology Center (MTC) to assist small and medium-sized manufacturers with information, training, and technical assistance regarding new technology. The area to be served is the mid-Atlantic region of the nation consisting of the states of Delaware, Maryland, Pennsylvania, Virginia, and West Virginia and the District of Columbia.

Program Relevance

Catonsville Community College has served industry in Maryland as a training school and has had good participation by industry in that state. It has taught computer use in manufacturing to technical school level students and has used hands-on experience. However, the proposal does not indicate adequately an understanding of AMRF or similar advanced manufacturing technologies.

Technical Capability

The center director has a Master's degree in education, has been chairman of the Industrial Technology Department, and has promoted computer-aided design and manufacturing training. Other available personnel have experience in teaching the use of computers

in manufacturing, largely in practical use rather than research. The facilities include a 7,000 square foot automated manufacturing laboratory with ample computer capabilities and are more than adequate for the proposed MTC.

Market Requirements

The proposed resources to serve the other states in the mid-Atlantic region are not well documented. The proposal indicates that employment in manufacturing has dropped by 40,000 jobs in Maryland since 1972, yet there is growth in microelectronics, telecommunications, and biotechnology. Seventy-five percent of the proposer's potential clients (identified as regional members of the National Tooling and Machining Association) are located in Pennsylvania, which is some distance from Catonsville and in a different state from the proposer's major experience.

Regional Relationships

The proposer belongs to numerous community college networks and could have a wide influence through them. Letters of support have been received from regional technology organizations. The University of Maryland, the University of Delaware, and the state of Maryland and Baltimore county education departments have endorsed the center. The linkage with Maryland organizations has been good under the current training programs in manufacturing technology. The linkage to other states is not well demonstrated and must be developed.

Organization and Management Staff

The full-time center director has been named. The program coordinator will spend 25 percent of his time coordinating the MTC efforts with other organizations; he will also assure that proper staff is in place. Six field representatives (full-time) are expected to be industry representatives. Ten to 15 professionals are proposed for handling workshops, training, technical assistance, and consulting; they would serve on a variable time basis. The proposer has demonstrated that it can attract quality personnel.

Funding

Indirect costs, provision of in-kind space and equipment, and industry-furnished equipment are used to match the NIST grant. A good portion of the NIST funds would be spent for equipment such as a flexible manufacturing system, computer numerical control lathe, computers, and robots. It is not clear how the operation would be supported after the NIST funds are expended. The timing of the project is not spelled out. .

Summary

The proposer demonstrates a good capability to assist Maryland industry with training; it currently is involved with extensive and effective training activities in the local area. It has good technical capabilities and facilities, and it is clear to the committee that the whole proposing organization is behind the program. The committee notes weaknesses, however, that include a lack of demonstrated understanding of AMRF or similar advanced manufacturing technologies, an effective plan to establish linkages to the rest of the mid-Atlantic region, and documentation that shows the timing of the project and continued stability after NIST funds are expended.

MILWAUKEE AREA TECHNICAL COLLEGE
Proposal No. 134

The Milwaukee Area Technical College and the Wisconsin Department of Development propose to establish a Midwest Regional Manufacturing Technology Center (MTC). The center would serve the states of Wisconsin, Ohio, Michigan, Indiana, Illinois, and Minnesota.

Program Relevance

This proposal identifies 27 technologies ready for immediate transfer. These include current capabilities plus successful transfers. It states that, after further analysis, all AMRF or similar technologies can be transferred to manufacturers in SIC 33, 34, 35, 36, and 37.

Technical Capability

Existing facilities seem outstanding. They include a computer-integrated manufacturing (CIM) facility similar to AMRF and a

flexible manufacturing system cell implemented primarily by vendors. Programs in place cover computer-aided design, computer-aided manufacturing, CIM, and machining operations. Capabilities of the staff could not be determined from the proposal because new people will fill three top positions, and 16 others will be on loan from other academic institutions. Technical skills of staff are more in training than in implementation. The proposer foresees use of an industrial firm (Rexnord/Radian Corporation) for project management and technical support. The proposer has a solid reputation for working with other state institutions and industry to provide practical, hands-on training and has about 550 training contracts with over 150 organizations each year. The plan to send someone to the NIST's AMRF for three to six months is praiseworthy.

Market Requirements

An assessment of the region, mainly Wisconsin, is not given, but the implied focus is on metalworking and CIM cell areas of interest to manufacturers in the state. Industry funding and heavy usage of the proposer's training programs appear to confirm that this focus is on target. The proposal implies that the service region might extend to Detroit, St. Louis, and Minneapolis. The proposer operates the state's television training stations. A national video conference is planned for the first year of the program.

Regional Relationships

The proposal indicates extremely strong connections with two- and four-year colleges and many other organizations in Wisconsin. Also cited is linkage with the Council of Great Lakes Governors and contracts with Michigan, Ohio, Indiana, Illinois, and Minnesota. CIM associate partners listed include the University of Wisconsin at Milwaukee, Marquette, and the Milwaukee School of Engineering.

Organization and Management Staff

A full-time project manager will be hired, and the proposal calls also for three new project directors, four secretaries, and 16 professionals. The professionals would be hired for one year from sister institutions. Also contemplated is a project management consultant (from Rexnord/Radian).

Funding

The proposal shows $1.4 million (which needs to be appropriated) from the state of Wisconsin and $6.9 million from the value of current laboratory facilities. Payment for the 16 professionals is allocated from the NIST grant and state funds only for the first year. No plan is given for continuation beyond termination of the NIST funds.

Summary

The committee considers this proposer well qualified to achieve the goals of the proposed MTC. About the only new function it would need to establish is the field extension system. Staffing and the ability to sustain the program need clarification, but the proposer has a history of productive ties and programs with industry and sister institutions.

SOUTHERN ARKANSAS UNIVERSITY TECH
Proposal No. 135

Southern Arkansas University Tech, located in Camden, is the state's only Associate Degree-granting, two-year public technical/junior college. The proposed Manufacturing Technology Center (MTC) will work through cooperative agreements with other Arkansas organizations to diffuse "productivity-enhancing advanced manufacturing technology to U.S. industry, especially small and medium-sized companies." The MTC is proposed to serve Arkansas, Louisiana, and Mississippi.

Program Relevance

The proposal offers insufficient evidence of having the organization and the technical capability needed to establish a MTC on the scale proposed. The existing unit is relatively small and new, but seems to have been used effectively.

Technical Capability

The staff is small in number, and its technical capabilities are not well documented. The facilities also are quite modest.

Market Requirements

The proposal refers to a local survey, but the target industries are not well defined. It is worth noting that the proposal concerns an area—the rural South—that is rarely considered. It does not contain the same concentration of industry as, say, the Northeast, but its needs are perhaps greater.

Regional Relationships

Some linkages are demonstrated within the proposer's own state of Arkansas, and the region has expressed an interest in improving manufacturing capabilities.

Organization and Management Staff

Staffing is minimal (eight people designated), and the proposer plans to draw on local resources for many projects and training. Success in attracting personnel is not adequately demonstrated.

Funding

The proposer makes a case to have matching funding for this project. A large proportion of the NIST funds is targeted for equipment and facilities, the acquisition of which would add to the time necessary to accomplish meaningful technology transfer. The proposer does not make a convincing case that it will be able to continue to operate effectively when NIST funds terminate.

Summary

It is difficult to see what results could be achieved through the existing proposal. Even so, the committee perceives strengths that could make the proposer a good technology transfer agent in a less sophisticated program. It serves a region that has few alternative organizations and has made a good start with a relatively modest center.

INSTITUTE FOR MANUFACTURING AND AUTOMATION RESEARCH
Proposal No. 136

The Institute for Manufacturing and Automation Research

(IMAR), in conjunction with its affiliate, the Western Research Application Center, proposes to transfer a specific AMRF technology to small and medium-sized manufacturers in southern California. IMAR, located in Los Angeles, is a cooperative, industry-based organization that supports manufacturing and automation research, education, training, and technology transfer on behalf of its member companies.

Program Relevance

This proposal identifies for transfer the AMRF turning workstation and its surrounding technologies. The proposer gives specific details that are highly relevant—arguing that the AMRF turning workstation is production-ready, proven, and would address an identified need. The AMRF turning workstation was developed for the U.S. Navy for particular applications. It will be installed in the near future at the Naval Shipyard on Mare Island in California.

Technical Capability

The proposer's personnel understand the AMRF technology and understand technology transfer. They have on hand or have access to the necessary technical base. No physical facility exists, however, and the time required to get the technology up and running is not stated.

Market Requirements

The proposer gives clear evidence of an excellent understanding of the market and describes a large and diverse group of prospective clients, who mainly comprise classical machine tool job shops. The proposer has the support of the Navy, which is interested "in establishing a flexible, economical *industry* source of supply at the sub-tier level (small and medium-sized companies) for support of Navy...requirements for spare and repair parts, *including* those that the AMRF turning workstation is designed to produce."

Regional Relationships

The relationships cited are very extensive and with experienced organizations, but are confined to the Los Angeles Basin and southern

California. This region, however, has a very high concentration of relevant manufacturers.

Organization and Management Staff

The organizational concept is logical, and much of it is in place. The staff has strong management capabilities but lacks depth. The basic requirements for the job are defined; the qualifications are applicable and impressive.

Funding

Strong and broadly based support is indicated from both industry and government. Matching funds are assured, and while there is no documented track record, funding continuity seems relatively safe.

Summary

The strengths of this proposal, in the committee's opinion, are the narrow focus, the demonstrated knowledge of technology transfer and the target market, the demonstrated insight into the AMRF turning workstation, and the fact that much of the technology to be transferred will be in place and operational at one location—the Naval Shipyard on Mare Island. A major question is how much time will be needed to purchase machine tools, get the system running, and begin transfer activities.

Suggestions to NIST for Site Visits

The committee believes that undertaking site visits to qualified proposers is essential to selecting a successful Manufacturing Technology Center (MTC). During the eight-week proposal evaluation process, the committee's concern intensified; site visits are a necessary part of the proposal evaluation process for this program, especially in light of the fact that many proposers are suggesting start-up or umbrella MTCs. The committee strongly recommends that prospective MTC awardees be visited by NIST staff and that consideration be given to the following suggestions. These suggestions are a compilation of questions that emerged during committee discussions of the proposals. They are grouped under four general headings.

The Proposing Organization

- For organizations noted for technical capabilities, can they demonstrate the organizational and management capabilities to run an MTC? Will the MTC actually take advantage of the technical capabilities of the organization?
- For established organizations, what are previous successes in programs of technology transfer? Can the organization show that it can imitate its own successes without having to redo them each time?

- For large, established organizations, is specific management dedicated to the MTC in order to keep it from getting lost within programs of the organization?
- For organizations planning to hire new staff for the MTC, if they had the money today, whom would they hire tommorrow?

The Proposal

- How can the site visit team distinguish between creative ideas contained in the proposal and the ability to deliver in a short time frame?
- Is there a commitment that the outstanding personnel named in the proposal will remain involved on the MTC team?

The Customer for MTC Products

- Does the organization have customers lined up and ready to go? If so, can it produce them in person? Can the site team visit the customer in the customer's factory?
- If the organization has identified a set of early-adopter customers, have the customers agreed to work with the organization, and do the customers have the capability to hold up their end of the technology transfer deal?
- Does the organization truly understand what will make a positive difference to potential customers?
- Does the organization know how to evaluate a customer? Can it say no to potential customers if it thinks an arrangement won't work?

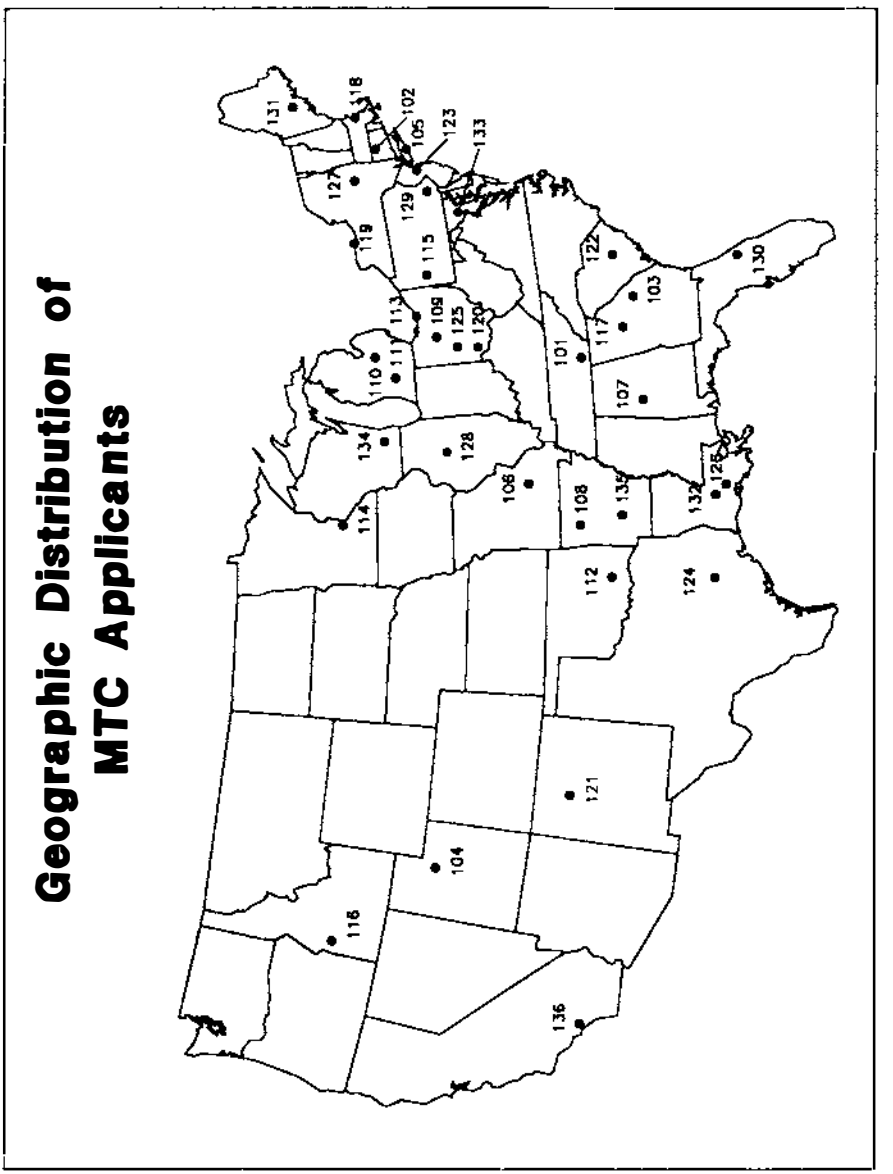
The MTC Itself

- Does the organization demonstrate a true understanding of the entire problem: combining technology transfer with manufacturing technology skills and experience with small and medium-sized companies?
- Does the organization have a plan and the facilities to identify, gather, and modify AMRF or similar technologies? Does it truly understand what is involved in acquiring, adapting, installing, and maintaining process technology? Can it match the available technology with specific client operations and business needs and problems?

- **Where will the MTC be physically located? If it is separate from the proposing organization, visit that site also.**

As a final suggestion, the committee believes that NIST can learn much about a proposing organization by having the organization propose the initial agenda for the visit.

Appendix A
List of MTC Proposers



Manufacturing Technology Centers
List of Proposers

No	Title
101	Chattanooga State Technical Community College 4501 Amnicola Highway Chattanooga, TN 37406
102	The Hartford Graduate Center 275 Windsor Street Hartford, CT 06120
103	Augusta Technical Institute 3116 Deans Bridge Road Augusta, GA 30906
104	Brigham Young University 296 University Press Bldg. Provo, UT 84602
105	State University of New York College of Technology Melville Road Farmingdale, NY 11735
106	DeMaTec Foundation 101 ERL, University of Missouri-Rolla Rolla, MO 65401

No	Title
107	The University of Alabama Office of Sponsored Programs Box 870104 Tuscaloosa, AL 35487-0104
108	University of Arkansas Board of Trustees College of Engineering 120 Ozark Hall Fayetteville, AR 72701
109	The Ohio State University Research Foundation Engineering Research Center for Net Shape Manufacturing 1314 Kennear Road Columbus, OH 43212
110	GMI Engineering and Management Institute 1700 W. Third Ave. Flint, MI 48504
111	Industrial Technology Institute P.O. Box 1485 Ann Arbor, MI 48106
112	Rural Enterprises, Inc. 10 Waldron Drive P.O. Box 133 Durant, OK 74702
113	Cleveland Advanced Manufacturing Program 17325 Euclid Avenue Cleveland, OH 44112
114	Minnesota Advanced Manufacturing Technology Center (MAMTC) 2416 West 95th Street Minneapolis, MN 55431
115	Technology Development & Education Corporation SPIRC 4516 Henry Street Pittsburgh, PA 15213

No	Title
116	Boise State University 1910 University Drive Boise, ID 83725
117	Georgia Tech Research Corporation Georgia Institute of Technology Atlanta, GA 30332
118	Massachusetts Centers of Excellence Corporation Center for Applied Technology Nine Park Street Boston, MA 02108
119	Rochester Institute of Technology Office of the Provost One Lomb Memorial Drive Rochester, NY 14623
120	Institute of Advanced Manufacturing Sciences, Inc. 1111 Edison Drive Cincinnati, OH 45216
121	University of New Mexico College of Engineering Southwest Industry Manufacturing Technology Center Albuquerque, NM 87131
122	University of South Carolina College of Engineering Columbia, SC 29208
123	New Jersey Institute of Technology Newark College of Engineering 323 King Boulevard Newark, NJ 07102
124	Texas Engineering Experiment Station Institute for Manufacturing Systems 334 W.E.R.C./MS 3124 College Station, TX 77843

No	Title
125	Edison Materials Technology Center (EMTEC) 3171 Research Boulevard Kettering, OH 45420
126	Advanced Technology Center/Louisiana Productivity Center-USL Regional Manufacturing Technology Center P.O. Box 44172 241 E. Lewis Lafayette, LA 70504
127	Rensselaer Polytechnic Institute Center for Manufacturing Productivity and Technology Transfer 110 Eighth Street Troy, NY 12180
128	University of Illinois Mechanical & Industrial Engineering 809 S. Wright Street MC-330 Champaign, IL 61820
129	University City Science Center Worldwide Services Division 3624 Market Street 1st Floor East Philadelphia, PA 19104
130	University of Florida College of Engineering/DSR 219 Grinter Hall Gainesville, FL 32611
131	Maine Science and Technology Commission One Memorial Circle Augusta, ME 04330
132	Southern University Department of Mechanical Engineering SU Branch Post Office Baton Rouge, LA 70813

No	Title
133	Catonsville Community College 800 S. Rolling Road Catonsville, MD 21228
134	Milwaukee Area Technical College Industrial and Technical Division 700 West State Street Milwaukee, WI 53233
135	Southern Arkansas University Tech SAU Tech Station Camdem, AR 71701
136	Institute for Manufacturing and Automation Research OHE 200 University Park Los Angeles, CA 90089

Appendix B
Federal Register Notice

National Bureau of Standards

[Docket No. 880388-8138]

NBS Manufacturing Technology Centers Program

AGENCY: National Bureau of Standards, Commerce.

ACTION: Notice: Announcing program to fund cooperative agreements for manufacturing technology centers.

SUMMARY: The purpose of this notice is to inform potential applicants of a Program to fund Cooperative Agreements for Manufacturing Technology Centers. The National Bureau of Standards (NBS) is establishing a special Program for Manufacturing Technology Centers to provide seed money and technical assistance on a one-time basis to assist non-profit organizations.

Closing Date for Applications: Applications will be accepted until September 16, 1988.

ADDRESS: Applicants must submit one signed original plus two (2) copies of their proposal along with the Standard Form 424 as referenced under the provisions of Attachment M of OMB Circular A-110 to: NBS Manufacturing Technology Centers Program, National Engineering Laboratory, National Bureau of Standards, Room B-118, Technology Building, Gaithersburg, MD 20899.

FOR FURTHER INFORMATION CONTACT: To receive additional Program information telephone Dr. John W. Lyons, Director of the National Engineering Laboratory, (301) 975-2300.

SUPPLEMENTARY INFORMATION: The National Bureau of Standards will provide one-time seed money to not more than three non-profit organizations for the operation of Manufacturing Technology Centers (MTC) serving different U.S. geographic regions. The goal of the Manufacturing Technology Centers is to accelerate the transfer of advanced manufacturing technology to U.S. industry (especially small and medium-sized companies) and to assist firms in improving their productivity and competitiveness. Each center will be capable of applying advanced manufacturing techniques to the needs of manufacturers located in its region and demonstrate its capability to transfer specific advanced manufacturing technologies developed at the National Bureau of Standards' Automated Manufacturing Research Facility. Applicants must identify the technologies to be demonstrated and transferred by the proposed center.

To accomplish the technology transfer mission effectively, each center shall be active in assisting the adoption of advanced manufacturing techniques by U.S. industry. Each center shall work with firms within its region to improve their manufacturing and process capabilities. The services of the center shall be available to firms located in its state, in its region, and elsewhere. Also, each center is expected to amplify (leverage) its regional efforts so its technology transfer experience will have national impact.

The transfer of pragmatic technology applications is the primary objective rather than performance of basic research. This task requires that each center must: (1) Inform and educate the industrial firms in its region; (2) demonstrate the applicability of advanced technology to those firms; (3) actively assist firms to evaluate their requirements; (4) assist with implementation of desired applications; (5) support work force training and retraining; and (6) amplify appropriate transfer experiences to a relevant national audience. Each center shall operate as an active agent in precipitating technology transfer, rather than operating as a passive agent that only provides information.

Each MTC will be operated by a nonprofit organization which already may exist or may be incorporated specifically for this purpose. NBS will support the operating budget of each center for the purpose of carrying out this program on an equal matching-funds basis with the host organization providing the remaining financial support. The matching share must meet the criteria in Attachment E of OMB Circular A-110. The funds provided by NBS may be used for capital and operating and maintenance expenses. NBS will provide technical and financial support for the Program, and will assist each center with its planning and implementation activities for this Program during the time that the centers are receiving seed monies. NBS will monitor the performance of each center in meeting its technology transfer mission and in fulfilling its fund-matching requirements for this Program.

A national competition will be held during 1988 to make the Operating Awards. It is anticipated that up to three Operating Awards of up to $1.5 million each will be made. The amount of NBS investment in each Program will depend upon the particular requirements and plans for the Program, as well as the availability of NBS funds. No further appropriations will be sought for this Program.

The purpose of the Manufacturing Technology Centers Program is to accelerate the diffusion of productivity-enhancing advanced manufacturing technology to U.S. industry (especially small and medium-sized companies). This purpose will be achieved through the:

(1) Rapid transfer to industry of new specific advanced manufacturing technologies including those developed at the NBS Automated Manufacturing Research Facility;

(2) Active participation from industry, universities, Federal/State government, and NBS in the Program;

(3) Efforts to make new manufacturing technology and processes available and usable by U.S.-based industries, especially small and medium-sized companies;

(4) Dissemination of scientific, engineering, and management information about manufacturing to industrial firms including small and medium-sized manufacturing companies; and

(5) Utilization where appropriate of the technical expertise and capability that exist in Federal laboratories other than NBS, when centers and the laboratories find it to be in their mutual interest.

Proposal Review Process

NBS will provide all proposals to a Merit Review Panel organized by the National Research Council which will evaluate the proposals. NBS will consider the evaluations of the Merit Review Panel and make a selected number of Operating Awards, to the extent feasible and within limitations of available funds. Applications should be in sufficient detail to permit NBS to evaluate the proposal under the criteria set forth in the six general categories below:

(a) Program Relevance

(1) The specific advanced manufacturing technologies including those developed at the NBS Automated Manufacturing Research Facility which will be demonstrated and transferred to

a wide range of companies and enterprises in the region and whenever possible, small and medium-size manufacturers.

(b) Technical Capability

(1) Relevant experience and education of the full-time key technical staff.

(2) Adequacy of the facilities and equipment to support the proposed Program.

(3) Proximity and availability of staff to service the targeted industrial base.

(4) Adequacy of the work force training and retraining activites.

(5) Relevance of the applicants technical capabilities to the needs of the regional industrial base.

(c) Market Requirements

(1) Appropriateness of the regional target user groups; i.e., the identification, analysis, and justification of the regional industries to be served. This includes an assessment of the needs and receptivity of those groups to technology transfer efforts.

(2) Appropriateness and potential effectiveness of the Program in producing technology transfer to the target industries. Where the service area of the center includes firms from other states, the approach for linking with these states to serve these markets should be detailed.

(3) Appropriateness of national audience; i.e., identification, and analysis of national audience that would be most usefully served.

(4) Appropriateness and effectiveness of the center's programs, plans, and mechanisms (e.g., plan for allocating intellectual property rights) for producing technology transfer to a larger national audience.

(5) Budget, personnel, and facility allocations to the program activities.

(d) Regional Relationships

(1) Demonstrated linkages with regional/state/local economic development and extension organizations.

(2) Demonstrated linkages with regional industrial, educational, and training organizations.

(3) Demonstrated interest of the region (local, state, industrial, or other entities) in improving its manufacturing capabilities.

(4) Geographic location of the proposed center vis-a-vis the concentration of target industries, the location of other centers and similar Programs and the technical focus of the other centers.

(e) Organization and Management Staff

(1) Appropriateness of the legal and organizational structure proposed for facilitating technology transfer.

(2) Appropriateness of the full-time staffing levels of management and technical personnel, and the quality of this staff's manufacturing, marketing, and technology transfer experience.

(3) Record among the management team for attracting top personnel and for raising funds with industry, industrial associations, and state/local governmental bodies.

(4) Record of the management team in building successful organizations and the team's commitment to technology transfer.

(f) Funding

(1) Stability and duration of the Applicant's matching funding commitments.

(2) Percent of operating costs guaranteed by the Applicant.

(3) Ability to continue to operate when NBS funds terminate.

The enumerated criteria will be equally weighted. To be considered for an Operating Award, a proposal must receive at least 70 percent of the evaluation points from each of the categories above.

Additional Requirements

Applicants are reminded that a false statement may be grounds for denial or termination of funds and grounds for possible punishment by a fine or imprisonment. Except where declared by law or approved by the head of agency, no award of Federal funds shall be made to an applicant who is delinquent on a Federal debt until the delinquent account is made current or satisfactory arrangements are made between affected agencies and the debtor. The grantee will administer the grant in accordance with OMB Circular A-110.

Classification

This document is not a major rule requiring a regulatory analysis under Executive Order 12291 because it will not have an annual impact on the economy of $100 million or more, nor will it result in a major increase in costs or prices for any group, nor have a significant adverse effect on competition, employment, investment, productivity, innovation, or on the ability of U.S.-based enterprises to compete with foreign-based enterprises in domestic or export markets. It is not a major federal action requiring an environmental assessment under the National Environment Policy Act. The NBS Manufacturing Technology Centers Program does not involve the mandatory payment of any matching funds from a state or local government, and does not affect directly any state or local government. Accordingly, NBS has determined that Executive Order 12372 is not applicable to the NBS Manufacturing Technology Centers program. This notice does not contain policies with Federalism implications sufficient to warrant preparation of a Federalism assessment under Executive Order 12612. This notice contains a collection of information requirements subject to the Paperwork Reduction Act which have been approved by the Office of Management and Budget under control number 0693-0009 for use through September 1989. The NBS Manufacturing Technology Centers Program is being carried out under the authority of 15 U.S.C. 1525, 15 U.S.C. 3705 and 3706, and Department of Commerce Organization Order 30-2A.

Ernest Ambler,

Director, National Bureau of Standards.

Dated: July 12, 1988.

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Appendix C
Information on the AMRF and the MTC Program

The information contained in this appendix was developed by NIST in November 1987 for inclusion in their Information Packet for Cooperative Agreement Program.

NATIONAL BUREAU OF STANDARDS

MANUFACTURING TECHNOLOGY CENTERS

What is the NBS Manufacturing Technology Centers Program?

The National Bureau of Standards (NBS) Manufacturing Technology Centers Program will provide support, with one-time awards of up to $1,500,000, to not more than three non-profit organizations to operate programs in regional centers for the transfer of advanced manufacturing technology.

The mission of the NBS Manufacturing Technology Centers Program is to accelerate the transfer of advanced manufacturing technology to small and medium-sized U.S. businesses to assist these firms in improving their manufacturing and process capabilities and market competitiveness--an important ingredient to successful international economic competition. Each center will apply advanced manufacturing techniques to the needs of manufacturers located within its region. The advanced technologies transferred will emphasize those developed at the National Bureau of Standards' Automated Manufacturing Research Facility (AMRF). Each center is expected to communicate its experience to all interested parties.

Who may submit a proposal for this support?

Any U.S. nonprofit organization which already exists or is incorporated specifically for this purpose may submit a proposal. Consortia, including, for example, state/local economic development agencies, private sector firms, colleges and universities, are encouraged to submit proposals. However, a single non-profit entity must accept the overall project management responsibility in making the proposal and in dealing with NBS.

How will the funds be made available?

NBS will support the operating budget of the host organization for the purpose of carrying out this program on an equal matching-funds basis. Funds will be made available on a periodic basis and in accordance with an agreed-upon financial plan, once satisfactory evidence of matching funds is provided. Payments to the host organization will also be in accordance with sound accounting principles and established financial management practices.

- Sensory interaction. The AMRF makes use of an unusually versatile robot control system in which sensory information from, for example, the NBS robot vision system is fed back to the controller to provide a basis for its decisions. This is important because it enables the system to react to its environment, eliminating the need for a lot of rigid programming.

- The scope of the facility. Research at the AMRF covers everything from the preparation of data on a new part to final automated inspection.

Is the AMRF a prototype or demonstration project?

No. The AMRF is not a prototype of the "factory of the future." It is extremely unlikely that any actual factory would resemble the AMRF, at least physically. The AMRF is a laboratory for studying factory automation.

The AMRF is not a demonstration project. Although it does demonstrate several new and potentially important techniques for machine control and the integration of diverse systems, the completed AMRF will not be a museum piece but rather a working research facility.

In the coming year, work at the AMRF will concentrate on aggressive transfer of the technology we have learned about, as well as research on manufacturing data preparation and precision manufacturing. The Research Associate Program has proven to be an effective method of technology transfer. NBS is now studying plans to create regional centers for technology transfer, and a "Technology Extension Service" to increase this flow of information to American industry.

computer-aided design (CAD) systems, developed by a government-industry coalition led by NBS, was adopted by the American National Standards Institute (ANSI), a private voluntary standards organization. The standard now is supported by all U.S. CAD vendors which have at least a 1% market share.

In the near future, the AMRF will be used as a "testbed" to assist a joint industry-government project to develop the Product Definition Exchange Specification (PDES), the next generation of data interchange standards for automated manufacturing.

AMRF research also led to standards for the characterization of computerized coordinate measurement machines, and for a method of surface texture measurement. Seven other potential standards are now being considered by various industrial standards groups.

What makes the AMRF unique?

Several things, including:

- Its location at the National Bureau of Standards. As an open federal laboratory with no commercial interests, NBS can make this facility accessible to private firms interested in automation research---firms that individually could not afford such a complex research facility. NBS has a long history of working with private firms and organizations to develop standards and measurement and test methods that benefit the entire industry.

- The active participation in the AMRF by industry, universities,and other government agencies. The AMRF has become a focal point for interactions among all American researchers in automated manufacturing.

- The use of a wide variety of commercially available machine tools and robots. This is a direct result of the NBS decision to study the most practical, incremental route to automation for the small- to medium-sized firm; it is an approach that has never been used before.

- The flexibility of the system. One of the goals of the AMRF is to create a facility that is, in the jargon of the researchers, "data driven"--the actions of the various machines and robots should be determined primarily, or solely, by a computerized description of the part to be manufactured. This stands in contrast to modern "flexible manufacturing" cells which are truly flexible only for a limited "family" of parts for which the machine tools are programmed.

or more computers. How then do you ensure that the dimensions of the finished parts can be shown to be in agreement with national standards of measurement?

What is the importance of "standardized interfaces"?

Economics. The automated "factory of the future" offers American industry an important weapon in the highly competitive world marketplace, but even for the largest firms the lack of agreed-upon standards for "interfacing" complex equipment is a difficult--and costly--problem.

For close to 90 percent of the discrete parts industry--about 100,000 firms--the problem is worse. These are much smaller companies (fewer than 50 employees) without great financial resources. Discrete parts producers, those who make products in small batches, are responsible for about 75 percent of the total U.S. trade in manufactured goods.

These smaller companies need to be able to buy automated machinery in stages, one or two machines at a time, and slowly build up to an integrated system. They need the flexibility to buy from different manufacturers at different times with the assurance that the machines they buy will work together properly without a lot of expensive, custom-designed interfaces. They need the same flexibility that one can now find when buying the parts of a home stereo system from several different manufacturers, knowing that they will all plug together.

These firms also need a system flexible enough to switch from the production of one part to another quickly and without expensive reprogramming.

These are mostly problems of standardization--standard procedures, standard protocols, standard interfaces. The challenge is to develop standards which support current technology and yet still encourage equipment manufacturers to develop new and innovative products. These are problems that NBS is studying in the AMRF.

Will NBS set these standards for the industry?

No. NBS is not a regulatory agency, and does not set standards, at least in the legal sense. However, NBS has a long history of working as a neutral, third party, providing technical knowledge and leadership and encouraging the establishment of standards. NBS research has become the basis for many standards adopted by private industry on a voluntary basis.

Three industrial standards have already been developed based on NBS automation research. For example, a standard method for exchanging graphics data between otherwise incompatible

through the NBS Research Associate Program. (A list of private contributors is attached to this fact sheet, along with a list of universities receiving AMRF-related grants.) The AMRF is an example of what can be achieved when industry, government, and academe cooperate.

What is this "new way of making precise parts"?

Historically, manufacture and measurement have always been two separate processes. A machinist would cut a part on a milling machine and stop periodically to check dimensions with calipers and gages. As manufacturing techniques became more and more efficient, the measurement part of the operation consumed an ever-greater percentage of the total work required to produce a part. The development of automated "coordinate-measuring machines" (CMMs) in the 1970s helped somewhat, but measurement still used up about 50 percent of the total time required to produce a precision part.

It would be many times more efficient if the machining process could be made to produce accurate parts without being interrupted by the measuring process. Not only would it take less time, but fewer parts would have to be scrapped for being out-of-tolerance. (Some surveys have shown that in the U.S. one-third of the work force in manufacturing industries is engaged in re-work--correcting out-of-tolerance parts made by the other two-thirds.)

NBS research suggests that problem can be solved by use of today's computer-controlled machine tools, because the position of the cutting edge of the tool is known and controlled at all times, at least in theory, by the computer. The computer can be programmed to compensate for known errors in the machine's movement, using sensors that feed back information on the machine's condition.

This concept of feedback and process control is well known in some industries, such as oil refining and chemical production. In discrete parts manufacturing, however, it will require the development of a whole new generation of sensors and control systems.

This isn't all just theory. NBS researchers have already applied some of these ideas to commercial machine tools and improved their performance in terms of accuracy and control five to ten fold. Some of this research already is finding its way into the marketplace in new industrial machine controllers.

One of the important issues to be studied in the AMRF is: You can no longer calibrate a measurement process that is deeply embedded in the manufacturing process, one that depends on the interaction of a machine tool with its environment and with one

November 1987

AUTOMATED MANUFACTURING RESEARCH FACILITY

What is the AMRF?

The Automated Manufacturing Research Facility (AMRF) is a unique engineering laboratory at the National Bureau of Standards (NBS) Center for Manufacturing Engineering. The facility provides a basic array of manufacturing equipment and systems--a "test-bed"--that researchers from NBS, industrial firms, universities, and other government agencies can use to experiment with new standards and to study new methods of measurement and quality control for automated factories.

The AMRF includes several types of modern automated machine tools, such as numerical control milling machines and lathes, automated materials-handling equipment (to move parts, tools, and raw materials from one "workstation" to another), and a variety of industrial robots to tend the machine tools.

The entire facility operates under computer control using an advanced control approach pioneered at NBS. The AMRF incorporates some of the most advanced, most flexible automated manufacturing techniques in the world.

Why has NBS built this facility?

NBS, as the nation's primary laboratory for measurement science and engineering, has two principal goals for its automated manufacturing program: to supply American industry with a radically new way of making precisely machined parts--with dimensions that can be referenced to national measurement standards maintained by NBS--and to encourage the modernization of American manufacturing by providing the technical information necessary to develop standardized "interfaces" between various types of equipment.

NBS also is using this facility as a testbed for research on the next generation of "knowledge-based" manufacturing systems--automation systems that incorporate artificial intelligence capabilities.

Who supports this research?

In addition to NBS funding, the Navy's Manufacturing Technology Program is a major source of support. Several private firms and universities also contribute to AMRF research through the donation or loan of equipment or by providing personnel

Who will be on the Merit Review Panel?

The NRC Merit Review Panel will be composed of experts in manufacturing technology, marketing, and manufacturing operations from industry, academe, and state government.

When are the proposals due?

Proposals will be accepted until September 16, 1988.

How are proposals to be submitted?

Proposals should be in sufficient detail to permit NBS to evaluate the proposals for meeting the program goals and the criteria set forth in the six general categories detailed in the Federal Register notice.

Submit one signed original plus two (2) copies of the proposal along with Standard Form 424 as referenced under the provisions of Attachment M of Office of Management and Budget Circular A-110. Proposals should be submitted to:

NBS Manufacturing Technology Centers Program
Room B119 Technology Building
National Bureau of Standards
Gaithersburg, MD 20899.

Where can additional information be obtained?

To receive additional information, contact:

Dr. John W. Lyons
Director
National Engineering Laboratory
National Bureau of Standards
Gaithersburg, MD 20899

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What are the advanced AMRF technologies?

Many advanced manufacturing technologies have been developed and implemented in the AMRF. Although the purpose of the AMRF is research on broad issues such as advanced techniques for making precisely machined parts and standardized interfaces between various types of equipment, there are narrower pieces of new technology that may be transferred separately. More information on these technologies is contained in the document "Examples of Advanced Manufacturing Technologies Developed and Implemented in the NBS AMRF," dated July 1988.

How can a center communicate technology transfer experiences to a national audience?

There are many ways this communication can be achieved, including participation in local and national seminars and workshops, active participation in relevant trade and professional societies, marketing products of successful technology transfer efforts to a national audience, and adapting successful technology transfer techniques, innovations or products to industries outside the target region or industry. Each applicant should propose a method for achieving this communication.

How will a center interact with NBS?

An NBS Technical Program Coordinator will be assigned as liaison for each center. The Coordinators will provide the exchanges of information, views and ideas needed to maintain a high degree of collaboration and participation to assure program vitality. The Technical Program Coordinators will provide access to NBS technical resources.

How will successful applicants be chosen?

The National Research Council (NRC) is establishing a Merit Review Panel to provide technical reviews of proposals. This panel will establish and conduct an evaluation process that includes site visits to the most promising applicants and a technical evaluation of the strengths and weaknesses of each proposal vis-a-vis the criteria set out by NBS in the Federal Register. The panel will provide NBS with a summary of its findings and the technical qualifications of each proposal. NBS will make the final selection.

What is the definition of matching funds?

The host organization may count as part of its matching funds, dollar contributions from state, county, city, industrial, or other sources; and in-kind contributions of full-time personnel, equipment, and centrally located office, laboratory, and shop floor space directly related to this program. Details on, and the criteria for, matching funds are set forth in Attachment E, of Office of Management and Budget Circular A-110. The matching share provided by the host organization must meet these criteria.

What will a center do as part of this program?

The purpose of the program is to accelerate the transfer of new automated manufacturing technologies developed at the NBS Automated Manufacturing Research Facility, to small and medium-sized U.S. manufacturing companies. A center should become a mechanism for accomplishing significant results more effectively and in a more timely manner than would be possible without NBS financial support. NBS support is intended to complement, not substitute for, center operating funds derived from state and local government agencies and from other sources.

The transfer of advanced manufacturing technology is the primary task of this program, rather than the performance of research. Activities of each center are expected to include: 1) informing and educating the industrial firms in its region about advanced manufacturing techniques; 2) demonstrating the applicability of advanced technology to these firms; 3) actively assisting firms in evaluating their requirements; 4) assisting with the implementation of desired applications; 5) supporting work-force training and retraining; and 6) communicating technology transfer experiences to a wide national audience.

What is the AMRF?

The NBS Automated Manufacturing Research Facility is a set of computer-controlled machines--mills, lathes, inspection devices, robots, and material handlers--made by different manufacturers and with each device having its own proprietary software. These machines are integrated into a unified system by means of a hierarchical, modular, distributed, and data-driven software control system with non-proprietary interfaces and communications concepts.

Further information on the AMRF is contained in the document entitled "Automated Manufacturing Research Facility," dated November 1987.