
Review of NSF's Experimental Program to Stimulate Competitive Research (EPSCoR)

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EXECUTIVE SUMMARY

Authorized in 1978, the National Science Foundation's (NSF's) Experimental Program to Stimulate Competitive Research (EPSCoR) seeks to develop research infrastructure in states that have historically received a small share of federal research dollars. EPSCoR is managed by an office within NSF's Directorate for Education and Human Resources (EHR). In FY 2000, the program had a budget of \$48 million; nineteen states and the Commonwealth of Puerto Rico participated.

We reviewed EPSCoR to assess how well the program complies with selected NSF requirements and addresses NSF-wide and program-specific goals. Our review included consideration of program administration at NSF and project administration in two states, Mississippi and Maine. We chose these state projects because they had undergone significant recent changes that were of particular interest to NSF program managers and because the states were substantially different in their demographics and research infrastructures.

We found that the EPSCoR program played a role in building a "research culture" at universities that lack the physical facilities and institutional practices that facilitate research. Many such universities build research infrastructure by funding groups composed of a critical mass of researchers with similar interests. Institutional leadership plays a crucial role in identifying and developing promising niches. To become competitive within a niche requires assembling researchers at various career stages, not all of whom need help in becoming competitive for federal research funds. It also may involve funding researchers who are not likely to remain in the EPSCoR state.

The EPSCoR program also tries to bring new researchers into the mainstream of NSF funding by its "co-funding" initiative. Through co-funding, EPSCoR helps NSF's regular research programs support proposals that, though meritorious, do not rank high enough to warrant support from regular program funds. We found that co-funding was operating much as it was designed to do, but that the program was targeted at broad areas of science and did not appear to have the focused impact on specific research areas that EPSCoR's infrastructure awards had. We also noted that NSF does not adjust the EPSCoR program's co-funding contribution in cases where the principal investigator (PI) moves to a non-EPSCoR state and the award is transferred to the PI's new university, and we questioned the advisability of this practice.

EPSCoR requires that states form statewide committees representing the views of leaders in various institutional sectors, including business, government, and higher education. EPSCoR committees are supposed to guide research infrastructure planning in their states to ensure that each state appropriately balances focused impact and broad participation, the EPSCoR project builds diverse partnerships that help it achieve its goals and sustain support in the state, and the EPSCoR project is well integrated into the state's development strategy. In the two states we visited, we found that EPSCoR had facilitated statewide coordination in higher education and research and played an integral part in economic development planning. We looked at the committees' efforts to build broad and sustainable partnerships in support of research-based development. We concluded that these efforts could be improved by cultivating knowledgeable persons from outside higher education to play more prominent roles in EPSCoR.

We examined how NSF's EPSCoR Office administered its large infrastructure awards. We found widespread agreement that NSF project monitoring was reasonable, that proposal review had been constructive, and that more NSF site visits could improve project performance. As evidence for the latter point, we note that our visit to Mississippi catalyzed an organized effort to create a dedicated source of state funds to meet federal matching requirements. We also heard numerous suggestions that NSF ought to develop general eligibility criteria for EPSCoR support and not simply publish a list of eligible states. We concluded that such criteria could improve program administration.

Our review of coordination among the federal agencies with EPSCoR-like programs indicated that current practices were adequate and posed no significant problems for the states that we visited. Our examination of awardee institutions' compliance with NSF financial and administrative requirements indicated that awardees needed to monitor their subcontractors more closely.

We made seven recommendations to improve performance either in the EPSCoR program or in the projects we visited:

1. EHR and the EPSCoR Office, in conjunction with higher levels of NSF management and NSF's research directorates, should develop an administrative mechanism to ensure that EPSCoR co-funding dollars are targeted at their original purpose and do not support, either directly or indirectly, researchers who have moved to non-EPSCoR states. (p. 23)
2. The Mississippi EPSCoR project should decide whether to make business and state government participation in EPSCoR committee activities more structured and formal. (p. 28)

3. EHR and the EPSCoR Office should decide whether, as part of future infrastructure awards, NSF should require broader or more formal participation in Mississippi's EPSCoR committee by representatives of the private sector and public sector organizations outside higher education. (p. 28)
4. EHR and the EPSCoR Office should decide whether to adopt general criteria to determine EPSCoR eligibility, rather than merely publishing a list of eligible states. (p. 37)
5. EPSCoR awardees in Mississippi and Maine should exercise more control and accountability over subrecipient expenditures by either: a) requiring more documentation to support significant sub-recipient expenditures so that a detailed review of expenditures can be conducted off-site or b) conducting regular site visits to inspect the accounting records and documentation that sub-recipients maintain. (p. 42)
6. EPSCoR awardees in Mississippi and Maine should maintain current accounting and cost sharing records for EPSCoR projects. (p. 43)
7. Mississippi's EPSCoR awardee should consider the potential for start-up delays in formulating future award budgets. (p. 43)

In addition, we made numerous observations and suggestions in the report that we believe may help managers focus their own efforts to improve performance.

We sent a draft of our report to EHR and the EPSCoR awardees in the two states we visited. In their responses to the draft, EHR and the two awardees said they found the report useful. EHR generally agreed with all of our recommendations. Maine EPSCoR was also generally in agreement with our recommendations. Mississippi EPSCoR largely disagreed with our financial recommendations. However, Mississippi was receptive to our suggestion that forming an advisory committee might enhance business and government participation in the state's EPSCoR effort. Copies of the responses from EHR, Maine, and Mississippi appear in Appendices C, D, and E, respectively.

PURPOSE AND SCOPE

The purpose of this review was to examine the administration of NSF's Experimental Program to Stimulate Competitive Research (EPSCoR). We assessed whether program activities comply with selected NSF requirements and how well activities were targeted toward program purposes and NSF strategic goals. Throughout our review, we sought an integrated understanding of financial, administrative, and programmatic elements of performance relating to the EPSCoR program. We also sought to understand the relationship between NSF administrative activities and performance at awardee field sites.

We chose the EPSCoR program for review for several reasons:

- Because many of the strategies that NSF highlights in its strategic plan¹ as crucial to realizing the agency's outcome goals are central to the mission and design of the EPSCoR program, we believed an EPSCoR review might shed light on issues that are more broadly relevant to NSF's strategies. Two of NSF's three "core strategies" are "develop[ing] intellectual capital" and "promot[ing] partnerships." EPSCoR seeks to develop intellectual capital by "tap[ping] into the potential evident in previously underutilized parts of the Nation's human resource pool," i.e., the parts in states that receive relatively little NSF funding. It seeks to promote partnerships "to enable the movement of people, ideas and tools throughout the public and private sectors"² by "actively cooperat[ing] with state leaders in government, higher education, and business to establish productive long-term partnerships capable of effecting lasting improvements to the state's academic research infrastructure."³ NSF's strategic plan has four "five-year plans and strategies," one of which is to "broaden participation and enhance diversity in NSF programs." In discussing this strategy, the strategic plan promises that NSF will "build on" EPSCoR's "cumulative

¹ NSF Strategic Plan FY 2001-2006. See especially Section IV, Strategies.

² Ibid., pp. 8-9.

³ Experimental Program to Stimulate Competitive Research (EPSCoR) Program Solicitation, page 1. NSF 98-12.

experience” in its efforts to “strengthen and broaden the education and research capability of states, regions, institutions, and groups.”

- The design of the EPSCoR program has changed significantly since OIG’s last review of an EPSCoR project⁴ and the most recent outside evaluation of the EPSCoR program itself.⁵ Among the most important design changes have been the use of "co-funding" to support research projects and the development of enhanced outreach to EPSCoR states. We believed that NSF could benefit from an independent examination of how these design changes were working in practice.
- EPSCoR warrants periodic outside review because, relative to many of the projects that NSF funds, EPSCoR projects are difficult to administer. EPSCoR projects are large, their activities are varied, the day-to-day tasks of project personnel are loosely connected, and project leaders need to coordinate disparate, independent organizations to make a project succeed. Because EPSCoR projects involve numerous administrative challenges, NSF officials are expected to play a relatively active oversight role.
- In addition to NSF, six federal agencies have EPSCoR-like programs to fund research in states that have not traditionally received extensive federal research support. Policymakers are concerned about coordination of related programs and possible duplication of effort among agencies, as evidenced by the fact that the President’s Office of Management and Budget (OMB) requires federal agencies to address these issues in their performance and strategic plans. We sought to understand how NSF and the other agencies with similar programs handled coordination and possible duplication. In addition, we sought information about how these other agencies administer their programs to determine whether their experience suggested ways that NSF could improve its practices.
- EPSCoR cooperative agreements raise non-routine financial and compliance issues. Unlike most NSF awards, they require awardees to share project costs by supplying funds from non-federal sources equal to a fixed percentage of the amount of their NSF award, and they often involve subcontracts. Prior work by our office indicates that awards involving these practices warrant more than routine monitoring by NSF.
- NSF requires awardees for EPSCoR cooperative agreements to maintain databases with information about who has participated in the project, what research

⁴ “NSF’s South Carolina Experimental Program to Stimulate Competitive Research,” OIG 96-3506, August, 1996.

⁵ Cosmos Corporation, “A Report on the Evaluation of the National Science Foundation’s Experimental Program to Stimulate Competitive Research. NSF 99-115. This report covers programmatic developments through 1994.

has been accomplished, and other elements of project performance. NSF requires similar databases for other projects of comparable size and scope. These data bear on achievement of NSF's performance goals, although NSF has not relied on the quantitative data from these databases in its Government Performance and Results Act-mandated performance reporting system. We sought information on the reliability of these awardee-collected data, as well as on their use by NSF program staff, so that NSF management can better assess whether it is necessary and worthwhile to make efforts to improve the quality and utility of awardee-supplied data.

Two OIG employees conducted this review, a Ph.D. social scientist and a financial and compliance auditor. We reviewed NSF's strategic and performance plans and applicable sections of relevant OMB circulars and NSF manuals on administrative policies and procedures; examined internal NSF documentation concerning the EPSCoR program, including program solicitations, annual reports prepared by the EPSCoR Office describing program accomplishments, and an outside program evaluation; interviewed NSF and other federal officials involved in EPSCoR and EPSCoR-related activities; interviewed awardee personnel and others involved in state EPSCoR projects; and reviewed documentation concerning EPSCoR co-funding, in which the EPSCoR Office helps fund grants in EPSCoR states made by other organizations within NSF. We also reviewed NSF and awardee records relevant to EPSCoR cooperative agreements and grants that support projects in Mississippi and Maine and made site visits to examine how EPSCoR projects in those two states were administered. Site reviews in Mississippi took place in April and September, 2000; site reviews in Maine were in May and July, 2000. Information about the cooperative agreements and grants we reviewed in those two states can be found in Appendix A. Additional detail concerning the methodology used in our review can be found in the sections of our report that present findings.

We chose Mississippi and Maine for site reviews because NSF program managers expressed particular interest in these states, the state projects had undergone significant recent administrative or personnel changes, and the states were significantly different in their demographics and research infrastructures. We looked at the records of cooperative agreements with other EPSCoR states and consulted knowledgeable observers outside NSF's EPSCoR program to ascertain whether there was reason to believe that the EPSCoR projects in Mississippi and Maine were especially unrepresentative. We neither saw nor heard anything to suggest that they were. Nonetheless, each EPSCoR state is unique, and generalizations based on these two cases should be treated with caution.

We hope that the report's integrated description of how the EPSCoR program functions helps policy level officials develop a better appreciation of the issues facing EPSCoR

and similar programs and informs their decisions about program design. In addition, we hope that our observations and suggestions will help NSF managers and leaders at awardee institutions in their continuing efforts to refine and improve their administration of the EPSCoR program and the projects that it supports.

We sent a draft of our report to the NSF directorate responsible for the EPSCoR program and the EPSCoR awardees in the two states we visited. In their responses to the draft, NSF and the two awardees said they found the report useful. NSF generally agreed with all of our recommendations. Maine EPSCoR was also generally in agreement with our recommendations. Mississippi EPSCoR largely disagreed with our financial recommendations. However, Mississippi was receptive to our suggestion that forming an advisory committee might enhance business and government participation in the state's EPSCoR effort. Copies of the responses from NSF, Maine, and Mississippi appear in Appendices C, D, and E, respectively.

BACKGROUND

NSF's EPSCoR Program

In 1978, Congress authorized NSF to establish the EPSCoR program. The purpose of the program was to reduce the geographic concentration of NSF funding and facilitate the development of the academic research infrastructure in states that historically had received a relatively small share of federal research funding. The program solicitation describes the program's mission:

EPSCoR acts on the premise that universities and their science and engineering faculty and students are valuable resources that can potentially influence a state's development in the twenty-first century much the same way that agricultural, industrial, and natural resources did in the twentieth century. EPSCoR's goal, therefore, is to identify, develop, and utilize a state's academic science and technology resources in a way that will support wealth creation and a more productive and fulfilling way of life for its citizens.⁶

Nineteen states and the Commonwealth of Puerto Rico currently participate in NSF's EPSCoR program. Additional states have expressed interest in participation. The program does not have precise, quantified eligibility criteria; eligible states are simply named in the program solicitation. In FY 2000, the program budget was \$48 million. Congress authorized an increase to \$75 million for FY 2001.

In recent years, EPSCoR support for eligible states has taken three forms. First, EPSCoR makes large awards to support strategically chosen efforts to improve state research infrastructure. Currently funded at up to \$1 million per state annually for up to three years, these awards, prior to 1998, had been funded for up to \$1.5 million over five years and could support research projects as well as infrastructure. In NSF's 2000 solicitation, EPSCoR states are invited to apply for infrastructure awards for a maximum of \$9 million over a three year period. Second, NSF has funded two-year EPSCoR grants for up to \$500 thousand to supply "venture capital to initiate projects with a high potential for

⁶ Experimental Program to Stimulate Competitive Research (EPSCoR) Program Solicitation, page 1. NSF 98-12.

significant short-term impact on the state's academic research competitiveness."⁷ The 1998 solicitation included a competition for such grants, but the EPSCoR program decided not to run such a competition in 2000. Third, NSF began a co-funding initiative in FY1998. In this initiative, eligible researchers in EPSCoR states apply to regular NSF programs for research project support. Through co-funding, the EPSCoR program helps support meritorious projects that are in state-chosen strategic areas, that were proposed by researchers who have received little or no funding in the past, and that NSF research programs would not have been able to fund without EPSCoR's contribution.

According to the EPSCoR program's FY 1999 annual report, the program spent approximately \$18 million on its large infrastructure awards, \$8 million on the smaller EPSCoR grants, and \$20 million on co-funding proposals with NSF's research and education programs. In addition, the program spent nearly \$150,000 to fund outreach visits by NSF program staff to institutions in EPSCoR states to acquaint researchers there with opportunities at NSF and assist them in developing competitive proposals.

EPSCoR states are required to have an EPSCoR committee, the membership of which "should reflect the state's leadership and represent state government, higher education, and the private sector."⁸ The committee identifies research areas where developing the state's science and technology infrastructure will be critical to the state's competitiveness for research and development awards. While the fundamental responsibility for administering a state's EPSCoR program lies with the state project director and the institution that receives the NSF award, the committee is supposed to provide general program and policy oversight and ensure that the state's NSF EPSCoR proposals fit with state strategies for development.

NSF's EPSCoR program is designed to give states the flexibility to choose a variety of administrative mechanisms and strategic directions for developing their research infrastructure. Even the term "infrastructure" is open-ended: the program solicitation suggests that infrastructure involved sustainable improvements to a state's capacity to support research and gives several examples of infrastructure, but it does not offer a definition. The program's flexibility enables state EPSCoR projects to vary considerably. In all cases, however, NSF requires that states focus on research-oriented, Ph.D. granting universities; contribute matching funds in support of the NSF award dollars; and work according to a strategy developed and approved by the state's EPSCoR committee in consultation with state leaders in different institutional sectors.

The EPSCoR Office is located within NSF's Directorate for Education and Human Resources (EHR). It is staffed by an office head, three NSF program officers (one of whom is on temporary assignment to EPSCoR), a program specialist, a senior program

⁷ Ibid., p.4.

⁸ Ibid., p.4.

assistant, and an administrative officer whom it shares with another NSF division. EHR has a senior advisor for EPSCoR who formerly headed the office and continues to work closely with it. In addition, an off-site, half-time program director is employed via an Independent Personnel Act appointment to help with outreach.

Mississippi

Mississippi is an economically disadvantaged rural southern state. It ranks last among U.S. states in per capita income and is among the five least urban states in the nation. In all but three states, a higher proportion of the adult population has graduated from high school, and in all but five a higher proportion has graduated from college.⁹ The state has a large black population and a history of racial segregation. A law suit to remove remnants of *de jure* segregation in Mississippi higher education has been in process for twenty-five years.

Higher education in Mississippi is almost entirely state-run. There are eight state university campuses, four of which—Jackson State University (JSU), Mississippi State University (MSU), the University of Mississippi, and the University of Southern Mississippi—consider research to be a significant element of their institutional mission. According to the 1999 Research Catalog of the Board of Trustees of Mississippi's State Institutions of Higher Learning (IHL), these four institutions together account for over 90 percent of the \$214.2 million in external research funding received by universities in the Mississippi system in FY 1999 and over 97 percent of the \$12 million in NSF funding received in that year. MSU, with \$71.8 million in external research funding and \$4.7 million in NSF support, led the other universities in both categories. In FY1998, the most recent year for which data are available, MSU ranked ninety-fourth among U.S. colleges and universities in federal support for academic research and development. JSU is the state's only historically black research university. While JSU's federal research funding has risen rapidly in recent years, it remains less than that of Mississippi's other three research universities.

Among U.S. states, Mississippi ranked thirty-second in federal expenditures for academic research and development. The state has excellent supercomputing capacity and is home to the Stennis Space Center, a National Aeronautics and Space Administration (NASA) facility.

The Mississippi Research Consortium (MRC) comprises the chief research officers of the state's four research institutions. Founded in 1986, the MRC describes its mission as follows:

⁹ Data on state rankings in this paragraph come from the U.S. Census Bureau, Statistical Abstract of the United States: 1999, pages 468, 40, and 171. Data presented below on Maine's rankings come from the same source.

. . . to attract and retain quality researchers, enhance the scientific research and education environment, and improve the economy of the State and the quality of life of those whom it serves by

- Promoting collaborative research initiatives among the State's public universities
- Identifying research opportunities and resources
- Developing and implementing enabling policy
- Providing management structure to conduct collaborative projects, and
- Facilitating technology development, transfer, and commercialization

Mississippi's state EPSCoR committee is composed of the MRC plus the Commissioner of Higher Education or his representative. It has no government representative outside of higher education and no private sector representatives.

Mississippi's EPSCoR infrastructure award (EPS-9874669) is administered by MSU and includes subcontracts with the different Mississippi universities whose faculty participate in the activities EPSCoR funds. The project director is the Vice President for Research at MSU, who has extensive experience in engineering research. The co-project director has a doctorate in higher education administration. She oversees the day-to-day management of EPSCoR activities in Mississippi. Unlike the members of the MRC, none of whom has been in his present position for more than three years, the co-project director has been a part of Mississippi EPSCoR since its inception in 1989.

The infrastructure award focuses primarily on four groups of researchers. Each of Mississippi's research universities is headquarters for one of the groups, but two groups have members at more than one university. The EPSCoR committee gives priority to focus areas that can draw on complementary strengths at the different university campuses and are not restricted to a single institution. The infrastructure award also supports a variety of "campus strengthening" activities, such as seed funding for scientists interested in developing research ideas suitable for possible commercial development or small grants for faculty research in departments without graduate programs.

Mississippi has made several recent efforts to improve its research infrastructure and help translate its research capacity into economic growth. In 1992, the legislature established the Mississippi University Research Authority to permit faculty who wished to commercialize their research to do so without violating state conflict of interest laws. In 1994, the Mississippi Enterprise for Technology, an incubator for new businesses seeking to exploit advanced technology, was established at the Stennis Space Center. More recently, the state government created the Mississippi Science and Technology Commission, composed of leaders from various institutional sectors in Mississippi, to

advise the state “on matters related to the application of science and technology to stimulate economic development in the state.”¹⁰ The Commission issued its report in 1998 and recommended formation of Mississippi Technology, Inc., (MTI) a nonprofit corporation to “focus attention on technology-based business development and system-wide capacity enhancement and . . . help synergize the efforts of diverse organizations.” The state government accepted this recommendation and in 1999 appropriated \$1.5 million to enable MTI to begin operation.

Maine

Like Mississippi, Maine is a rural state with relatively few college graduates. It ranks sixth among U.S. states in the percentage of the population living outside metropolitan areas and forty-sixth in the percentage of the adult population that has completed college; in both categories it ranks right behind Mississippi. Maine is unlike Mississippi in other respects. It is located in the Northeast and its population is overwhelmingly white. The percentage of the adult population that has graduated from high school is above the national average, and the state ranks thirty-sixth in per capita income.

The University of Maine (UM) is the predominant research university in the state. In FY 1998, it received \$14.1 million in federal academic research and development funding, including \$3.1 million in support from NSF. This was almost 87 percent of Maine’s federal academic research and development funding and over 78 percent of NSF’s academic research and development support in the state. The University of Southern Maine, several small private liberal arts colleges, and a private university receive the remainder of the federal funds.

Maine ranks forty-eighth among U.S. states in federal academic research and development funding. The state has several nonprofit research institutions that receive federal research awards. The largest of these, Jackson Laboratories, is a center for genetic research.

Maine’s current large EPSCoR infrastructure award (EPS-9629575) is to the Maine Science and Technology Foundation (MSTF). Almost all of the spending and infrastructure development, however, are focused on UM, and UM’s Vice President for Research and Development serves as project director. NSF EPSCoR has also made two grants to UM to develop centers that promise to facilitate connections between university-based research and economic development in the state. Maine has decided that, rather than including UM as a subcontractor on awards to MSTF, future NSF infrastructure

¹⁰ Mississippi Science and Technology Commission, Mississippi Science and Technology Action Plan, Chairman’s letter.

awards will go directly to UM and future awards from other federal EPSCoR-like programs will go directly to the lead research institutions.

Maine's state EPSCoR committee, the Research Capacity Committee (RCC), had sixteen members, including representatives from business, higher education, government, and Maine's independent nonprofit research institutions, at the time of our site visit in May, 2000. There were plans to expand its membership. During our visit, Maine was in the process of hiring a state EPSCoR director who would act as staff to the RCC and be responsible for ensuring that researchers in the state were fully aware of federal funding opportunities in EPSCoR and similar programs.

The relationships among MSTF, the RCC, and UM, and their respective roles in the administration of EPSCoR-like programs, are evolving. MSTF sees itself as changing "from a program agency to a policy, evaluation, monitoring and information resource organization"¹¹ that needs to be formally independent of program operating responsibilities. The RCC will continue to set broad policy regarding state EPSCoR-like efforts, but will let UM administer both the financial and programmatic components of the NSF EPSCoR program. The RCC chair will be appointed by the governor. The members of the RCC will be selected by a management committee consisting of the chair, the MSTF President, and the Chancellor of the UM system and will continue to represent the various constituencies in the state interested in the development of Maine's research capacity. Although MSTF will no longer act as fiscal agent for federal awards, the RCC will serve as fiscal agent for state funds appropriated specifically as matching funds for those awards.

UM's Vice President for Research, who formerly headed an interdisciplinary scientific research center on campus, serves as project director for Maine EPSCoR. Maine's EPSCoR infrastructure projects have consisted largely of spending for equipment, funding for new faculty lines, and start-up research funds to develop research groups in areas relevant to industries the state has designated as targets for economic development.

In recent years, Maine has developed plans for strengthening its economy through investment in science and technology and, accordingly, has put resources into the UM system and other technology-related activities. In 1997, MSTF developed a state science and technology action plan¹² that the state has used as a guide for its technology-related investments. The Maine legislature created a Joint Select Committee on Research and Development in the same year, and established a line item in the university budget to support investment in targeted science and technology areas. The following year, the state's voters passed a \$20 million bond issue to support research and development infrastructure in the state, much of it at UM. In 1999, the state established and funded the

¹¹ State EPSCoR Management Plan, page 1.

¹² "Answering the Call for an Entrepreneurial State: High Quality Jobs Through Investment in Science and Technology."

Maine Technology Institute to facilitate private sector research and development and substantially increased the state's bonding authority for capital improvements to the university system's research and development infrastructure.

PROGRAM AND RESEARCH REVIEW

The information, observations, and conclusions presented in this section of the report were gathered through review of award and other relevant documentation as well as interviews with NSF personnel, people involved in NSF's Mississippi and Maine EPSCoR projects, and officials at other federal agencies that have EPSCoR-like programs. Detailed information about whom we interviewed appears in Appendix B.

Building Infrastructure

In attempting to develop their research infrastructure, EPSCoR states face multiple challenges. The states typically have limited resources to fund the modern facilities and equipment needed for research and the technicians and support personnel who enable researchers to be productive. Moreover, institutions in EPSCoR states face a competitive environment, in which more established institutions in other states have both resources and reputations that give them advantages in attracting and retaining the best faculty and students. Increasingly, the competition for faculty and students is broadening in geographic scope, as regional and national barriers to mobility become less formidable.

EPSCoR states often lack elements of what some of the people we talked with termed a "research culture." This is an elusive concept which, roughly speaking, refers to the beliefs and practices among a state's leaders and in its top research institutions that facilitate research. Among a state's leaders, this involves a shared appreciation of the long-term economic and social benefits that research institutions bring to a community and a widespread willingness to forgo immediate, tangible benefits from other kinds of spending and invest instead in research. At the institutional level, it involves tolerating the uncertainty and open-ended exploration that are part of cutting-edge research and developing flexible institutional practices geared to the uncertainties endemic in a research environment. Such practices may range from expedited purchasing for research related supplies and equipment to administrative skill in handling technology transfer to capacity to support successful researchers so that they can sustain their laboratories

during interruptions in the flow of external funding, to mention just three of the issues raised with us in our faculty interviews.

At land grant universities, such as the leading research institutions in many EPSCoR states, many researchers have long performed service functions that, especially in fields such as agriculture and forestry, are primarily aimed at furthering social and economic development in their state. For a state to genuinely embrace research as a path to development involves going beyond this. It involves fostering industries more heavily based on continuous innovation in scientific and engineering knowledge and more reliant on highly educated, scientifically trained personnel than the industries in EPSCoR states have traditionally been.

EPSCoR states vary considerably in how well developed their physical and cultural infrastructures for research are. The research universities in states such as South Carolina, Louisiana, Oklahoma, and Kansas have many more researchers who are competitive for federal funds than the universities in Wyoming, South Dakota, Idaho, and Maine. Success rates vary as well. In many EPSCoR states, for example, success rates are low, suggesting that proposal quality is a problem. This is not the case, however, in Maine. Both NSF officials and administrators at UM told us that a high proportion of UM's proposals are competitive, but that the university submits relatively few proposals and thus receives limited NSF funding. NSF EPSCoR staff recognize the variation among states and sometimes explain that they wish to foster "quality within context," setting expectations that are tailored to states' particular situations.

Likewise, variations among universities are significant, and EPSCoR's ability to adapt to these variations is an advantage. At the three universities we visited, we heard somewhat different assessments of the most important infrastructure development needs and the greatest challenges to recruiting and retaining a high-quality, research-oriented faculty. At UM, researchers cited a shortage of good laboratory space as a problem, along with inequities suffered by experienced and productive scientists when the university made competitive offers to attract new researchers. At MSU, the quality and availability of graduate research assistants, often attributed to low graduate stipend levels, was a frequent theme. We interviewed fewer faculty members at JSU, making it harder to generalize with confidence. It was our impression that researchers at JSU, while recognizing that the university had made significant strides in building research infrastructure, believed that high teaching loads and less well developed physical facilities continued to be especially acute problems. On all three campuses, research administrators were well aware of faculty members' views and shared similar perceptions. Not surprisingly, for most faculty members, the quality of the research environment in a faculty member's research center or academic department was more important than that in the university as a whole.

Developing Competitiveness in Niches

NSF's program announcement states that "past EPSCoR experience indicates that state infrastructure improvement strategies which sharply focus available fiscal and human resources on a limited number of R&D areas are most successful."¹³ Overwhelmingly, NSF program staff and scientists and administrators in the EPSCoR states shared this view. They believe that EPSCoR states can compete most effectively by a "niche development" strategy, in which the states aim for competitiveness in designated specialties, and not across the full range of research areas. In Mississippi and Maine, we heard frequent references to the importance of building a "critical mass" of researchers in targeted areas.

Many also argued that interdisciplinary, interinstitutional groups were now at the forefront of science, so that institutions that fostered collaborative research were more likely than others to make significant scientific advances. In their view, the potential for scientific achievement, and not just the exigencies faced by less developed research institutions, suggested a strategy of niche development. Both the MRC strategic plan in Mississippi and the MSTF and RCC in Maine stressed collaborative work as a promising path to developing research infrastructure.

Niche development has several advantages. Specialized strengths help an institution recruit and, especially, retain research oriented faculty and students because researchers value the specialized facilities and equipment, complementary expertise, and opportunities for collaboration that are available in a niche. Specialized strengths also enhance the reputation of the entire institution, since the institution's specialties, and organized activities flowing from them, are visible in the scientific community and identified with the institution; the work of isolated, individually excellent researchers is less likely to be as closely associated with the institution.

In addition, developed niches create a model of a research culture for other parts of the university and the state. While at MSU, we heard frequent mention of the NSF-funded Engineering Research Center on campus, with various characteristics of the center cited to illustrate how to build and sustain research competitiveness. At UM, the NSF-supported National Center for Geographic Information and Analysis was discussed in similar terms. Neither of these models directly benefited from EPSCoR support, and their ability to compete successfully in regular NSF programs was part of what made them models. But certain groups of EPSCoR-funded researchers, especially the group at UM's Advanced Engineered Wood Composites Center and Mississippi's research groups in polymers and computational chemistry, were also held up as models.

¹³ NSF 98-12, page 2.

Models can be inspiring, but they also have direct practical benefits. Where, as in EPSCoR states, models of a research culture are scarce, researchers can feel the absence of those benefits. Thus a researcher who found himself taking on increasing administrative responsibilities in a growing group told us he needed to know more about research management. Relevant managerial know-how would have been easily accessible on a campus with numerous research centers, some in related disciplines, that have experienced directors to whom one can turn for guidance. It is less available at most EPSCoR state universities, and formal management training and distant colleagues are only partial substitutes.

In our interviews, NSF officials stressed that EPSCoR's investment in a state is too small to have a major direct impact in transforming a state's entire research infrastructure, and administrators in the states we visited made similar observations. However, by developing niches that model how a research culture functions, EPSCoR investments arguably have an impact on infrastructure that goes beyond the activities that EPSCoR funds directly.

The Role of Leadership

Nurturing strength in a niche requires leadership at both the institutional and the research group levels. At the institutional level, chief research officers need the authority to choose niches for development. This, in turn, depends on having credibility with their researchers and with higher levels of administration, so that they can concentrate EPSCoR resources without incurring charges of favoritism.¹⁴ At both MSU and UM, the two universities where we talked with numerous faculty with varying degrees of involvement with EPSCoR, we heard strong expressions of confidence that research administrators understood what it took to develop a research culture, had the support of higher levels of the administration in their efforts to build research infrastructure, and were making reasonable investments to achieve their goals. At both institutions, long-time faculty members said that one or another of these conditions had been absent in most earlier time periods. Some observed that funding for earlier EPSCoR awards had been spread too thinly to have a real impact and that too many older, relatively unproductive researchers had been supported for too long a time. NSF officials, having come to a similar conclusion, decided in FY1998 not to support research projects in NSF's large infrastructure awards and to insist that state EPSCoR awards stop supporting long-time recipients of EPSCoR funds.

In both Maine and Mississippi, the essential institutional strategy for niche development is, in the words of UM's Vice President for Research, to "water the green spots." He told us that "throwing money at a non-functioning academic unit doesn't work" and that, instead,

¹⁴ The EPSCoR project director for each of the states we visited was a university chief research officer. In some other states, however, other scientists at a university play this role. We were unable to assess the effects of locating the EPSCoR project elsewhere in the university's structure.

he tries to identify people who have a record of achievement as researchers and show potential to move up to a different level of research leadership—who have the capacity to energize whole groups and build a research unit that is greater than the sum of its parts. He acknowledged that he had chosen an already competitive researcher to develop a proposal for a new EPSCoR-funded research group and explained that he did so in the hope that this researcher would act “as a magnet” and attract other promising researchers into his group. His counterpart at MSU also stressed the role of institutional leadership, saying that, at an institution like his, there had to be more central direction than at more developed places, and that research administrators needed to play an active role in helping interdisciplinary groups to form. He, too, emphasized that research group leaders needed to be able to lead other scientists by making their research groups attractive, but to exercise managerial authority with a light hand.

Complementarity within Research Groups

To develop a group that is competitive within a niche requires assembling compatible people who have complementary expertise and are at different career stages. Even insofar as EPSCoR funding is targeted at cultivating researchers on the verge of competitiveness at the federal level, a favorable environment for developing such researchers may involve established senior faculty mentors and collaborators who can help junior scientists focus and develop their research programs. Thus at least two EPSCoR-supported groups in Mississippi are headed by scientists with named professorships at their institutions. We interviewed one of these scientists, who told us she had a history of external research support from other federal agencies. The other three members of her group were untenured scientists recently appointed to the MSU faculty and at relatively early stages in their careers. All of them stressed the advantage they derived from having infrastructure support to develop an interdisciplinary focus area, and one said he found that the opportunity to establish a close link to a senior investigator had eased his transition to a new university. Although the senior professor, in isolation, may appear to be an inappropriate choice for EPSCoR support, her group, viewed as a whole, is not. Supporting senior people may be part of the price of helping junior scientists become more competitive researchers. Similarly, a JSU administrator, explaining the “campus strengthening” activities that EPSCoR supports, said that the university was trying to compensate for the small number of senior mentors on campus who can help less experienced researchers become competitive.

Developing a competitive group also involves attracting good graduate students and postdoctoral fellows. An active researcher at MSU who was struggling to become competitive for federal funds said that his lack of access to first-rate graduate students had been the most important factor impeding his progress. Many other faculty echoed his emphasis on the contribution graduate students make to competitive research; as we noted earlier, MSU’s low student stipends and inability to attract a sufficient number of

strong graduate students were the barriers to research competitiveness that faculty cited most frequently in our interviews.

Because EPSCoR institutions have difficulty competing for high quality local graduate students, they recruit graduate students and postdoctoral fellows who have little prospect of remaining in the EPSCoR state and contributing to its research infrastructure. Most are foreign nationals who, especially beyond the master's level, are practically the only graduate students that in many cases even active, successful faculty researchers at EPSCoR institutions can attract. Most of the advanced graduate students and all of the postdoctoral fellows we interviewed were from outside the United States. Many expected to return to their native countries, and, of those who wished to remain in the United States, none had any special or long-term commitment to the EPSCoR state in which he or she happened to be doing research. Supporting these researchers contributes to developing infrastructure in a variety of ways at the faculty and undergraduate levels: faculty gain capable research assistants and co-workers who have a sophisticated grasp of their ideas and can help bring them to fruition, while undergraduates, such as those we met at UM, get opportunities to work closely with persons engaged in solving novel research problems and to experience the excitement of creative research. However, for expanding the research infrastructure of EPSCoR states, the value of supporting graduate students and postdoctoral fellows, like that of supporting established researchers, lies in its contribution to building a research culture and sustaining the larger units to which these persons contribute.

One element of building infrastructure in EPSCoR states is facilitating connections to more established research institutions elsewhere. The EPSCoR Office has devoted considerable resources in recent years to ensuring that research universities in EPSCoR states have high-speed connections to Internet2. We noted that the EPSCoR program easily accommodates collaborative efforts among EPSCoR states, but that NSF lacks specific mechanisms aimed at fostering durable ties between research groups in EPSCoR states and complementary groups elsewhere. The absence of such mechanisms is especially striking in view of the EPSCoR states' emphasis on developing competitiveness in niches and their affinity for interdisciplinary and inter-institutional collaborative science. In addition, improved electronic communication makes it increasingly feasible to create research centers or other substantial collaborations that unite distant researchers and reduce the effects of the EPSCoR states' geographic isolation.

We asked NSF officials and EPSCoR state researchers and research administrators whether they thought NSF should do more to develop ties between EPSCoR state researchers and researchers in non-EPSCoR states. This idea was greeted skeptically. Sources of skepticism included concerns that collaborations would be dominated by more established institutions, that EPSCoR state participation would be nominal, and that attempts to foster such ties might in the end lead EPSCoR money to be diverted to more

developed states. In Mississippi and Maine, some argued that collaborations ought to develop “naturally,” without the prompting of special programmatic mechanisms, an argument that seems in tension with the infrastructure-building mechanisms at the heart of the EPSCoR program itself. Indeed, it was our impression that among scientists in the EPSCoR states a considerable part of the skepticism was rooted in unease with a concerted effort at institution-building that departed from the traditional model of NSF’s research portfolio, in which investigator-initiated projects and intellectual merit-driven programs dominate. Such unease is at odds with NSF’s review criteria for proposals, which stress the broader impact of an activity, including its infrastructure-building effects, and we did not detect it among NSF staff members, either inside or outside the EPSCoR Office. But, insofar as such unease is present among the scientists who prepare and review proposals for NSF, including those who directly benefit from infrastructure-building programs, it poses a challenge for the agency’s effort to make the broader impacts of proposed activities a central criterion in funding decisions.

Mainstreaming Researchers

Co-funding

In addition to helping states develop sustainable infrastructure, EPSCoR promotes research competitiveness by “accelerating the movement of EPSCoR researchers and institutions into the mainstream of federal and private sector R&D support.”¹⁵ EPSCoR’s co-funding initiative, launched in FY1998, is centrally concerned with mainstreaming researchers. To receive co-funding, researchers from EPSCoR states do not submit proposals to the EPSCoR program. Rather, they submit to regular NSF grant programs, and their work is merit reviewed in the same way that other proposals to those programs are reviewed. Before submitting a proposal to NSF, the researchers seek the state project director’s certification that the proposal is in an area of science to which the state gives high priority for infrastructure development. If NSF determines that the proposal is of sufficiently high quality to warrant NSF support, but not of sufficiently high priority for the regular program to fund with its own limited resources, the program may approach the EPSCoR Office and request that it support a share of the project’s cost. In deciding which proposals to co-fund, EPSCoR gives priority to proposals “from first-time investigators (i.e., junior and mid-career faculty who have not previously had NSF research support) and members of interdisciplinary research clusters developed through EPSCoR support.” It does not fund experienced investigators who have previously been extensively supported by the division to which they are applying. The EPSCoR Office will fund up to half of the total award cost “with the funds committed up front in the first year of the

¹⁵ NSF 98-12, page 1.

award.”¹⁶ Co-funded awards are managed by the regular grant program that reviewed the proposal, not by the EPSCoR Office.

When NSF began the co-funding initiative, it also enhanced its outreach to EPSCoR state researchers to better acquaint them with NSF’s regular grant programs and NSF funding opportunities outside the EPSCoR program. The EPSCoR Office provides travel funds so that NSF program officers from outside the EPSCoR Office can visit EPSCoR states. Most visits are initiated by invitations from state EPSCoR projects and involve appearances at conferences or organized gatherings. Each of NSF’s grant-making directorates has a liaison to the EPSCoR program, and the directorate liaisons authorize the outreach visits and ensure that the visits are designed to serve EPSCoR program purposes. Liaisons generally thought the outreach visits were worthwhile, though they noted that they had no systematic data to support this judgment. They told us that staff time, not travel funds, was the major constraint preventing more numerous outreach visits. They also noted that an auxiliary benefit of the visits was that NSF program staff became more familiar with EPSCoR state universities and their capabilities. Administrators and researchers in the states we visited were generally enthusiastic about the outreach program, though most of the researchers had not had direct experience with it. Administrators in Mississippi especially praised a well-attended conference on social science research opportunities at NSF.

At the three campuses we visited, research administrators and sponsored projects officials were well aware of EPSCoR co-funding and took steps to ensure that eligible proposals received certification before being sent to NSF. Most of the researchers we interviewed were aware of co-funding and thought it was a good idea. Many were somewhat uncomfortable with any kind of special treatment for researchers in EPSCoR states, preferring to get support that could be defined, in the words of an NSF program officer, as “NSF dollars and not EPSCoR dollars.” While these researchers understood the rationale for the EPSCoR program and did not believe EPSCoR states could build competitive infrastructure without special federal and state effort, they liked the co-funding mechanism because it moved them closer to the mainstream of NSF support.

A primary function of the directorate liaisons is to make NSF program staff aware of EPSCoR co-funding and encourage them to recommend suitable proposals for co-funding. From our interviews with the liaisons, we concluded that they were knowledgeable about and committed to the co-funding initiative. They said that the initiative effectively targets proposals that are “on the bubble” in the competition for NSF support. One praised the EPSCoR Office for being “hard-nosed” in scrutinizing candidates for co-funding, and others indicated that both the directorate and the EPSCoR Office conscientiously checked program officer recommendations to verify that co-funding

¹⁶ “Report on the EPSCoR Co-funding Initiative – the first two years,” page 2.

was warranted. Liaisons told us that they try to rank order proposals for EPSCoR co-funding according to EPSCoR Office priorities, but that they err on the side of inclusion in recommending proposals for co-funding. Some liaisons told us that in their experience proposals had been rejected for funding on policy grounds, but not for lack of available funds; none said that shortage of funds had been a significant constraint.

Liaisons judged it highly unlikely that a program officer could or would “cook” the review process to make strong proposals appear marginal, thereby inducing the EPSCoR Office to help support projects that should have been supported fully by a regular program’s funds (and thus increasing the funds available to that program). They noted that review panels did not know which proposals were certified as eligible for EPSCoR co-funding and could not be certain that EPSCoR would have funds available to support all eligible proposals. Because funding decisions at the margin inevitably involve debatable judgments, we cannot exclude the possibility that some program officer recommendations are influenced by knowledge that the EPSCoR Office would be likely to support a proposal. However, our impression is that the likelihood of serious abuse in this area is remote.

We examined the merit review records for 24 proposals from Mississippi and Maine that had been awarded co-funding in FY 1998 and 1999. We found three funded proposals, all from Maine, that appeared to us to have been highly enough rated to have warranted full support from the programs to which they had been submitted, but only one of these might reasonably be characterized as having slipped by the checks designed to keep proposals such as this from being co-funded.¹⁷ We were also told, however, that the EPSCoR Office seeks to find co-fundable proposals from Maine to achieve geographic balance in its co-funding portfolio, and it is possible that the paucity of eligible proposals from Maine influenced the office’s decision to co-fund in one or more of these cases.

Although co-funding is ostensibly aimed at building infrastructure in focused areas, the areas that states designate can be very broad. UM administrators, for example, told us that a proposal from an eligible researcher in the UM system would be certified if it were submitted to any NSF directorate except Education and Human Resources. Similarly, the EPSCoR Office FY 1999 Annual Report lists Mississippi’s focus areas as chemical sciences; computational sciences (including high-capacity networking); materials sciences; biological sciences; and social, behavioral, and economic sciences. While this list omits some areas of science, notably geoscience, it includes many areas with enormous internal diversity, where it would be possible for numerous researchers to receive co-funded awards and still be working in relative isolation from each other.

¹⁷ One of these received EPSCoR co-funding as part of an arrangement whereby the relevant program agreed to support a marginal proposal from another EPSCoR state that had not been certified at the state level due to an administrative error. The other was funded near the beginning of the co-funding initiative and at a time when funds had been set aside for proposals to NSF’s CAREER program, which funds awards to faculty beginning their careers.

We heard several suggestions, both at NSF and in the states we visited, that NSF drop the certification requirement for co-funding, and simply give priority to promising researchers at early stages in their careers. The logic behind this suggestion was that co-funding was already essentially a researcher development and mainstreaming initiative and that it otherwise had little focused impact on infrastructure.

When Researchers Relocate

For the most part, developing competitive researchers in EPSCoR states is a component of developing research infrastructure. However, there are points of tension between these two kinds of development. One such point occurs when EPSCoR-funded researchers choose to relocate to non-EPSCoR states. From the standpoint of researcher development, relocation often is a success story: an EPSCoR-supported researcher is offered a position at a more prestigious, research-oriented university, and EPSCoR support may have helped make the researcher more competitive in the academic marketplace. From the standpoint of infrastructure development in the EPSCoR state, however, the researcher's departure is a loss, and the infrastructural legacy the researcher leaves behind is often, at best, minimal. Consistent with the logic of researcher development, NSF permits co-funded awards to be transferred to the researcher's new institution, rather than forcing the researcher to either relinquish the award or stay at the original awardee institution. None of the other agencies with EPSCoR-like programs¹⁸ permits projects that have benefited from EPSCoR support to move to institutions in non-EPSCoR states. NSF program staff told us that they believed it would be inequitable to co-funded researchers to impose special mobility barriers on them. Despite the logic of infrastructure development, however, NSF does not alter the predetermined EPSCoR share of the award cost to reflect the fact that the award, when transferred, ceases to play an EPSCoR-related infrastructure purpose.

We believe that, once EPSCoR-supported researchers relocate to non-EPSCoR states, the EPSCoR program should no longer share in the cost of their awards, and NSF's regular programs should fully cover award costs. The overarching goal of the EPSCoR program is to build research competitiveness in the EPSCoR states, and the co-funding initiative, by mainstreaming EPSCoR state researchers, is intended to further this goal. When NSF knows that the award is no longer serving EPSCoR purposes, the rationale for a continuing EPSCoR share in costs vanishes.

We raised this issue with staff members in the EPSCoR Office and with the EPSCoR liaisons elsewhere in NSF. They offered two arguments in favor of the EPSCoR Office's

¹⁸ These are the Department of Agriculture (USDA), the Department of Defense (DOD), the Department of Energy (DOE), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), and the National Institutes of Health (NIH). Their programs are discussed on pages 37-40 below.

current practice concerning relocations. The first was that researchers did not relocate frequently. We consulted NSF's computerized awards database and found 13 awards¹⁹ that had received EPSCoR co-funding and were subsequently transferred to non-EPSCoR states. We have reason to believe, however, that the database understates the frequency of transfers.²⁰ Moreover, since many co-funded awards remain open, it is reasonable to anticipate that some of these will be transferred out of the EPSCoR states before they expire.

The second rationale for the current practice regarding relocations was that it would be administratively complicated to reallocate funds among different programs after researchers changed institutions.²¹ We believe the administrative complications of ensuring that EPSCoR's co-funding dollars stay targeted at their intended purpose are not insurmountable. NSF might use contingency funds, either at the division, the directorate, or the agency level, to replace EPSCoR contributions. Alternatively, in anticipation of relocations, NSF might augment the Congressionally authorized EPSCoR budget by an amount intended to cover the cost of continuing to support awards for which EPSCoR co-funding is no longer appropriate.

Recommendation 1. EHR and the EPSCoR Office, in conjunction with higher levels of NSF management and NSF's research directorates, should develop an administrative mechanism to ensure that EPSCoR co-funding dollars are targeted at their original purpose and do not support, either directly or indirectly, researchers who have moved to non-EPSCoR states.

¹⁹ There is no simple way to characterize this number as a proportion of EPSCoR's co-funded awards. Ideally, one would want to assess the proportion of awards that transferred before the award ended. Because co-funding is relatively new, however, most co-funded awards are still in progress and there is an insufficient number of completed co-funded awards to permit such a comparison. The following information is relevant to gauging the frequency of relocation: According to EPSCoR's FY1999 annual report, EPSCoR co-funded 82 awards in FY1998 and 136 in FY1999. Although FY1998 was the first year of the co-funding initiative, the EPSCoR Office had co-funded a limited number of awards in prior years. Nine of the transferred awards in the database predate FY1998, two were made in FY1998, and two were made in FY1999. Many of the FY1998 co-funded awards, such as those supporting enhanced computer connectivity for EPSCoR state institutions, were infrastructural, did not involve mainstreaming researchers, and were essentially immune from transfer. Fewer FY1999 awards fit this description. The proportion of FY1999 awards that has been transferred is relatively small, but these awards are relatively early in the award period and have more time remaining in which to transfer. In our view, these data indicate that NSF's current practice regarding these awards does not represent a large diversion of EPSCoR program funds away from their intended purpose, but the data do not indicate that the current practice is acceptable.

²⁰ During our review at MSU in April, we learned of one PI with a co-funded award who had relocated to a non-EPSCoR state and another who was in the process of doing so. As of December, 2000, even though both PIs had left MSU months earlier, neither of their awards had been transferred, and the NSF database gave no indication that a transfer was in process. We therefore consider it likely that the database lacks information about additional PIs who have left EPSCoR states.

²¹ We were also told that, because EPSCoR funds support the initial part of the award period, these funds would overwhelmingly be spent at the EPSCoR state institution before the award was transferred. This strikes us as irrelevant to the main issue, which is whether award costs are properly distributed between the programs whose purposes the award expenditures serve. The EPSCoR program makes an up front contribution to the award, rather than contributing a portion of each year's cost, for administrative convenience. It does not do so because the initial award expenditures, as compared to expenditures in later years, contribute disproportionately to achieving EPSCoR program goals.

State EPSCoR Committees

NSF requires states to form EPSCoR committees to plan for the development of their research infrastructure. The committees are responsible for assessing the strengths and weaknesses of the state's research infrastructure, identifying key areas of science and technology to be designated for focused development, selecting a project director and fiscal agent for the state's large infrastructure project, submitting a proposal for that project, and ensuring that the proposal supports the state's research and development objectives. Committees are supposed to choose a sustainable course of development and reflect the state's leadership in different institutional sectors.

The EPSCoR committees in Mississippi and Maine face similar challenges, though they have responded to them differently. One challenge is addressing how much concentration of EPSCoR activities within the state is desirable, i.e., how much the state can broaden participation in NSF-funded EPSCoR activities without reducing the quality of its investment in research infrastructure or losing the focused impact that comes from concentrating resources. NSF officials refer to this as the “peanutbuttering” issue—the issue of whether the money is spread too thinly. In a sense, NSF faces this same issue at the national level as the agency seeks to broaden participation both through special programs such as EPSCoR and within its regular grant programs. A second challenge is building a constituency for university-based research in states that lack a well developed research culture on the state level and where research has not traditionally been an engine of economic growth. Potentially, at least, the state EPSCoR committee is a focal point for developing partnerships with elites outside the university sector that can strengthen long-term efforts to build research infrastructure. Likewise, the committee can be the focal point for partnerships within the state's higher education and research sector itself. A third, related challenge is coordinating EPSCoR planning with state government economic planning and local industry needs so that the EPSCoR effort becomes truly integral to the state's development strategy. Part of this challenge is achieving coordination at a sufficiently specific level to be meaningful, but not at such a micro level that the committee is either involving itself in decisions better left to people with subject matter expertise or diverting EPSCoR money away from infrastructure and toward short-term needs.

Below, we refer to these three challenges as broadening participation, building partnerships, and creating broader impact. These terms derive from NSF's strategic plan and proposal review criteria, and we use them to underscore that these challenges raise issues that relate to NSF goals and strategies generally and transcend the EPSCoR program.

Mississippi

In Mississippi, broadening participation means grappling with the disparities among the state's different research universities. The research infrastructure in these universities is differentially developed in different research areas, and is more developed in some universities than in others. The disparities are rooted in regional variations and different historical roles. In addition, they stem from Mississippi's long history of racial discrimination, which effectively precluded the possibility that JSU, an historically black university, would become a federally competitive research institution.

Committee members, including JSU's chief research officer, told us that the committee is aware that JSU has a narrower base of potentially competitive research and a less developed administrative infrastructure for research than Mississippi's other research universities. But they said that, beyond being sensitive to JSU's areas of strength and attempting to ensure that EPSCoR takes full advantage of opportunities to develop those areas, they gave no special treatment to JSU in EPSCoR-related decisions. It was our impression that the historic racial inequities in Mississippi higher education were generally perceived to be an issue that, for the most part, had to be addressed at a higher and more politically responsible level than the EPSCoR committee.

Although the members of the MRC are relatively new to their positions, they reported that they had a comfortable working relationship. All of them have histories in Mississippi higher education administration that predate their membership on the MRC, and in some cases they can build on preexisting relationships. To some extent, they have also been able to build on the long-standing pattern of comfortable interaction their predecessors had established. Because the MRC meets about once a month and its members face similar issues in their institutional roles, MRC members benefit from a depth of shared concerns and perspectives that would be hard to achieve if Mississippi's EPSCoR program were their sole focus of common interest.

MRC members and other long-time participants in Mississippi's EPSCoR effort said that the cooperative working relationship among Mississippi's research institutions had been among the greatest benefits the state derived from EPSCoR-related activities. One EPSCoR committee member observed that EPSCoR has caused the four research universities to deal with each other, share ideas, and collaborate, and that the chief research officers had pioneered greater collaboration among these universities on a variety of issues. We were also told that the state legislature responded much more positively to higher education when it presented a common front than when divergent institutional interests predominated.

Because MRC members are intimately familiar with the research activities on their own campuses, they rely on their informal knowledge of opportunities for developing research

infrastructure and do not engage in a formal scanning or assessment process to guide decisions. They also do not use formal mechanisms for eliciting input from leaders in industry and state government, but instead rely on extensive informal contacts to make themselves aware of these leaders' perspectives. In our interviews, MRC members said they believed that a larger, more diverse EPSCoR committee would be too diffuse and could not develop the close working relationships and shared perspectives that made the MRC effective.

We saw ample evidence that EPSCoR planning was linked to state economic development planning more generally and oriented toward creating a broader impact beyond the academic research community. MRC members agreed that Mississippi's higher education leadership was well aware that tying research to economic development was vital to making the case for research to the state legislature. As one committee member said, "we can't deal in generalities or idealism" in making the case for research in an economically disadvantaged rural state.

As the chief research officers for Mississippi's research institutions, the MRC members are well aware of how MRC decisions can affect the interests of their home institutions. We were concerned about whether a state EPSCoR committee whose members were unavoidably sensitive to institutional interests could be sufficiently objective to make plans and exercise oversight in ways that kept statewide interests firmly in view. Committee members told us that their shared commitment to developing multi-institutional areas of research strength shaped their discussions of possible infrastructure investments and helped them overcome the weight of institutional interests, while recognizing that those interests have a legitimate role in statewide planning. Thus, although it is probably not accidental that Mississippi's four EPSCoR-funded research groups are coordinated by scientists at different universities, it is also not strong evidence that institutional interests caused the MRC to compromise its commitment to meeting the state's infrastructure needs. An interviewee familiar with how the committee functions said there was "a gentleman's agreement" among the members to protect one another's turf, but also to "leave your baggage outside the door" when you came to MRC meetings. Another said that once interinstitutional areas had been identified for development, the committee was able to turn detailed planning responsibilities over to the scientists involved, for whom scientific considerations were more important than institutional interests. He added that, although there were institutional interests in being credited as the fiscal agent for externally funded awards, these were relatively insulated from decisions about which scientific collaborators at which institutions would receive funds from an award.

We believe that NSF and the Mississippi EPSCoR committee should reconsider whether more structured and formal participation by business and state government representatives would be advantageous to Mississippi's EPSCoR effort. In our view, such participation offers three potential advantages. First, it can provide an added check

against the effects of institutional interests by bringing to bear the influence of parties from outside the university system. Second, it can increase the likelihood that the knowledge and perspectives of business and government leaders affect EPSCoR-related decisions and promote additional ties among EPSCoR researchers, business leaders, and government officials. Third, it creates opportunities for leaders outside the higher education sector to gain a fuller grasp of the various ways that research activity can benefit higher education and the state in general and thus builds alliances that can strengthen the state's commitment to research.

This last point requires some elaboration. The industry and government representatives we spoke with in Mississippi, while they were supportive of EPSCoR and aware of its relevance to their particular interests, were not effective spokespeople for the larger purposes of EPSCoR or the general value of research institutions to a state like Mississippi. In the short run, research investment in Mississippi may not need such spokespeople. As one of the MRC members pointed out to us, the climate for university-led economic development is currently positive, with examples such as Austin, Texas, and the Research Triangle area of North Carolina providing well known models of success in other Southern states. This, especially in a favorable economic climate, may be sufficient to ensure continued investment in Mississippi's research infrastructure. But, when research investment competes with more immediate, pressing needs, it is helpful to have knowledgeable and prominent advocates outside the university system and without a direct stake in research funding who will act to preserve and enhance the state's commitment to research funding and development. Moreover, involvement of leaders from other institutional sectors in EPSCoR could usefully complement ongoing processes that are apt to strengthen the involvement of such leaders in applied and commercial aspects of research in Mississippi. Notable among these is the creation of MTI, which aims to concentrate on technology-based business development and not primarily on building the basic research environment in Mississippi's universities that helps lay the groundwork for such development. The EPSCoR program is predicated on the idea that broad-based research capacity is important to help a state develop. By bringing leaders in other sectors into more regular interaction with the EPSCoR committee, the MRC could cultivate allies whose support for this idea would prove useful in the future and who could balance MTI's more applied and commercial orientation.

At an earlier stage, Mississippi EPSCoR had a business advisory group that did not function effectively and was disbanded. With research now more prominently on the state's agenda, the time may be right to create a similar, but more broadly-based, advisory panel, drawing on government as well as industry. Such a panel could bring Mississippi the advantages of broader institutional participation in EPSCoR without sacrificing the advantages of the MRC's close working relationships and in-depth knowledge of university research.

Recommendation 2. The Mississippi EPSCoR project should decide whether to make business and state government participation in EPSCoR committee activities more structured and formal.

Recommendation 3. EHR and the EPSCoR Office should decide whether, as part of future infrastructure awards, NSF should require broader or more formal participation in Mississippi's EPSCoR committee by representatives of the private sector and public sector organizations outside higher education.

Maine

In Maine, the issue of broadening participation is essentially an issue of deciding to what degree EPSCoR can fund institutions other than UM. NSF's focus on Ph.D. granting institutions has made UM the center of NSF EPSCoR funding, and the recent reorganization of the governance of Maine's EPSCoR effort explicitly recognizes that the state's large NSF EPSCoR infrastructure award needs to be administered at UM. As one RCC member commented, for this kind of NSF funding, "all roads lead through [UM at] Orono."

At the same time, the RCC (and predecessor versions of the state's EPSCoR committee) have included numerous representatives of nonprofit research centers and selective liberal arts colleges in Maine. MSTF and the RCC have stressed the value of collaborative relationships among Maine's research institutions and sought to encourage investments that link UM to these other institutions. UM officials have been more cautious about collaborations, although they pointed out that they had pursued certain collaborations, notably with Jackson Laboratories, that promised to enhance their competitiveness in the federal arena. But UM administrators were more concerned than RCC or MSTF officials about whether potential collaborators had the capacity to contribute meaningfully to Maine's competitiveness at the federal level.

Our interpretation of the recent reconstitution of the RCC, insofar as it bears on breadth of participation in EPSCoR-related activities, is that it (1) gives UM almost complete control of the NSF EPSCoR project, with only general RCC oversight of NSF-related activities and (2) gives the RCC a considerably more active role in planning and selecting proposals to EPSCoR-like programs administered by other federal agencies. When, in some of our interviews, we offered this interpretation, we were told it was reasonably accurate. To some degree, this outcome represents a political compromise among different contenders for federal support. But, to a considerable extent, it represents a belief that, while UM will continue to receive the vast majority of Maine's NSF support for the foreseeable future, additional research institutions in Maine may be potentially competitive at other federal agencies, which place less emphasis on university-based research infrastructure.

At the time of our July visit, Maine was on the verge of hiring a statewide EPSCoR coordinator. The coordinator was to be responsible for keeping a close eye on the science priorities and EPSCoR-like programs in the various federal agencies and helping catalyze collaborative relationships in Maine that would lead to competitive proposals. In addition, the coordinator was supposed to supply knowledge of federal grant-making to complement the RCC's sensitivity to Maine's economic development needs and political dynamics. Interviewees knowledgeable about the history of Maine's EPSCoR committee told us that the committee had sometimes involved itself in details of proposal development that were beyond its scientific expertise and that they were hoping the coordinator could influence the RCC to be more judicious in the future. As described to us, the coordinator was expected to be scientifically sophisticated enough to identify hitherto unrecognized opportunities for federal funding and help the RCC cast research proposals in ways that maximized their chances of success. Yet the coordinator was also expected to be scientifically modest enough to defer to the technical judgments of the researchers and research institutions that develop proposals. This combination of sophistication and modesty may be difficult to achieve.

Research administrators at UM, with support from the Chancellor of the university system and following up on earlier, faculty-initiated efforts, have cultivated support in the legislature for research funding. They told us that in recent years UM and the state university system have developed strong relationships with Maine's political leadership, and both the MSTF officials and the legislator we interviewed confirmed this assessment. UM administrators noted that bringing legislators to NSF-sponsored EPSCoR conferences had been an effective means of acquainting them with the potential contribution of research universities to helping states develop.

Building a constituency for research has meant emphasizing that research leads to economic development. Contrasting recent EPSCoR projects with Maine's earlier efforts, the EPSCoR project director at UM stressed that recent projects were chosen for their capacity to "catch the imagination of the leadership in Maine" with their economic development potential and that they were geared more toward federal support generally than toward NSF funding in specific. He said that earlier EPSCoR efforts had been successful in generating federal grants, but that the legislature and governor "counted jobs, not publications" and were especially excited by projects with potential private sector spin-offs. A faculty member we interviewed, who had not received support from the EPSCoR infrastructure award and who believed that research like hers was too basic to fit with Maine EPSCoR's more applied orientation, endorsed Maine EPSCoR's attention to economic benefit as important for sustaining political support for research in the state. As was the case in Mississippi, it seemed to us that Maine's EPSCoR activities were selected and managed with a view to their broader impact as well as their intellectual merit.

Research administrators were mindful of the fact that federal research grants themselves produced jobs, even when they did not lead to industrial application of research findings. They also understood that some EPSCoR-funded research that had potential long run benefits for Maine and its industries was most likely, in the short-run, to be exploited by out-of-state companies. The RCC members from outside higher education whom we interviewed appreciated the complexity of the relationship between research infrastructure and economic development. Thus the RCC chair, who comes from the business sector, said he did not necessarily expect an EPSCoR project to foster commercial applications, but added, “the more research that’s done, it eventually rises to the level where it can have commercial value.”

MSTF has also worked to coordinate state research planning with economic development planning. It has played a leading role in planning for statewide technology-based development and outlining strategies for evaluating state investments in research and technology. As EPSCoR and related research and technology development efforts have become more prominent in Maine, tensions between MSTF and the UM system emerged, a pattern that NSF officials told us was not uncommon between infrastructure development foundations and universities in EPSCoR states. Though some tension remains, it was generally agreed that relations were now much better than they had been a few years ago. Administrators at both MSTF and in the university system were optimistic that recent organizational changes in Maine’s EPSCoR effort would further improve working relations. They especially cited the transfer of award administration responsibilities to UM, recommended by MSTF and UM to the RCC, as likely to cause improvement.

One of the primary benefits of EPSCoR-related activities in Maine, as in Mississippi, was that they fostered interinstitutional partnerships. Such partnerships had developed within the research community as well as among research institutions, government, and, perhaps to a lesser degree, business. Indeed, MSTF’s President was particularly appreciative that NSF made developing partnerships a core strategy in its strategic plan.

Because Maine’s EPSCoR committee includes members from government and the private sector, it is more broadly representative than Mississippi’s. However, it is similar to Mississippi’s in that to a large extent its members join the committee because they have institutional interests at stake. It was our impression that interest representation was the dominant model for RCC participation, perhaps more so than it was for Mississippi’s MRC. Thus, some of our interviewees characterized the RCC as the voice of Maine’s nonprofit research institutions or viewed it as a counterweight to UM’s interests, and others said that members sometimes did not transcend the interests of their own institutions. Likewise, Maine’s plans for expanding the RCC are intended to make it more representative in the sense that affected institutions will be at the table when decisions are made. This kind of representativeness can be valuable. But representation can have

another function. It can bring to bear on statewide policy the perspectives of people who are familiar with the needs and practices of an institutional sector, but who either lack a direct stake in RCC decisions or can transcend their institutional interests when participating in RCC deliberations. One interviewee claimed that many executives knowledgeable about research-related business in more economically developed states have retired to Maine and suggested that the RCC might look to them as a source of disinterested, business-oriented perspectives on issues facing the state. When legislative proponents of investment in research infrastructure leave government due to term limits, they could play a similar role in providing government-oriented perspectives.

In our view, the EPSCoR committees in both Maine and Mississippi could benefit from cultivating knowledgeable, relatively disinterested persons from outside higher education who, if they are willing to involve themselves deeply in EPSCoR-related activities, could help sustain statewide investments in developing a robust university-based research infrastructure against possible future pressures to devote resources to more immediate needs. We recognize that, even more than in Mississippi, the current climate in Maine is favorable to research-based development, as evidenced by the state government's infusion of new resources into research. It seems to us prudent to take advantage of this favorable environment to cultivate knowledgeable, persuasive, well-connected supporters for broad-based research investment, rather than waiting until support for research is threatened. The RCC would benefit from committed members whose orientation was similar to that of the RCC chair, who saw his role primarily as supplying management expertise to further development in Maine, and not as representing his company.

EPSCoR and Education

Although the EPSCoR program is administered by EHR, NSF's education directorate, it is as much a research program as most of the programs run by NSF's research directorates. In part, there is some logic to EPSCoR's institutional location in EHR, in that EPSCoR is an infrastructure and human resource development program and, as such, is broadly similar to other EHR programs. Furthermore, because NSF's research directorates are defined by the areas of science they fund, EPSCoR would not fit comfortably in any one of them. EPSCoR Office staff told us that the Office's institutional location was not a problem as long as EHR leadership was supportive of the EPSCoR program's mission.

One of NSF's core strategies is the integration of research and education. We asked faculty members and administrators at the universities we visited about EPSCoR's role in improving education. In response, many stressed that EPSCoR enhanced graduate and undergraduate education at their universities by supporting meaningful research

experiences for their students. At all three universities we visited, faculty and students provided us with significant evidence of undergraduate participation in research. EPSCoR-supported researchers at both MSU and UM had received NSF awards to fund Research Experience for Undergraduate Sites, which supported groups of students spending summers doing research at the university. Especially in Mississippi, researchers cited numerous instances of student participation in professional conferences, where they presented the results of their EPSCoR-supported research.

We were also told that research universities in EPSCoR states had little choice but to integrate students into faculty research, because these universities lacked the infrastructure of technicians and postdoctoral fellows available elsewhere. This integration appeared to be most effective where there was a critical mass of researchers, so that postdoctoral fellows and advanced graduate students could help mentor students at earlier stages in their careers and enable those students to take on progressively more responsible research roles. Thus one administrator told us that funding groups of faculty facilitated undergraduate research participation because the scale of the research became large enough to sustain undergraduate participation. Similarly, a faculty member with a co-funded EPSCoR award, who was not a part of an EPSCoR-funded group, said that he needed technician support to create a level of research activity that could support meaningful undergraduate involvement. He said that federal funding agencies had declined to provide such support and pushed him to employ students on his projects instead. He speculated that the funding agencies sent his proposals to reviewers who worked at institutions with a more developed infrastructure for research and who therefore did not really understand his situation.

Several interviewees expressed concern about signals from NSF that EPSCoR projects should become actively involved in education at the pre-college level. Such concern was especially pronounced in Maine, where faculty and administrators said that EPSCoR funds were best targeted at the program's basic goal of developing a university-based research infrastructure. They argued that pre-college education in Maine was comparable in quality to that elsewhere in the nation and was both a less pressing need for the state and a need better addressed through other programs.

Because of NSF's interest in fostering synergy between its education and research projects, we looked at the relationship between Mississippi's EPSCoR project and the Mississippi Alliance for Minority Participation (MAMP), a project to increase minority participation in research and education in science and engineering at the undergraduate level. MAMP is administered by JSU, but involves all of Mississippi's state university campuses. MAMP's PI is also involved in EPSCoR. Although EPSCoR and MAMP appeared to be closely connected at JSU, the connection seemed looser at MSU, where EPSCoR-funded faculty did not generally see MAMP as an important resource for undergraduate research assistants. While MAMP's strategy of "empowering students to

take responsibility for their own success²² emphasizes student initiative, rather than coordination between projects, as the major vehicle for engaging students in research and related activities, it appeared to us that somewhat closer ties between EPSCoR and MAMP might prove fruitful at MSU and other campuses. An NSF official in EHR's Division of Human Resource Development, which funds MAMP, told us that NSF has recently increased its efforts to encourage closer relationships between projects such as MAMP and other NSF-supported projects with complementary goals.

Administering EPSCoR at NSF

Proposal Review

The EPSCoR Office reviews proposals and monitors progress for EPSCoR's large infrastructure awards, but not for its co-funded research awards, for which proposal review and project monitoring are the responsibility of NSF's regular programs. The Office strives to select reviewers with varied professional perspectives on an infrastructure project by picking a review panel composed of what one NSF official described as "a microcosm of university roles," including academic researchers and administrators. Because the Office views the review process as an opportunity to acquaint scientists from other states with the developing research capacity at EPSCoR institutions, it tends not to select reviewers from EPSCoR states. EPSCoR program staff told us that their care in reviewer selection ensured that they had ample information to apply both of NSF's proposal review criteria when making judgments about EPSCoR proposals.

Although all eligible states are currently receiving EPSCoR infrastructure funding and no one we interviewed could recall NSF terminating an infrastructure award, neither NSF officials nor university administrators in Mississippi and Maine viewed EPSCoR funding as an entitlement. There was general agreement that EPSCoR's review process was as rigorous as that for other NSF programs and that an NSF request that a state revise and resubmit a proposal sent a powerful message that a state's program was in trouble. Administrators at UM and MSTF, for example, told us that NSF's rejection of Maine's 1995 infrastructure proposal was a "great wake up call" that sensitized the state EPSCoR leaders to the need for a more focused, higher quality proposal. NSF officials noted that in many states an initial rejection could be acutely embarrassing politically, not least because EPSCoR project directors, having courted state or university leaders to secure matching funds to meet the cost sharing requirements of the anticipated NSF award, now had to explain why the funds were not needed. In cases where NSF recommended substantial changes in a proposed infrastructure activity, notably in the neuroendocrine

²² Proposal abstract for HRD-9623750, entitled "Mississippi Alliance for Minority Participation."

interactions group in Mississippi, the researchers and administrators we met were unanimous and enthusiastic in their view that the changes had improved the project.

In examining the proposal review records for a Mississippi infrastructure proposal, we noted the absence of names and *curricula vitae* (resumes) for the faculty members in the research groups for which Mississippi was seeking EPSCoR support. A proposal reviewer suggested that including brief resumes would improve the review process, and we agree. Resumes would enable reviewers to assess whether the qualifications and experience of the researchers in the group make them suitable for EPSCoR support, or whether they are either already competitive for federal awards or lack the potential to become so. Moreover, resumes would provide information about a group's potential to develop sustainable strength in a niche by telling reviewers whether the group had the related and complementary skills and interests that would make it more than the sum of its parts or, alternatively, was a collection of researchers who were unlikely to gel as a group. NSF EPSCoR staff were sympathetic to these arguments and said they would consider asking that resumes routinely be included in proposals in the future.

Award Monitoring

Annual progress reports are NSF officials' primary tool for monitoring infrastructure projects. Program officials use the language of the award instrument²³ as their guide to project performance, and the progress reports are organized according to the categories in the award document. Several administrators, both at NSF and in the states we visited, observed that timing for progress was difficult to predict and that timetables in proposals could not be used as more than a rough, flexible monitoring tool. They said that performance milestones had proven more useful in charting whether a project was moving in the right directions. EPSCoR program officials also said that their quarterly conferences with project directors and frequent telephone contact help keep them informed about project developments. The head of the Office told us that he thought the Office was hearing about significant issues earlier, especially when these involved project-wide matters such as leadership changes or problems in securing commitments for matching funds. Although we heard some complaints during our visits to Maine and Mississippi about the burden imposed by NSF reporting requirements, most scientists and administrators viewed the requirements as reasonable, and some said the burdens had been diminishing in recent years. Several people said the reporting burdens NSF imposed compared favorably to those involved in dealing with other federal agencies.

²³ Currently, the large infrastructure awards are cooperative agreements, but the most recent program solicitation is for grants. EPSCoR Office staff members told us that this change would not affect their project monitoring practices, however, and that they would include reporting requirements in future grants that would be similar to those in the current cooperative agreements.

We heard numerous expressions of regret that NSF officials could not make more site visits. Thus an NSF program officer said that states want NSF officials to visit yearly and to know what is going on-- that the message from the states was not "fund me and leave me alone." Similarly, several scientists we interviewed suggested that additional site visits would be helpful. One, for example, noted that such visits improved project performance by "tightening things up a bit" and another, whose previous funding had come from other federal agencies, said that he had expected more visits for monitoring purposes. NSF program staff told us that they gave a high priority to making visits to projects that were encountering problems, but would like to do additional routine site visits if time and staff resources permitted. They viewed site visits as the best way of getting beyond a project's reputation and developing a more accurate sense of how well a project was functioning.

Much NSF project oversight is better described as coaching than monitoring. As a research administrator in Mississippi told us, the people at NSF have been "our advocates, and they also chastise us when necessary." An EPSCoR Office official characterized his relationship with state projects as "collaborative," and an administrator at UM described NSF staff as supportive and praised the "feeling of team play-- they are our allies in building infrastructure." Experienced EPSCoR program officers impressed us as knowledgeable about individual research groups and personally committed to their success. In some cases, research group leaders in the EPSCoR states relied on the advice and support of their program officers and appreciated the program officers' personal interest in their progress.

Attention from NSF can have benefits beyond those that come from coaching. It can catalyze action that improves project performance. One of the consequences of OIG's own review in Mississippi illustrates this point. During our visit, we discussed with the members of the MRC the challenge Mississippi universities face in meeting federal cost sharing requirements. After we returned, we were told that our discussions had prompted the IHL to include a \$2 million line item for federal matching funds in its proposed budget for FY 2002 and that this was the first time that the MRC had prevailed upon the IHL to specifically designate funds for this purpose. Although we were told, perhaps in jest, that this was "your [OIG's] idea," it was not. However, in this case a visit from someone at NSF focused attention on a long-standing programmatic need and helped set in motion local efforts to address it. Similarly, an administrator in Maine told us that NSF visits improved the EPSCoR-related interactions within the state.

According to EPSCoR Office staff members, the Government Performance and Results Act (GPRA), which mandates that government agencies collect and use results information to improve their management practices, has not had a major impact on the way NSF administers the EPSCoR program. The Office has traditionally collected quantitative data about its large infrastructure projects, including data bearing on results. Program officials told us that they have become somewhat more vigorous in pursuing

"nuggets"--qualitative information that can be used for GPRA reporting to illustrate exemplary results-- but added that they had always collected such information, even before GPRA was enacted. Although they noted that EPSCoR results involved program-specific goals that, though fully consonant with NSF-wide goals, do not map easily into NSF's, and especially EHR's, reporting frameworks, they did not see this as a significant problem.

Eligibility Criteria

In the 21 years since NSF began the EPSCoR program, no EPSCoR state has yet succeeded in building its research infrastructure to the point where it has graduated from EPSCoR eligibility. NSF officials recognize that currently eligible EPSCoR states cannot realistically hope to receive as many federal research awards as the states that now lead the nation in this research funding. For many EPSCoR states, even aspiring to a middle rank in the foreseeable future is unrealistic; their economic, demographic, and institutional infrastructure makes "quality within context"-- qualitative improvement that does not appreciably affect their ranking-- the only realistic aspiration. It seems to us sensible that EPSCoR does not make graduation a major goal of the program or a significant measure of program success.

At the same time, we heard numerous suggestions that NSF's EPSCoR would benefit from having clearly articulated, general eligibility criteria, rather than using a mandated list of eligible states.²⁴ The suggestions came from a variety of people, including NSF officials, officials at other federal agencies, and scientists and administrators in the states we visited. We believe these suggestions have merit from the standpoint of administrative effectiveness and that NSF ought to consider pursuing them in the political arena. Criteria would shield EPSCoR from undue political influence by providing an objective basis for discussions of whether new states should be admitted to the program. They might also help NSF refine its indicators of infrastructure development and develop objective measures of the distinctions that, in an informal way, are generally recognized among more and less developed EPSCoR states. This might, in turn, facilitate further movement toward tailoring the program to states' unique situations. NSF might, for example, using eligibility criteria as a starting point, develop a basis for varying the size of its infrastructure awards to different states or the balance within states between support for large, focused infrastructure projects and co-funding to help mainstream researchers. We note that the 2000 report of EPSCoR's Committee of Visitors, a group of external experts NSF appointed to review the program, also suggested that the EPSCoR program would benefit from general eligibility criteria.

²⁴ We discuss the criteria that other federal agencies use below on pages 38-40.

Recommendation 4. EHR and the EPSCoR Office should decide whether to adopt general criteria to determine EPSCoR eligibility, rather than merely publishing a list of eligible states.

Interagency Coordination and Comparisons

Coordination

NSF is one of seven federal agencies that have EPSCoR-like programs²⁵ to support research projects and research infrastructure in states that have not traditionally received a large share of federal research funds. The other agencies are the Department of Agriculture (USDA), the Department of Defense (DOD), the Department of Energy (DOE), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), and the National Institutes of Health (NIH).

Officials at NSF and the other agencies told us that they meet about three or four times a year to discuss issues of common concern, such as adding or graduating states from their EPSCoR programs. These meetings also provide opportunities to exchange information about significant activities at individual agencies, including planned changes in budgets or program design and newly developed outreach initiatives. There was general agreement that the meetings were cordial and productive. An official from one of the other agencies, who had experience with another interagency research-related coordination process, said that EPSCoR coordination worked better than the other process and that all of the agencies had opportunities to participate in a meaningful way in joint activities, such as conferences and outreach presentations. He said that, although NSF took the lead in organizing interagency activities, the committee was not perceived as "NSF's committee." Other agency representatives appreciated NSF's efforts to include them in the EPSCoR conferences that NSF organizes and found the conferences to be an effective vehicle for meeting representatives from EPSCoR states and acquainting them with their agencies' programs and priorities.

Representatives from all of the agencies, including NSF, were unanimous in the view that the different EPSCoR programs could not be consolidated into a single program. Other agency representatives viewed their EPSCoR-like activities as serving their agency missions, and some agencies, notably DOE and NASA, were trying to align their EPSCoR awards more closely with their agencies' laboratories and research centers. Several

²⁵ Some of these agencies use the EPSCoR designation as part of the program title and others do not. By "EPSCoR-like" programs, we mean programs whose goal is to increase participation in federally funded research by states that have historically received relatively little federal research support. When discussing the various agency programs, we use the terms "EPSCoR" and "EPSCoR-like" synonymously.

representatives noted the advantages for EPSCoR states in having multiple avenues into the world of federal research funding, saying that agency EPSCoR coordinators could help connect scientists to agency program managers who would be interested in their research. State EPSCoR administrators in Mississippi and Maine likewise believed that consolidation was unworkable and, with one or two exceptions, generally agreed that the current loose coordination among the agencies posed little or no problem at the state level. Neither they nor the federal officials we interviewed believed that duplication of effort among the different agency EPSCoR programs was a problem, and we saw no evidence that caused us to question their judgment on this issue.

Comparisons

The different agency EPSCoR-like programs all have designated program coordinators and use competitive merit review in making funding decisions. They vary in how they balance research project and general infrastructure support, how they define which states are eligible for awards, what role they assign to NSF's state EPSCoR committees, how big their budgets are, and how they are perceived by administrators and scientists at the state level.

While all of the EPSCoR-like programs seek to develop research infrastructure, some (DOD, EPA) do so essentially by supporting research projects. Others (USDA, DOE) do so with a combination of research project support and human resource development activities, such as support for sabbatical leaves for EPSCoR state researchers or collaborations with federal laboratories. NASA and NIH have recently revised their programs, and both include specifically infrastructural components. NASA's EPSCoR 2000 program combines infrastructure funding that is expected to go to all eligible states with competition for a limited number of research awards. NIH's Centers of Biomedical Research Excellence program (COBRE) is part of a larger research infrastructure effort that aims to build groups that have the wherewithal to remain competitive for NIH research support.

At USDA and NSF, EPSCoR supports researchers who have submitted proposals to regular agency research programs. At the other agencies, proposals for EPSCoR funding for research proposals, though subject to merit review, are processed through different channels from proposals to regular agency research programs.

Regarding infrastructure, NSF's EPSCoR program differs from most of these other agencies in being more targeted at Ph.D. granting institutions. NSF's program is also less agency-specific, in that it is not exclusively focused on building competitiveness for NSF research awards, but funds some research infrastructure that is more likely to facilitate research proposals to other agencies than proposals to NSF. EPSCoR program managers at NSF and administrators in the states we visited agreed that, while

competitiveness at NSF was a primary goal of NSF EPSCoR support, an award could be successful if it resulted in substantially enhanced competitiveness at other federal agencies. Their view reflects an NSF mission in research that is broader and less agency-specific than that of other agencies. Similarly, the breadth of NSF's research mission explains the fact that NSF's is the only agency EPSCoR-like program that gives uniformly large infrastructure awards to all eligible states; NASA officials expect their EPSCoR 2000 program to make infrastructure awards to all EPSCoR states, but, at \$125,000 per year, these awards are much smaller than NSF's infrastructure awards.

NSF's EPSCoR program, with a FY 2000 budget of \$48 million, has long been considerably larger than comparable programs at other agencies. Recently, NIH's program jumped to \$40 million a year in FY 2000, making it the second largest of the federal programs. The head of NIH's program told us that, after years of resistance by agency executives to program expansion and budgets in the \$2-5 million range, agency officials at the highest levels were now personally committed to the program and further expansion was likely. Other agency programs were considerably smaller than NSF's.

DOD, DOE, and EPA require that proposals be approved by the states' NSF-sponsored EPSCoR committees; USDA, NIH, and NASA do not. NIH and NASA encourage coordination with the NSF committees, however, and NASA has its own, separate state committee structure. State committees concentrated most on the NSF and DOE proposals. Unlike EPA, these agencies had relatively large programs, and, unlike DOD, they sought a coordinated approach to capacity-building, rather than a set of discrete projects oriented toward agency mission goals. Maine's EPSCoR committee has also put considerable effort into developing proposals responsive to NIH's COBRE program.

All agencies have similar lists of EPSCoR states. DOE, EPA, and DOD require that states be eligible at NSF. In addition, DOD restricts eligibility to states that receive less than 60% of the average amount of federal research support, with the result that two NSF EPSCoR states (Louisiana and South Carolina) have become ineligible through graduation. At USDA, the 20 states that receive the least research support are eligible. NASA uses a slightly expanded version of NSF's list based on the eligibility requirements of a NASA capacity-building program that predates NASA EPSCoR. NIH has the largest number of eligible states (23, plus Puerto Rico). It used a formula-based approach, taking into consideration a state's success rate in proposals to NIH and the amount of NIH funding it received. While it is difficult to generalize from other agencies' experience with eligibility criteria, we found no evidence that quantitative criteria had created political or administrative problems for the agencies that had them.

EPSCoR personnel in Maine and Mississippi said that the different agencies' requirements, once mastered, were easy enough to keep up with. They said that

significant changes, including changes in the direction of greater uniformity, were potentially more disruptive than the current lack of uniformity.

When we asked what NSF could learn from the other agencies about how to administer EPSCoR, several interviewees in Maine and Mississippi responded by saying that the other agencies had things to learn from NSF, not the other way around. We were told that NSF appeared to take EPSCoR and the idea of building research infrastructure more seriously than other agencies, some of which appeared to be concerned simply with spreading current funds among additional states or using their EPSCoR-like programs to support mission-related projects that would have been funded in any event. Some also noted that NSF was the only agency that over the years had consistently requested a high level of support for EPSCoR and that its EPSCoR office had a larger staff and a more prominent position in the agency than the offices that administered comparable programs at other agencies. It was our impression that some of the praise for NSF was not EPSCoR-specific, but involved appreciation of more flexible grant conditions and less burdensome reporting requirements. But some of the praise involved a perception that the NSF program had been run in a consistent way, had made administrative adjustments in light of experience, and had more consistent high-level agency support than the other programs.

FINANCIAL AND COMPLIANCE REVIEW

We examined the systems for accounting, cost sharing, and performance data collection at MSU and MSTF to evaluate their overall adequacy and identify potential deficiencies. Our review was designed as a quick assessment and did not include the detailed testing normally associated with financial audits. Therefore, we do not express an opinion on the financial statements or internal controls for either MSU or MSTF.

To accomplish our objectives, we interviewed personnel; reviewed policies and procedures, financial records, and prior audit reports; and tested selected transactions for compliance with certain award requirements. We reviewed transactions and reports for MSU for the period August 1, 1995, through March 14, 2000, and for MSTF for the period October 1, 1997, through March 31, 2000. The transactions were drawn from the financial records for EPS-9452857, EPS-9629575, and EPS-9874669. Additional detail on these and the other EPSCoR awards we reviewed can be found in Appendix A.

Accounting System

Monitoring and Reporting of Sub-Recipients' Expenditures

Both MSTF and MSU can improve their oversight of sub-recipients' expenditure claims by maintaining better source documentation to support expenditures. Neither awardee collects complete and timely source documentation about all of its significant EPSCoR expenditures, because neither has policies specifying what information it should collect or how it should monitor its sub-recipients' claims for reimbursement.

OMB Circular A-110 Subpart C Section 21(b) requires that awardees exercise "*effective control over and accountability for all funds*," including those distributed to sub-recipients, and provide "*accurate, current, and complete disclosure of financial results*" (emphases

supplied). NSF's Grant Policy Manual reaffirms this guidance.²⁶ Careful oversight and control are particularly important for relatively large expenditures. They are also important for expenditures on participant or trainee support, since NSF does not permit awardees to rebudget funds in this category without agency approval. If awardees do not carefully monitor sub-recipient claims for reimbursement and subsequent financial reporting, there is an increased risk either that grant funds will be used for unallowable expenditures or that expenditures will be reported inaccurately to NSF.

We reviewed a small sample of invoices that sub-recipients submitted to MSTF and MSU and found several instances in which expenditure information important for effective oversight was unavailable. In some instances, information was not complete. Neither awardee asked sub-recipients to provide supporting documents for claimed expenditures, with the result that neither could easily check whether expenditure claims were warranted. In addition, expenditures claimed on some of the MSU sub-recipients' invoices were not categorized by budget line item, making it difficult to compare projected and actual expenditures. In one instance, information was not timely. MSU permitted two years to elapse before a sub-recipient (Mississippi College) submitted an invoice for award expenses, and then accepted an invoice for expenditures covering the entire period. A lengthy delay such as this precludes effective control and accountability over federal funds.

To ensure that sub-recipients follow proper administrative and accounting practices, we recommend that MSU and MSTF strengthen their oversight of NSF funds. Specifically, they should either (1) require more documentation to support sub-recipient expenditures so that a detailed review of expenditures can be conducted off-site or (2) conduct regular site visits to inspect sub-recipients' accounting records. Alternative oversight methods may be used as long as they provide appropriate assurance that sub-recipients are complying with federal requirements. In addition, to comply with OMB Circular A-110, MSU should advise sub-recipients to submit their invoices either quarterly or monthly.

Recommendation 5. MSU and MSTF should exercise more control and accountability over subrecipient expenditures by either: a) requiring more documentation to support significant sub-recipient expenditures so that a detailed review of expenditures can be conducted off-site or b) conducting regular site visits to inspect the accounting records and documentation that sub-recipients maintain.

In responding to this recommendation in our draft report, MSU stated that it believed it collected sufficient documentation and that "any additional documentation, e.g., receipts, are the responsibility of the institution making the expenditure, and that institution is

²⁶ NSF Grant Policy Manual Section 410 requires that all NSF grantees have financial management systems that meet the requirements of Section 21 of OMB Circular A-110.

auditable." It is important to note that awardees bear full responsibility for the administration of their awards, including responsibility for effective oversight over subcontractors (OMB Circular A-110 §__.51(a)). If, as a result of an audit, NSF were to determine that there was insufficient documentation to support questioned expenditures, NSF would seek recovery from the awardee, and not from an institution with which the awardee had subcontracted.

Budgeted Versus Actual Expenditures

MSTF and MSU can improve their project oversight by developing more realistic budget projections and comparing up-to-date expenditure data to these projections.

There were significant differences between budgeted and actual expenditures for both MSTF and MSU. For example, at MSU expenditures for EPS-9452857 were significantly below budget for the first two years of the award and above budget for the final two years. Although the budgeted and actual expenditures over the entire life of this award were approximately equal, for any individual year the information presented in the budget was misleading and could not have been used for monitoring progress. Similarly, at the time of our site visit, expenditures associated with a second award, EPS-9874669, were well below budget. Discrepancies such as these occurred because both awardees experienced delays in starting up their research activities. We were told by NSF and awardee officials that such delays were common for EPSCoR projects and were not a significant source of concern. Insofar as such delays can be anticipated, we believe that budgets should be developed using more realistic time frames to enable managers to spot unanticipated delays and take steps to address them.

In addition, MSTF did not update accounting records on a timely basis, making it difficult to use those records to monitor project progress. When we visited MSTF on July 28, 2000, accounting reports were available only up to March 30, 2000. OMB Circular A-110 Subpart C Section 21(b)(4) states that systems should enable managers to compare outlays with budget amounts for each award. MSTF and UM should keep their accounting systems updated by recording the revenue and expenditures in the general ledgers and other subsidiary ledgers on a timely basis.

Recommendation 6. MSTF and MSU should maintain current accounting and cost sharing records for EPSCoR projects.

Recommendation 7. MSU should consider the potential for start-up delays in formulating future award budgets.

Cost Sharing System

Cost Sharing Compliance

Where the accounting systems we reviewed had problems with realistic budgeting and timely data entry, the cost sharing systems had similar problems. Thus at MSU, cost sharing contributions for EPS-9874669 were behind schedule. This was a direct result of the delays in expending federal funds-- MSU's accounting system was set up to make cost sharing contributions in direct proportion to MSU's expenditure of award funds. In addition, at MSTF, we found some evidence suggesting a possible cost sharing shortfall. With less than two months left before the expiration of EPS-9629575, a four year award, MSTF was \$193,350 short of the total \$1,090,000 in cost sharing its had committed to provide.

We also noted that, although MSU maintains a separate account for receiving cost sharing funds, it does not use separate accounts to segregate expenditures it pays for with federal funds from those it pays for with MSU funds and treats as cost sharing. Instead, MSU makes expenditures from a unified account and, based on the cost sharing required as a condition of the EPSCoR award, attributes a percentage of the expenditure amounts to federal funds and a percentage to cost sharing. MSU's system is designed to draw funds proportionately from the federal government and MSU's own revenues to cover the expenditures under the award.

Without the detailed testing in an audit, we are unable to assess whether the MSU's accounting system contains sufficient controls on cash management to ensure that MSU does not draw down excess federal funds to cover the proportion of award expenditures allocable to cost sharing. We believe that MSU could more easily track its cost sharing contributions and better assure that the required cost sharing amount is fully expended by maintaining a separate record of cost sharing expenditures.

University Perspectives on Cost Sharing

In our interviews in Mississippi and Maine, we discussed NSF's requirement that EPSCoR states share in the cost of EPSCoR's large infrastructure projects by supplying matching funds. Because NSF's cost sharing requirements raise continuing policy and compliance issues, we report the observations of university officials on this topic.

In Mississippi, members of the MRC told us that this requirement did not necessarily generate new resources for research infrastructure. Administrators at MSU said that the requirement served only to force their university to rebudget existing institutional research funds and develop accounting records that demonstrated compliance. It did not serve to

increase the university's commitment to or resources for building research infrastructure. While MSU administrators agreed that cost sharing requirements could exert leverage within the university's research budget, they found the mechanism cumbersome. In one administrator's words, in a well-managed university that pools its internal resources to ensure that externally supported projects can succeed, cost sharing imposes a "huge administrative burden" that creates relatively little added value. The chief research officer at another Mississippi university said that he had had to forgo opportunities because of cost sharing requirements and characterized himself as having to "rob Peter to pay Paul" to get matching funds. It is possible that robbing Peter to pay Paul may interfere with the sustainability of EPSCoR improvements, and thereby limit the EPSCoR program's ability to meet its goals. Thus a scientist at a different university told us that his institution had in part met its cost sharing obligation on a previous EPSCoR award that funded his department by supporting numerous graduate student researchers. He told us that, although the EPSCoR award had helped his department increase its research support from other sources, the end of EPSCoR support had meant a significant reduction in the number of graduate students in the department and had had a somewhat depressing effect on the research environment.

Not all research administrators complained about the cost sharing requirement. In Maine, where the state government has recently committed itself to increasing its investment in research capacity, most of our interviewees who commented on the cost sharing requirement were comfortable with it. Interviewees in both states noted that cost sharing generated commitment and pushed the state to manage its money better. In addition, Mississippi's experience with adding a line item to its FY 2002 budget for meeting federal matching requirements (see above, page 27) suggests that the requirement sometimes prompts additional effort that can lead to improved performance.

Performance Data Collection System

We reviewed the systems that MSU and MSTF use to gather performance data that they report to NSF. These systems measure items such as the numbers of proposals submitted, papers published, presentations delivered, and positions funded by researchers or research units with EPSCoR support.

At MSU, we examined the data collection procedures for the June, 1999, progress report for EPS-9452857. According to MSU project executives, performance data reported to NSF are taken directly from reports submitted by EPSCoR-supported researchers. MSU project executives do not systematically review the accuracy of the self-reports that are the source documentation for the performance data MSU reports. We selected a small sample of statistical data from the report, which we successfully verified back to the

supporting documentation. MSTF's performance data system is operated by UM. To evaluate the adequacy of this system, we selected some quantitative data from a progress report and verified that UM had documentation to support these data. We did not attempt to test the non-quantitative portion of the data included in the progress reports for either of the institutions we reviewed.

RECOMMENDATIONS

Program and Research Review

1. EHR and the EPSCoR Office, in conjunction with higher levels of NSF management and NSF's research directorates, should develop an administrative mechanism to ensure that EPSCoR co-funding dollars are targeted at their original purpose and do not support, either directly or indirectly, researchers who have moved to non-EPSCoR states. (p. 23)
2. The Mississippi EPSCoR project should decide whether to make business and state government participation in EPSCoR committee activities more structured and formal. (p. 28)
3. EHR and the EPSCoR Office should decide whether, as part of future infrastructure awards, NSF should require broader or more formal participation in Mississippi's EPSCoR committee by representatives of the private sector and public sector organizations outside higher education. (p. 28)
4. EHR and the EPSCoR Office should decide whether to adopt general criteria to determine EPSCoR eligibility, rather than merely publishing a list of eligible states. (p. 37)

Financial and Compliance Review

5. MSU and MSTF should exercise more control and accountability over subrecipient expenditures by either: a) requiring more documentation to support significant sub-recipient expenditures so that a detailed review of expenditures can be conducted off-site or b) conducting regular site visits to inspect the accounting records and documentation that sub-recipients maintain. (p. 42)
6. MSTF and MSU should maintain current accounting and cost sharing records for EPSCoR projects. (p. 43)
7. MSU should consider the potential for start-up delays in formulating future award budgets. (p. 43)

APPENDIX A: AWARDS REVIEWED

Institution	Award Number	Award Title	Award Amount	Period of Performance¹	Award Instrument
MSTF	EPS-9629575	Maine/NSF EPSCoR Strategic Implementation Plan	\$4,994,817	10/1/96 to 9/30/00	Cooperative Agreement
MSU	EPS-9452875	Experimental Program to Stimulate Competitive Research (EPSCoR) Systemic Improvement	\$5,239,971	8/1/95 to 1/11/00	Cooperative Agreement
MSU	EPS-9874669	Mississippi EPSCoR Infrastructure Program	\$1,995,482	3/15/99 to 2/28/02	Cooperative Agreement
UM	EPS-9871991	Center for Technology-Based Business Development	\$499,570	7/1/98 to 6/30/00	Grant
UM	EPS-9977780	The Agent Institute: Develop an Infrastructure for Agent-Based Research and Development for the State of Maine	\$499,130	9/1/99 to 8/31/01	Grant

¹Listed closing dates are the actual closing dates for completed awards or the dates on which awards were scheduled to close at the time we completed our field work in Maine (July 28, 2000) and Mississippi (September 20, 2000).

APPENDIX B: PROGRAM AND RESEARCH REVIEW INTERVIEWEES

At NSF, we interviewed the head of the EPSCoR office, the three program directors who worked full-time in the office; the office's former head, who served as EHR's senior advisor for EPSCoR; and six persons who worked in NSF's research directorates and served as liaisons to NSF's EPSCoR program.

In Mississippi, we visited MSU and JSU. We interviewed 42 people who were or had been involved with Mississippi's EPSCoR project. These included:

- the four persons who served as chief research officers for Mississippi's research universities, one of whom was also the EPSCoR project director;
- the co-director of the EPSCoR project, who worked in the office of MSU's Vice President for Research;
- the Commissioner of Higher Education's representative to the state EPSCoR committee
- the heads of the sponsored projects offices at MSU and JSU;
- the MSU official who administered the technology transfer office at MSU and ensured compliance with federal regulations pertaining to commercialization of research;
- a state legislator;
- a state economic development official;
- two persons involved in technology-based business development outside government;
- ten faculty members at MSU who had received EPSCoR support;
- three faculty members at JSU who had received EPSCoR support;
- three persons involved in NSF-supported infrastructure building activities at MSU, but not in MSU's large EPSCoR infrastructure award;
- five post-doctoral fellows at JSU;
- three graduate students at JSU; and
- five graduate students at MSU.

We held group meetings with the graduate students at MSU and JSU and with the post-doctoral fellows. All other interviews were one-on-one meetings. Interviews ranged from forty-five minutes to about three hours.

In Maine, we visited MSTF and UM. We interviewed the President of MSTF; the Chairman of the MSTF Board of Directors; MSTF's chief financial officer, who had provided staff support to the RCC, the state's EPSCoR committee; and the business executive who chaired the RCC. At UM, we interviewed the following people:

- the Vice President for Research, who served as EPSCoR project director;
- the Assistant Vice President for Research, who helped administer UM's EPSCoR project;
- two persons who worked for the Chancellor of the UM system and dealt with EPSCoR issues on his behalf;
- a state legislator who served on the RCC;
- UM's Director of Research and Sponsored Programs;

- the UM official who handled technology transfer and headed the EPSCoR-funded Center for Technology-Based Business Development;
- two UM administrators who were responsible for minority recruitment;
- twelve UM faculty researchers who had received EPSCoR or other NSF funding while at UM;
- a postdoctoral fellow who worked in an EPSCoR-supported research group;
- a group of over a dozen graduate students who worked in the same group; and
- a group of four undergraduates who did research in this group.

Except for the interviews with Chancellor's office personnel, administrators responsible for minority recruitment, and the two groups of students, all interviews were one-on-one meetings. As in Mississippi, interviews ranged from 45 minutes to about three hours.

We interviewed officials who administered EPSCoR-like programs at the six U.S. government agencies—the Department of Agriculture, Department of Defense, Department of Energy, Environmental Protection Agency, National Aeronautics and Space Administration, and National Institutes of Health— that fund programs to build research capacity. These interviews lasted approximately an hour and involved one or two officials at each agency.

APPENDIX C: NSF EHR AND EPSCoR OFFICE RESPONSE

Memorandum

TO: Robert Bell
Senior Scientist for Multidisciplinary Reviews
Office of the Inspector General (OIG)

VIA: Judith Sunley, Interim Assistant Director *J Sunley 2/15/01*
Directorate for Education and Human Resources Directorate (EHR)

FROM: James B. Hoehn, Head *James B Hoehn*
Office of the Experimental Program to Stimulate Competitive
Research (EPSCoR)

SUBJECT: Response to Recommendations by the Office of the Inspector
General (OIG)

DATE: February 9, 2001

The EPSCoR staff has examined the program review conducted by the Foundation's Office of the Inspector General (OIG). The OIG should be commended for its thorough and insightful analysis of the program. The EPSCoR staff are especially gratified by the OIG's recognition that "...many of the strategies that NSF highlights in its strategic plan as crucial to realizing the agency's outcome goals are central to the mission and design of the EPSCoR program..." and that "...an EPSCoR review might shed light on issues that are more broadly relevant to NSF's strategies." The EPSCoR staff is also in general agreement with several other programmatic aspects cited as exemplary by the OIG (e.g., the development of a research niche as a means of improving research competitiveness). Shown below are the staff's response to specific OIG recommendations resulting from the program review of the EPSCoR programs conducted by the states of Maine and Mississippi.

Program and Research Review

1. Recommendation: EHR and the EPSCoR Office, in conjunction with higher levels of NSF management and NSF's research directorates, should develop an administrative mechanism to ensure that EPSCoR co-funding dollars are targeted at their original purpose and do not support, either directly or indirectly, researchers who have moved to non-EPSCoR states. (p. 17)

Response: The EPSCoR Office agrees with the concept that the Congressionally authorized EPSCoR budget should be applied to developing research competitiveness in EPSCoR jurisdictions. This, of course, suggests that NSF awards, which EPSCoR helps to support through the co-funding mechanism, should be nontransferable when Principal Investigators relocate to

non-EPSCoR states. EPSCoR will request the assistance of the Office of Budget, Finance, and Award Management (BFA) in developing an accounting mechanism to track transfers of grant funds to non-EPSCoR institutions. Based on BFA's recommendations and after consultation with the cognizant research officers in EPSCoR institutions an appropriate program policy will be developed.

2. Recommendation: The Mississippi EPSCoR project should decide whether to make business and state government participation in EPSCoR committee activities more structured and formal. (p. 21)

Response: The EPSCoR Office agrees that participation by representatives of the private sector and state government in a state's EPSCoR governing committee can be extremely valuable. Therefore, the EPSCoR staff will encourage the Mississippi's EPSCoR committee (i.e., the Mississippi Research Council, MRC) to better document the current level of participation by members of these groups and, if necessary, to consider establishing more formal mechanisms to solicit their increased involvement.

3. Recommendation: EHR and the EPSCoR Office should decide whether, as part of future infrastructure awards, NSF should require broader or more formal participation in Mississippi's EPSCoR committee by representatives of the private sector and public sector organizations outside higher education. (p 21)

Response: EPSCoR will require all states to address the issue of committee composition and operation as part of future infrastructure awards. With respect to the specific case of Mississippi's EPSCoR governing committee, the EPSCoR Office will ask the state to re-examine the design and operation of its committee prior to submission of a new Research Infrastructure Improvement proposal for the July 2001 competition.

4. Recommendation: EHR and the EPSCoR Office should decide whether to adopt general criteria to determine EPSCoR eligibility, rather than merely publishing a list of eligible states. (p. 28)

Response: Although the current group of EPSCoR participants, with few exceptions, are recipients of the least amount of NSF research support, the EPSCoR Office agrees with the general intent of this recommendation. The issue of EPSCoR eligibility criteria has been addressed in the program's Committee of Visitors report and has been the subject of discussions within the EHR Directorate and with representatives of the Office of Legislative and Public Affairs. The EPSCoR staff has previously proposed various options to address this issue. EPSCoR's eligibility strategy will be included in the topics to be presented in a forthcoming program briefing of the Foundation's higher management. This briefing will result in a decision on program eligibility.

Financial and Compliance Review

5. Recommendation: MSU and MSTF should exercise more control and accountability over subrecipient expenditures by either: a) requiring more documentation to support significant subrecipient expenditures so that a detailed review of expenditures can be conducted onsite or b) conducting regular site visits to inspect the accounting records and documentation that subrecipients maintain. (p. 33)

Response: The EPSCoR Office agrees. The EPSCoR staff has already discussed the general nature of this problem with the Cost Analysis/Audit Resolution Branch (CAAR), Contracts Policy and Oversight Division (CPO) in the Office of Budget, Finance and Award Management (BFA), and requested their assistance in working with all the EPSCoR jurisdictions, including Maine and Mississippi.

6. Recommendation: MSTF and MSU should maintain current accounting and cost sharing records for EPSCoR projects. (p. 33)

Response: The EPSCoR Office agrees. We have and will continue to work with the BFA's CAAR to raise the level of compliance by the EPSCoR community on this matter.

7. Recommendation: MSU should consider the potential for startup delays in formulating future award budgets. (p. 33)

Response: The EPSCoR Office agrees, and will discuss this issue with the EPSCoR community, including MSU, in order to ensure that the risk of start-up delays is minimized.

Office of the Vice President
for Research



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February 26, 2001

Dr. Robert Bell
Senior Scientist
Office of the Inspector General
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Dear Dr. Bell:

We appreciate the opportunity to comment on the draft report of your review of the NSF's EPSCoR program and EPSCoR-related activities in Maine. We have found this review a useful exercise. It has stimulated discussions within the state and resulted in a more energized view of our EPSCoR portfolio.

Below we present our comments on the draft report. They are broken into two categories: 1) general comments and 2) more specific editing suggestions keyed to specific pages.

General comments

State EPSCoR Committees – The report does an excellent job of spelling out the three challenges faced by State EPSCoR Committees: 1) addressing how much concentration of EPSCoR within the state is desirable; 2) building a constituency for university-based research in states that lack a well developed research culture on the state level and where research has not traditionally been an engine of economic growth; and 3) coordinating EPSCoR planning and local industry needs so that EPSCoR effort becomes truly integral to the state's development strategy (p17-18). We agree that these are the challenges and we are continuing to shape and define Maine's Research Capacity Committee (RCC) to address these challenges. We have broad representation on the RCC with University of Maine (UM), University of Southern Maine (USM), not-for-profit-institutions, private colleges and universities, industry and state government represented. We are working to broaden participation further and identify representatives who can come to the table without any institutional bias or interests. As stated in your report, it would be advantageous to identify knowledgeable disinterested persons from outside higher education. We recognize that this is an extremely important goal but we face a key obstacle – the size of our state. There is a not a large disinterested community to draw upon. However, we are renewing our efforts to seek out new expertise and recruit them to the EPSCoR effort.

MAINE'S LAND GRANT AND SEA GRANT UNIVERSITY
A Member of the University of Maine System

The EPSCoR coordinator/director position that was mentioned in your report was filled in the fall of 2000. Dr. Kerri-Ann Jones brings a strong scientific background and fifteen years of significant Washington science program and policy experience. She is extremely knowledgeable of federal research opportunities. We anticipate that her efforts combined with an expanded RCC, with more frequent meetings will improve collaborative efforts and funding opportunities in the state.

The reorganized RCC and EPSCoR management plan are working well. We have developed what we believe is a productive balance between the need for the University to be the focal point of NSF EPSCoR and the need to draw in other institutions in the state. The University will work with the EPSCoR Director and the RCC on those aspects of the new grant proposal that affect the broader Maine science and technology community, in particular, outreach. The new EPSCoR management plan and the hiring of the EPSCoR coordinator/director have facilitated this balance.

Accounting and Financial Management - Until the recent reorganization of the EPSCoR program in Maine, the RCC was hosted by MSTF. Decisions on state match for NSF EPSCoR proposals were recommended by the RCC and approved by the MSTF Board of Directors.

Both UM and MSTF recognized the potential for disconnect with operations monitoring located at UM and fiscal responsibility located at MSTF. They agreed that the restructured Maine EPSCoR program should centralize program monitoring and fiscal responsibility with the lead institution, i.e. the institution that receives the federal award from NSF EPSCoR or other EPSCoR like programs. MSTF will be the custodian of the state appropriated matching funds. The RCC will have fiscal agency responsibility for approval and disbursement of any state funds directly made for EPSCoR match. The statewide EPSCoR Director will monitor the provision of this match to recipient institutions.

Specific Comments

Page 7, first full paragraph should reference University of New England as well. The University of Southern Maine, several small private liberal arts colleges, **and a private university** receive the remainder of the federal funds.

Page 7, third full paragraph
Maine has decided that, rather than including UM as a subcontractor on awards to MSTF, future NSF infrastructure awards will go directly to UM **and that awards from other EPSCoR like programs will go directly to the lead research institutions. Under the restructured EPSCoR program, MSTF will not act as fiscal agent for federal awards. The RCC will act as fiscal agent for state dollars appropriated specifically for EPSCoR match.**

Page 23, top partial paragraph

Administrators at both MSTF and in the university system were optimistic that recent organizational changes in Maine's EPSCoR effort, especially *MSTF's and UM's recommendation to the RCC of the transfer of award administration responsibilities [away from MSTF] to UM*, would further improve working relations.

Page 32, Accounting System, paragraph 3

We reviewed a small sample of invoices that sub-recipients submitted to MSTF and MSU and found several instances in which expenditure information important for effective oversight was unavailable.

Based on the positive results of UM's annual compliance audits, MSTF relied on the systems in place at UM. Substantial amounts on a budgeted line item in any month were questioned by the MSTF grants manager and brought to the attention of UM's grant accountant and MSTF's CFO. If the expenditure was not explained to the grant accountant's satisfaction, the CFO could follow up with the UM EPSCoR office or the Office of Sponsored Programs.

During its annual compliance audit, MSTF discussed NSF's preliminary findings with its outside CPA firm and, given MSTF's reliance on UM's systems, asked the CPA firm to recommend an amount over which hard copy documentation would be required. The CPA firm and MSTF discussed a threshold of \$50,000 for a line item.

Some invoices were selected from prior fiscal years. The back up documentation at the UM, in some instances, was not readily available on demand because the files had been transferred from the Office of Sponsored Programs and were in storage. However, following the accounting review, the documentation was supplied to the IG's office.

Page 33, first paragraph under Budgeted vs Actual Expenditures

There were significant differences between budgeted and actual expenditures for both MSTF and MSU.

The EPSCoR funding cycle begins in October. As infrastructure building often requires hiring new staff or committing student time, the work cannot begin until either the next semester, or the next academic year. Therefore, historically, EPSCoR funding is below budget in the early years and accelerated in the later years.

Page 33, next paragraph

In addition, MSTF did not update accounting records on a timely basis, making it difficult to use those records to monitor project progress. When we visited MSTF on July 28, 2000, accounting reports were available only up to March 30, 2000.

MSTF's accounting records reflect all invoices received from the UM as soon as received. Although a delay of 3 months between UM month end and billing was not unusual, requests for reimbursement were not processed until invoices were received.

Page 33, Recommendation 6.

MSTF and MSU should maintain current accounting and cost sharing records for EPSCoR projects....

And page 34 under Cost Sharing Compliance

In addition, at MSTF, we found some evidence suggesting a possible cost-sharing shortfall. With less than two months left before the expiration of EPS-9629575, a four year award, MSTF was \$193,350 short of the total \$1,090,000 in cost sharing it had committed to provide.

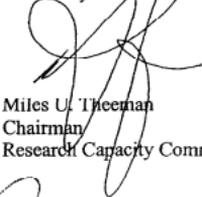
There were three sources of match for the NSF award: state match, UM match and industry match. All state and UM match is done on a pro rata basis. The \$1,090,000 in cost sharing is industry match that is obtained and tracked through the Department of Industrial Cooperation. Requests to industry for verification of equipment and in-kind contribution sometimes lag behind cash match. However, disbursement of funds to UM is not made until documentation of the cost sharing is provided.

We hope you find these comments useful. Please feel free to call us should you have any questions or require further information.

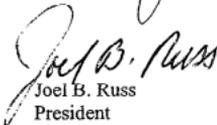
Sincerely,



Daniel Dwyer
Vice President for Research
University of Maine



Miles U. Theeman
Chairman
Research Capacity Committee



Joel B. Russ
President
Maine Science and Technology Foundation

MISSISSIPPI
EPSCoR

Experimental Program to Stimulate Competitive Research

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Mississippi State, MS 39762
(601) 325-8507 Voice, (601) 325-8028 Fax

5 March 2001

Dr. Robert Bell, Senior Scientist
National Science Foundation
Office of Inspector General
4201 Wilson Blvd.
Arlington, VA 22230

Dear Bob:

Enclosed is my response to the draft report of your review of the NSF EPSCoR program and EPSCoR-related activities in Mississippi. Generally, we found the report to be useful and to provide some suggestions that will strengthen the NSF EPSCoR program and efforts in Mississippi in particular.

Thanks for your effort and that of Bandana Sen as well.

Sincerely,



Robert A. Altenkirch
Chair, EPSCoR Committee and
NSF EPSCoR Project Director

jm

Enclosure

c: Mississippi EPSCoR Committee
Elizabeth Hawkins

Response to
Office of Inspector General
National Science Foundation
Draft Report

**Review of NSF's Experimental Program to Simulate Competitive Research
(EPSCoR)**

by

Mississippi EPSCoR

p. ii, line 3: A “small share of federal research dollars” should be defined. Small compared to what, fraction of US population, fraction of US gross national product, etc.? A qualitative statement here, as is the case now, invites criticism as to the makeup of the complement of EPSCoR states.

p. iii, line 1: We don't see how cultivating disinterested persons from outside higher education to play a more prominent role in EPSCoR would be helpful. If an individual is disinterested, it is unlikely that they would make a positive contribution, or even participate at all. We would suggest removing the words “relatively disinterested.”

p. iii, #4: It is not likely that EHR and/or the EPSCoR Office could establish eligibility criteria. That is more likely a matter of NSF's authorization in Congress. At present, there are no eligibility criteria, insofar as the last state admitted, Alaska, came in as a result of the political process. And, it would appear that a few others are about to enter in the same manner. If #4 remains, it would be better stated as “EHR and the EPSCoR Office should work to have eligibility criteria adopted rather than merely publishing a list of eligible states.”

p. iii, #5 b) Conducting site visits to inspect accounting records and documentation of sub recipients is impractical and would be to treat EPSCoR differently than other projects, some quite large, on which there are subcontracts. The impracticality comes about because such visits would require additional staff, which would require additional financial resources. But, the administrative portion of the F&A rate that we can recover is capped at 26%, and our actual rate is above this, so we are not now recovering the actual costs of research.

p. 1, first bullet, line 7: In the phrase “the parts in states that receive relatively little NSF funding,” little needs definition, little compared to what? This is basically the same comment with respect to p. ii, line 3 above. The terminology small, little, etc. appears several places in the report, and it may be best to define it up front. There always needs to be a comparator.

p. 2, first bullet, line 2: “Extensive federal research support” needs definition.

p. 3, line 4 after heading **NSF's EPSCoR Program**: "states that historically had received a relatively small share of federal research funding" needs definition.

p. 5, first line after heading **Mississippi**: The word poor is a relative term, and so it needs some definition. Poor in what respect? Not in the number of accomplished authors produced, musicians, etc. We would suggest the sentence be replaced with "Mississippi is a sparsely populated southern state with an historically agrarian economic base."

p. 5, fifth line after heading **Mississippi**: The sentence that refers to the lawsuit, the Ayers case, is not accurate. The suit was not filed to rectify racially-based funding inequities, it was filed to require the State to remove remnants of de jure segregation in higher education. We'd suggest the sentence be replaced with "A law suit to remove remnants of de jure segregation in Mississippi higher education has been in process for twenty-five years."

p. 5, third paragraph after heading **Mississippi**: We'd suggest that the statement about the Stennis Space Center be expanded. It houses a number of federal agencies in addition to the NASA John C. Stennis Space Center. A description of the facility can be found at <http://www.ssc.nasa.gov/about/agencies/multi-agency.pdf>

p. 6, third paragraph, line 2: The statement that "all groups except one have members at more than one university" is not correct. Two groups are contained within one institution.

p. 13, sixth line after subheading *Co-funding*: In the discussion about the merit review of a proposal that is ultimately co-funded, not sure why it would be stated that the "work is merit reviewed in much the same way that other proposals to those programs are reviewed." It would seem that either the work is reviewed in the same way or it is not. If not, then the differences should be delineated. As far as we know, the merit review process is the same as for any other proposal.

p. 13, eleventh line after subheading *Co-funding*: A judgement seems to be made here that regular programs have limited funds, but that does not seem to make sense in the context of the discussion. Limited in what way? A program has funds allocated to it, and it supports research within those funds, which, along with the number of proposals received, determines the merit cutoff for support. That's just factually how the system works. The word limited seems to bring in some unnecessary, undefined judgement. We'd suggest that the word limited be removed.

p. 15, lines 8-11: The statement that NSF EPSCoR Office support might influence a program officer's recommendation seems to be a judgement that needs some supporting evidence. It is close to questioning the integrity of individuals and the process, and is not something that should be stated lightly.

p. 15, third paragraph, line 8: For some reason the list of focus areas is interpreted to omit "much of engineering." That is not correct. Chemical sciences includes chemical engineering and mechanical and aerospace engineering, e.g., combustion; materials sciences includes almost all of engineering in many aspects; biological sciences includes biological engineering; and computational sciences includes computer engineering. There are no engineering disciplines omitted as a result of the focus areas.

p. 18, line 4 after subheading *Mississippi*: "Most importantly" at the end of the line seems inappropriate. Certainly de jure segregation had an impact on differences among the research infrastructure of the State's institutions. However, to single it out as the most important, as the statement seems to do, does not acknowledge the importance of other factors such as each institution's mission and differing character, e.g., land-grant versus urban, presence of a medical college, etc. It would be more accurate to say that some of the disparities derive from the era of de jure segregation rather than most importantly.

p. 19, third paragraph, line 6: Is the word poor the word of the individual being quoted? If so, that should be indicated. Otherwise, the same comment applies here as for page 5 above.

p. 21, Recommendations 2 and 3: In light of the close working relationship of the MRC, an advisory board with government and business people might be better than an addition to the EPSCoR Committee.

p. 25, line 11: If MAMP students are in an "EPSCoR" department as undergrads, then they are more likely to be hired on EPSCoR projects. This is discipline driven, not a result of coordination of programs. It is unclear how scientists would assist the MAMP goals with undergrads outside the scientists' disciplines.

p. 27, *Eligibility Criteria*: (See response for p. iii above) The statement that "It seems to us sensible that EPSCoR does not make graduation a major goal of the program or a significant measure of program success" is somewhat contradictory with the concept of establishing eligibility criteria, of which there are none at present. Once eligibility criteria are established, then, by definition, they determine graduation, i.e., if you are an EPSCoR state, and you no longer meet the eligibility criteria, then you cannot be an EPSCoR state, and so you have graduated. Whether graduation is a major goal, or significant measure of success, is really irrelevant; eligibility criteria are graduation criteria. EPSCoR like programs in other agencies work this way. So, any discussion of eligibility criteria must also carefully address "graduation," which, in our opinion, the current discussion in the report does not.

p. 28, line 2 after subheading *Coordination*: Large needs definition.

p. 33, Recommendation 5: The situation with Mississippi College (p. 32) has been remedied. MC now invoices quarterly in the prescribed format showing federal and cost share expenditures. As for documentation, we are of the opinion that more

documentation is not needed. Any additional documentation, e.g., receipts, are the responsibility of the institution making the expenditure, and that institution is auditable. Point b) is addressed in a response above for p. iii.

p. 33, Recommendation 6: Current needs definition. What is current to one is not current to another. The MSU EPSCoR Office has become aware of part of the delay in post-award accounting and has asked institutions to fax a copy of the invoice as the original is sent to MSU Accounting. Because of the new system of requiring purchase orders for each new year of a continuing project after the previous year's funds have been spent, invoices are not automatically processed. The EPSCoR Office now can process purchase orders immediately rather than waiting to be notified by accounting.

p. 33, Recommendation: Because budgets are built based on annual needs and are controlled by the project start and end dates, it is unclear how the prime can create budgets based on "start-up delays." It would seem that if the funds arrive on the proposed start date, there would be no start-up delays.

p. 34, third paragraph, line 1: If the cost sharing system raises "numerous concerns" those should be listed. If not, we suggest that the first three lines of paragraph 3 through the word example be removed and that the paragraph begin with "We are unable to"

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